CURRICULUM

B.E – COMPUTER SCIENCE AND ENGINEERING (FULL TIME)
2022 REGULATION-CURRICULUM

SEMESTER I

S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
1	22MC101	Induction Program	MC	-	-	-	0	-	-	-
THEORY										
2	22EN101	Communicative English (Theory cum Practical)	HS	2	0	2	3	50	50	100
3	22MA101	Matrices, Calculus and Ordinary Differential Equations	BS	3	1	0	4	40	60	100
4	22PH101	Engineering Physics	BS	3	1	0	4	40	60	100
5	22CY101	Engineering Chemistry	BS	3	1	0	4	40	60	100
6	22CS101	Problem Solving and C Programming	ES	3	0	0	3	40	60	100
7	22MC102	Heritage of Tamils / தமிழர்மரபு	HS MC	1	0	0	1	100	-	100
PRACTICAL										
8	22CS102	Computer Practice and C Programming Laboratory	ES	0	0	3	1.5	60	40	100
9	22ME102	Workshop Manufacturing Practices	ES	0	0	4	2	60	40	100
						TOTAL	**22.5**			**800**

SEMESTER II

S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22MA202	Linear Algebra and Linear Programming Problems	BS	3	1	0	4	40	60	100
2	22HS201	Universal Human Values	HS	2	1	0	3	40	60	100
3	22CS201	Digital Principles and System Design	ES	3	0	0	3	40	60	100
4	22EE101	Basic Electrical and Electronics Engineering	ES	3	1	0	4	40	60	100
5	22ME101	Engineering Graphics and Design	ES	1	0	4	3	40	60	100
6	22MCIN01	Engineering Sprints	EE	0	0	2	1	100	-	100
7	22MC201	Tamils and Technology/ தமிழரும்தொழில்நுட்பமும்	HS MC	1	0	0	1	100	-	100
8	22NC201	NCC COURSE – I (Only for NCC Students)	NC	3	0	0	3*	40	60	100
PRACTICAL										
9	22EN102	Professional Skills Laboratory	HS	0	0	2	1	60	40	100
10	22PH103	Physics Laboratory	BS	0	0	3	1.5	60	40	100
11	22CY102	Chemistry Laboratory	BS	0	0	3	1.5	60	40	100
12	22EE102	Basic Electrical and Electronics Engineering Laboratory	ES	0	0	3	1.5	60	40	100
						TOTAL	**24.5**			**1100**

SEMESTER III

S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22MA303	Probability and Numerical Methods	BS	3	1	0	4	40	60	100
2	22CS301	Computer Organization and Architecture	PC	3	0	0	3	40	60	100
3	22CS302	Software Engineering	PC	3	0	0	3	40	60	100
4	22CS303	Data Structures and Algorithms	PC	3	0	0	3	40	60	100
5	22CS304	Operating Systems	PC	3	0	0	3	40	60	100
6	22MCIN02	Innovation Sprints	EE	0	0	2	1	100	-	100
7	22NC301	NCC Course – II (Only for NCC Students)	NC	3	0	0	3*	40	60	100
PRACTICAL										
8	22CS305	Operating Systems Laboratory	PC	0	0	4	2	60	40	100
9	22CS306	Data Structures and Algorithms Laboratory	PC	0	0	4	2	60	40	100
TOTAL							**21**			**900**

SEMESTER IV

S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22MA401	Discrete Mathematics	BS	3	1	0	4	40	60	100
2	22CS401	Design and Analysis of Algorithms	PC	3	0	0	3	40	60	100
3	22CS402	Theory of Computation	PC	3	0	0	3	40	60	100
4	22CS403	Object Oriented Programming using C++	PC	3	0	0	3	40	60	100
5	22CS404	Microprocessors and Microcontrollers	ES	3	0	0	3	40	60	100
6	22MCIN03	Design Sprints	EE	0	0	2	1	100	-	100
7	22CYMC01	Environmental Science	MC	2	0	1	0	100	-	100
PRACTICAL										
8	22CS405	Object Oriented Programming using C++ Laboratory	PC	0	0	4	2	60	40	100
9	22CS406	Microprocessors and Microcontrollers Laboratory	ES	0	0	4	2	60	40	100
TOTAL							**21**			**900**

***NCC credit course level I is offered for NCC students only. The grades earned by the students will be recorded in the Mark sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER V										
S. No.	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**			**Credit**	**Max. Marks**		
				L	**T**	**P**		**CA**	**FE**	**Total**
THEORY										
1	22CS501	Database Management Systems	PC	3	0	0	3	40	60	100
2	22CS502	Java Programming	PC	3	0	0	3	40	60	100
3	22CS503	Computer Networks	PC	3	0	0	3	40	60	100
4	22CS504	Principles of Compiler Design	PC	3	0	0	3	40	60	100
5	22CSOExx	Open Elective I	OE	3	0	0	3	40	60	100
6	22MCIN04	Ideation Sprints	EE	0	0	2	1	100	-	100
7	22MC301	Indian Constitution	MC	2	0	0	0	100	-	100
PRACTICAL										
8	22CS505	Database Management Systems Laboratory	PC	0	0	4	2	60	40	100
9	22CS506	Java Programming Laboratory	PC	0	0	4	2	60	40	100
10	22EN401	Placement and Soft Skills Laboratory	HS	0	0	4	2	60	40	100
TOTAL							**22**			**1000**

SEMESTER VI (Regular Stream)										
S. No.	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**			**Credit**	**Max. Marks**		
				L	**T**	**P**		**CA**	**FE**	**Total**
THEORY										
1	22CSPExx	Professional Elective I	PE	3	0	0	3	40	60	100
2	22CSPExx	Professional Elective II	PE	3	0	0	3	40	60	100
3	22CSPExx	Professional Elective III	PE	3	0	0	3	40	60	100
4	22CSOExx	Open Elective II	OE	3	0	0	3	40	60	100
5	22CSOExx	Open Elective III	OE	3	0	0	3	40	60	100
6	22CSOExx	Open Elective IV	OE	3	0	0	3	40	60	100
PRACTICAL										
7	22CS601	Mini Project	EE	0	0	6	3	60	40	100
TOTAL							**21**			**700**

SEMESTER VI (Protosem Stream)										
S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22PSPE01	Computational Hardware	PE	3	0	0	3	100	-	100
2	22PSPE02	Coding for Innovators	PE	3	0	0	3	100	-	100
3	22PSPE03	Industrial Automation	PE	3	0	0	3	100	-	100
4	22PSOE01	Applied Design Thinking	OE	3	0	0	3	100	-	100
5	22PSOE02	Startup Fundamentals	OE	3	0	0	3	100	-	100
6	22PSOE03	Prototype Development	OE	3	0	0	3	100	-	100
PRACTICAL										
7	22PSEE01	Robotics	EE	0	0	6	3	100	-	100
TOTAL							**21**			**700**

SEMESTER VII										
S. No	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22CS701	Cryptography and Network Security	PC	3	0	0	3	40	60	100
2	22CS702	Python Programming and Frameworks	PC	3	0	0	3	40	60	100
3	22CS703	Machine Learning	PC	3	0	0	3	40	60	100
4	22CS704	Mobile Computing	PC	3	0	0	3	40	60	100
5	22MG701	Principles of Management	HS	3	0	0	3	40	60	100
6	22CSPExx	Professional Elective IV	PE	3	0	0	3	40	60	100
PRACTICAL										
7	22CS705	Machine Learning Laboratory	PC	0	0	4	2	60	40	100
TOTAL							**20**			**700**

SEMESTER VIII										
S. No	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22CSPExx	Professional Elective V	PE	3	0	0	3	40	60	100
2	22CSPExx	Professional Elective VI	PE	3	0	0	3	40	60	100
PRACTICAL										
3	22CS801	Project Work	EE	0	0	14	7	120	80	200
TOTAL							**13**			**400**

PROFESSIONAL ELECTIVES (PE)

S.No	Course Code	Course Title	Cat.	Hours/Week			C	Max.Marks		
				L	T	P		CA	FE	Total
List of Professional Electives I										
1.	22CSPE101	Software Project Management	PE	3	0	0	3	40	60	100
2.	22CSPE102	Artificial Intelligence	PE	3	0	0	3	40	60	100
3.	22CSPE103	Web Technology	PE	3	0	0	3	40	60	100
4.	22CSPE104	Agile Technology	PE	3	0	0	3	40	60	100
5.	22CSPE105	Data Mining and Warehousing	PE	3	0	0	3	40	60	100
List of Professional Electives II										
6.	22CSPE201	Software Quality and Testing	PE	3	0	0	3	40	60	100
7.	22CSPE202	Blockchain Technologies	PE	3	0	0	3	40	60	100
8.	22CSPE203	Parallel Computing Architecture and Programming	PE	3	0	0	3	40	60	100
9.	22CSPE204	Computer Graphics and Multimedia	PE	3	0	0	3	40	60	100
10	22CSPE205	Object Oriented Analysis and Design	PE	3	0	0	3	40	60	100
List of Professional Electives III										
11.	22CSPE301	Service Oriented Architecture	PE	3	0	0	3	40	60	100
12.	22CSPE302	Open-Source Technologies	PE	3	0	0	3	40	60	100
13.	22CSPE303	Big Data Analytics	PE	3	0	0	3	40	60	100
14.	22CSPE304	User Interface Design	PE	3	0	0	3	40	60	100
15.	22CSPE305	E-Commerce	PE	3	0	0	3	40	60	100
List of Professional Electives IV										
16.	22CSPE401	Wireless Sensor Networks	PE	3	0	0	3	40	60	100
17.	22CSPE402	Data Visualization Techniques	PE	3	0	0	3	40	60	100
18.	22CSPE403	Predictive Data Analytics	PE	3	0	0	3	40	60	100
19.	22CSPE404	Game Theory and its Applications	PE	3	0	0	3	40	60	100
20.	22CSPE405	Business Intelligence and its Applications	PE	3	0	0	3	40	60	100
List of Professional Electives V										
21.	22CSPE501	Information Security	PE	3	0	0	3	40	60	100
22.	22CSPE502	Data Science	PE	3	0	0	3	40	60	100
23.	22CSPE503	Social Network Analysis	PE	3	0	0	3	40	60	100
24.	22CSPE504	Natural Language Processing	PE	3	0	0	3	40	60	100
25.	22CSPE505	Ethical Hacking	PE	3	0	0	3	40	60	100

List of Professional Electives VI										
26.	22CSPE601	Computer Hardware and Troubleshooting	PE	3	0	0	3	40	60	100
27.	22CSPE602	Cyber Forensics	PE	3	0	0	3	40	60	100
28.	22CSPE603	Cloud Computing	PE	3	0	0	3	40	60	100
29.	22CSPE604	Mobile Application Development	PE	3	0	0	3	40	60	100
30.	22CSPE605	Deep Learning	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVE COURSES

S.No.	**Course Code**	**Course**	**Cat**	**Hours/Week**			**Credits**	**Maximum Marks**		
				L	**T**	**P**		**CA**	**FE**	**Total**
COURSES OFFERED BY THE DEPARTMENT OF MATHEMATICS										
1	22MAOE01	Sampling Theory and Numerical methods	OE	3	0	0	3	40	60	100
2	22MAOE02	Numerical Methods	OE	3	0	0	3	40	60	100
3	22MAOE03	Probability and Queuing Theory	OE	3	0	0	3	40	60	100
COURSES OFFERED BY THE DEPARTMENT OF CIVIL ENGINEERING										
4	22CEOE01	Environmental Management	OE	3	0	0	3	40	60	100
5	22CEOE02	Disaster Mitigation and Management	OE	3	0	0	3	40	60	100
6	22CEOE03	Repair and Rehabilitation of Building Elements	OE	3	0	0	3	40	60	100
7	22CEOE04	Mechanics of Deformable bodies	OE	3	0	0	3	40	60	100
COURSES OFFERED BY THE DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING										
8	22CSOE01	Object Oriented Programming Concepts	OE	3	0	0	3	40	60	100
9	22CSOE02	Operating Systems Principles	OE	3	0	0	3	40	60	100
10	22CSOE03	Computer Communications and Networks	OE	3	0	0	3	40	60	100
11	22CSOE04	Python Programming	OE	3	0	0	3	40	60	100
12	22CSOE05	Introduction to Programming in Java	OE	3	0	0	3	40	60	100
13	22CSOE06	Computer Organization	OE	3	0	0	3	40	60	100
14	22CSOE07	Data Structures using C++	OE	3	0	0	3	40	60	100
15	22CSOE08	Cloud Computing Fundamentals	OE	3	0	0	3	40	60	100
16	22CSOE09	Artificial Intelligence and Machine Learning	OE	3	0	0	3	40	60	100
COURSES OFFERED BY THE DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING										
17	22ECOE01	Fundamentals of Electron Devices	OE	3	0	0	3	40	60	100
18	22ECOE02	Principles of Modern Communication Systems	OE	3	0	0	3	40	60	100
19	22ECOE03	Microcontrollers and its applications	OE	3	0	0	3	40	60	100
20	22ECOE04	Computer Networks	OE	3	0	0	3	40	60	100
21	22ECOE05	Basics of Embedded Systems	OE	3	0	0	3	40	60	100
22	22ECOE06	Basics of Internet of Things	OE	3	0	0	3	40	60	100
23	22ECOE07	Basics of Artificial Intelligence	OE	3	0	0	3	40	60	100
COURSES OFFERED BY THE DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING										
24	22EEOE01	Renewable Energy Sources	OE	3	0	0	3	40	60	100

25	22EEOE02	Industrial Drives	OE	3	0	0	3	40	60	100
26	22EEOE03	Energy Conservation and Management	OE	3	0	0	3	40	60	100
27	22EEOE04	Electric Vehicles	OE	3	0	0	3	40	60	100
COURSES OFFERED BY THE DEPARTMENT OF MECHANICAL ENGINEERING										
28	22MEOE01	Design of Machine Elements and Machining	OE	3	0	0	3	40	60	100
29	22MEOE02	Industrial Engineering	OE	3	0	0	3	40	60	100
30	22MEOE03	Industrial Robotics	OE	3	0	0	3	40	60	100
31	22MEOE04	Power plant Engineering	OE	3	0	0	3	40	60	100
32	22MEOE05	Principles of Management	OE	3	0	0	3	40	60	100
33	22MEOE06	Professional Ethics in Engineering	OE	3	0	0	3	40	60	100
34	22MEOE07	Renewable Sources of Energy	OE	3	0	0	3	40	60	100
35	22MEOE08	Robotic Process Automation	OE	3	0	0	3	40	60	100
36	22MEOE09	Total Quality Management	OE	3	0	0	3	40	60	100
COURSES OFFERED BY THE DEPARTMENT OF METALLURGICAL ENGINEERING										
37	22MTOE01	Foundry and Welding Technology	OE	3	0	0	3	40	60	100
38	22MTOE02	Advanced Surface Engineering	OE	3	0	0	3	40	60	100
39	22MTOE03	Design and Selection of Materials	OE	3	0	0	3	40	60	100
40	22MTOE04	Nano Science and Technology	OE	3	0	0	3	40	60	100
41	22MTOE05	Materials for Automobile Components	OE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE COURSES - VERTICALS FOR HONOURS

Vertical I **Data Science**	**Vertical II** **Full Stack Development**	**Vertical III** **Cloud Computing and Data Center Technologies**	**Vertical IV** **Cyber Security and Data Privacy**
22CSH101 Exploratory Data Analysis	22CSH201 Full Stack Web Application Development	22CSH301 Cloud Computing	22CSH401 Cyber Physical Systems
22CSH102 Recommender Systems	22CSH202 App Development	22CSH302 Virtualization	22CSH402 Ethical Hacking
22CSH103 /Neural Networks and Deep Learning	22CSH203 Service Oriented Architecture	22CSH303 Cloud Services Management	22CSH403 Digital and Mobile Forensics
22CSH104 Text and Speech Analysis	22CSH204 UI and UX Design	22CSH304 Data Warehousing	22CSH404 Social Network Security
22CSH105 Business Analytics	22CSH205 Software Testing and Automation	22CSH305 Storage Technologies	22CSH405 Modern Cryptography
22CSH106 Image and Video Analytics	22CSH206 Web Application Security	22CSH306 Software Defined Networks	22CSH406 Engineering Secure Software Systems
22CSH107 Computer Vision	22CSH207 DevOps	22CSH307 Stream Processing	22CSH407 Cryptocurrency and Blockchain Technologies
22CSH108 Big Data Analytics	22CSH208 Principles of Programming Languages	22CSH308 Security and Privacy in Cloud	22CSH408 Cyber Security

MINOR DEGREE - VERTICALS

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes.

VERTICAL - I	VERTICAL - II	VERTICAL - III	VERTICAL - IV	VERTICAL - V	VERTICAL - VI
Civil Engineering	**Computer Science and Engineering**	**Electronics and Communication Engineering**	**Electrical and Electronics Engineering**	**Mechanical Engineering**	**Metallurgical Engineering**
22CEM01 Construction Materials	22CSM01 Programming in C++	22ECM01 Electron Devices	22EEM01 – Linear and Digital Electronics Circuits	22MEM01 Engineering Thermodynamics	22MTM01 Advanced Physical Metallurgy
22CEM02 Building Construction & Equipment	22CSM02 Advanced Data Structures and Algorithms	22ECM02 Digital Electronics	22EEM02 – Microprocessor and Microcontroller	22MEM02 Fluid Mechanics and Machinery	22MTM02 Thermodynamics and kinetics in Metallurgy
22CEM03 Concrete Technology	22CSM03 Computer Organization and Design	22ECM03 Electronic Circuits	22EEM03 – Control Systems	22MEM03 Manufacturing Processes	22MTM03 Mechanical Behaviour of Materials
22CEM04 Environmental Engineering	22CSM04 Advanced Operating Systems	22ECM04 Signal Processing	22EEM04 – Measurements and Instrumentation	22MEM04 Materials Engineering	22MTM04 Rate Processes in Metallurgy
22CEM05 Basics of Transportation Engineering	22CSM05 Data Communication and Computer Networks	22ECM05 Fundamentals of Microprocessors and Microcontrollers	22EEM05 – Electrical Machines	22MEM05 Kinematics of Machinery	22MTM05 Corrosion and Surface Engineering
22CEM06 Repair and Rehabilitation Structures	22CSM06 Programming Essentials in Python	22ECM06 Analog and Digital Communication	22EEM06 – Electrical Drives and Control	22MEM06 Hydraulics and Pneumatics	22MTM06 Materials Characterization
22CEM07 Green Building Technology	22CSM07 Advanced Database System Concepts	22ECM07 Communication Networks	22EEM07 – Electric Vehicles and Control	22MEM07 Design of Machine Elements	22MTM07 Automotive, Aerospace and Defense Materials
-----	22CSM08 Virtualization and Cloud Computing	22ECM08 Fundamentals of IoT	22EEM08 – Electrical Energy Conservation and Auditing	22MEM08 Heat and Mass Transfer	-----
-----	-----	22ECM09 Wireless Sensors and Networking	22EEM09 – SMPS and UPS	22MEM09 Metrology and Quality Control	-----
-----	-----	22ECM10 Fundamentals of Embedded Systems	22EEM10 –Utilization of Electrical Energy	22MEM10 Dynamics of Machinery	-----

LIST OF MINOR DEGREE - VERTICALS

S.No.	Course Code	Course	Cat	Hours/Week			Credits	Maximum Marks		
				L	T	P		CA	FE	Total
CIVIL ENGINEERING										
1	22CEM01	Construction Materials	OE	3	0	0	3	40	60	100
2	22CEM02	Building Construction & Equipment's	OE	3	0	0	3	40	60	100
3	22CEM03	Concrete Technology	OE	3	0	0	3	40	60	100
4	22CEM04	Environmental Engineering	OE	3	0	0	3	40	60	100
5	22CEM05	Basics of Transportation Engineering	OE	3	0	0	3	40	60	100
6	22CEM06	Repair and Rehabilitation of Structures	OE	3	0	0	3	40	60	100
7	22CEM07	Green Building Technology	OE	3	0	0	3	40	60	100
COMPUTER SCIENCE AND ENGINEERING										
1	22CSM01	Programming in C++	OE	3	0	0	3	40	60	100
2	22CSM02	Advanced Data Structures and Algorithms	OE	3	0	0	3	40	60	100
3	22CSM03	Computer Organization and Design	OE	3	0	0	3	40	60	100
4	22CSM04	Advanced Operating Systems	OE	3	0	0	3	40	60	100
5	22CSM05	Data Communication and Computer Networks	OE	3	0	0	3	40	60	100
6	22CSM06	Programming Essentials in Python	OE	3	0	0	3	40	60	100
7	22CSM07	Advanced Database System Concepts	OE	3	0	0	3	40	60	100
8	22CSM08	Virtualization and Cloud Computing	OE	3	0	0	3	40	60	100
ELECTRONICS AND COMMUNICATION ENGINEERING										
1	22ECM01	Electron Devices	OE	3	0	0	3	40	60	100
2	22ECM02	Digital Electronics	OE	3	0	0	3	40	60	100
3	22ECM03	Electronic Circuits	OE	3	0	0	3	40	60	100
4	22ECM04	Signal Processing	OE	3	0	0	3	40	60	100
5	22ECM05	Fundamentals of Microprocessors and Microcontrollers	OE	3	0	0	3	40	60	100
6	22ECM06	Analog and Digital Communication	OE	3	0	0	3	40	60	100

7	22ECM07	Communication Networks	OE	3	0	0	3	40	60	100
8	22ECM08	Fundamentals of IoT	OE	3	0	0	3	40	60	100
9	22ECM09	Wireless sensors and networking	OE	3	0	0	3	40	60	100
10	22ECM10	Fundamentals of Embedded systems	OE	3	0	0	3	40	60	100
ELECTRICAL AND ELECTRONICS ENGINEERING										
1	22EEM01	Linear and Digital Electronics Circuits	OE	3	0	0	3	40	60	100
2	22EEM02	Microprocessor and Microcontroller	OE	3	0	0	3	40	60	100
3	22EEM03	Control Systems	OE	3	0	0	3	40	60	100
4	22EEM04	Measurements and Instrumentation	OE	3	0	0	3	40	60	100
5	22EEM05	Electrical Machines	OE	3	0	0	3	40	60	100
6	22EEM06	Electrical Drives and Control	OE	3	0	0	3	40	60	100
7	22EEM07	Electric Vehicles and Control	OE	3	0	0	3	40	60	100
8	22EEM08	Electrical Energy Conservation and Auditing	OE	3	0	0	3	40	60	100
9	22EEM09	SMPS and UPS	OE	3	0	0	3	40	60	100
10	22EEM10	Utilization of Electrical Energy	OE	3	0	0	3	40	60	100
MECHANICAL ENGINEERING										
1	22MEM01	Engineering Thermodynamics	OE	3	0	0	3	40	60	100
2	22MEM02	Fluid Mechanics and Machinery	OE	3	0	0	3	40	60	100
3	22MEM03	Manufacturing Processes	OE	3	0	0	3	40	60	100
4	22MEM04	Materials Engineering	OE	3	0	0	3	40	60	100
5	22MEM05	Kinematics of Machinery	OE	3	0	0	3	40	60	100
6	22MEM06	Hydraulics and Pneumatics	OE	3	0	0	3	40	60	100
7	22MEM07	Design of Machine Elements	OE	3	0	0	3	40	60	100
8	22MEM08	Heat and Mass Transfer	OE	3	0	0	3	40	60	100
9	22MEM09	Metrology and Quality Control	OE	3	0	0	3	40	60	100
10.	22MEM10	Dynamics of Machinery	OE	3	0	0	3	40	60	100
METALLURGICAL ENGINEEING										

1	22MTM01	Advanced Physical Metallurgy	OE	3	0	0	3	40	60	100
2	22MTM02	Thermodynamics and Kinetics in Metallurgy	OE	3	0	0	3	40	60	100
3	22MTM03	Mechanical Behaviour of Materials	OE	3	0	0	3	40	60	100
4	22MTM04	Rate Processes in Metallurgy	OE	3	0	0	3	40	60	100
5	22MTM05	Corrosion and Surface Engineering	OE	3	0	0	3	40	60	100
6	22MTM06	Materials Characterization	OE	3	0	0	3	40	60	100
7	22MTM07	Automotive, Aerospace and Defence Materials	OE	3	0	0	3	40	60	100

Computer Science and Engineering Scheme of Instruction

Categories	Credits recommended by AICTE	Credits recommended by Anna University	Credits Breakup for CSE Students
Humanities and Social Sciences (HS)/ Humanities and Social Sciences Mandatory Courses (HSMC)	16	10	14
Basic Sciences (BS)	23	25	27
Engineering Science (ES)	29	18	23
Program Core (PC)	59	61	57
Program Electives (PE)	12	18	18
Open Electives (OE)	9	12	12
Empl. Enhancement Courses (EEC)	15	16	14
Mandatory Courses (MC) (Zero Credit)	0	0	0
Total	**163**	**162**	**165**

SYLLABUS

PROFESSIONAL CORE COURSES

COMPUTER SCIENCE AND ENGINEERING- FULL TIME

REGULATION 2022 – SYLLABUS

SEMESTER-I

22MC101	**INDUCTION PROGRAM**			**Semester**		**I**
PREREQUISITES		**Category**	**MC**	**Credit**		**0**
		Hours/Week	**L**	**T**	**P**	**TH**
			0	**0**	**0**	**0**
INDUCTION PROGRAM (MANDATORY) - 3 WEEKS DURATION						
LIST OF EXPERIMENTS ● Physical activity. ● Creative Arts. ● Universal Human Values. ● Literary. ● Proficiency Modules. ● Lectures by Eminent People. ● Visits to local Areas. ● Familiarization to Dept./Branch & Innovations.						
						Total = 21 Days

22EN101	COMMUNICATIVE ENGLISH				SEMESTER		I
PREREQUISTIES Basic language skills listening, speaking, reading and writing		CATEGORY	HS		Credit		3
		Hours/Week	L	T	P		TH
			2	0	2		4

COURSE OBJECTIVES

1.	To develop the communicative skills of learners by engaging them in reading, writingand grammar learning activities
2.	To inculcate learners’ ability to read texts, summaries, articles and user manuals
3.	To assist learners to acquire writing skills for academic, social and professional purposes
4.	To improve learners’ vocabulary and grammar to supplement their language use at different contexts

UNIT I	COMPREHENSION	6	0	6	12

Listening – Interview with personal assistant, An interview with a business consultant, Describing changes in a company, Describing dimensions of products.
Speaking - Self-introduction, name, home background, study details, area of interest, hobbies, strengths and weaknesses, etc.
Reading - Reading for detailed comprehension, specific information, Understanding notices, messages, timetables, graphs relevant to technical contexts.
Writing – Dialogue writing in a business context.
Grammar - Parts of speech, Tenses, Voices, Common errors in English, Subject-Verb agreement, Noun-Pronoun agreement, Prepositions and Articles.

UNIT II	RECOMMENDATION	6	0	6	12

Listening – An interview about a production process, Telephone conversations, Making and changing appointments, Description of how a product is advertised.
Speaking - Personal interview, dress code, body language, required skills, corporate culture and mock interview.
Reading - Reading technical texts from journals, newspapers and technical blogs.
Writing - Writing checklists, Recommendations.
Grammar - Prefix and suffix, Synonyms, Antonyms, Verb forms - Auxiliary verbs, Modal verbs, Phrasal verbs, Pronouns, Adverbs and Adjectives.

UNIT III	CONVERSATION	6	0	6	12

Listening - Conversation between two employees, Interview about change in job and corporate gift giving, Creating good teams: a presentation.
Speaking - Role play - examiner and candidate, customer and sales manager, team leader and team member, interviewer and applicant, industrialist and candidate.
Reading - Reading advertisements, gadget reviews, user manuals.
Writing - Providing instruction, Writing E-mails - Attending workshops, Paper submission for seminars and conferences, Arranging and cancelling a meeting.
Grammar - Conditional statements, Redundancies, Collocations and Meanings of individual words.

UNIT IV	REPORTING	6	0	6	12

Listening – Working in an international team, Statistical information, Interview with investor relations, Radio interviews.
Speaking – Giving a speech, Describing given data, Discussing company information, Summarizing an article.
Reading - Reading longer technical texts, cause and effect essays, newspaper articles, company profiles.
Writing - Essay writing on social topics, Technical Report Writing – Status reports on projects, Feasibility reports and event reports on seminars, conferences, meeting.
Grammar - Compound words, Conjunctions, Sentence completion, Negation in statements and questions.

UNIT V	INTERPRETATATION	6	0	6	12

Listening – An interview with career advisor and recruitment agent, Feedbacks, Meeting extracts.
Speaking – Qualities required for employability, Improving employee productivity, presentation on problem-solving skills, teamwork, creativity and leadership quality.
Reading - Reading brochures, telephone messages, social media messages relevant to technical contexts.
Writing - Letter Writing – Formal Letters and Informal Letters - cover letter with resume, Mind maps, Charts - interpreting statistical data, charts, graphs and tables.
Grammar - One word substitution, Abbreviations and acronyms in technical contexts and technical vocabulary, Idioms.

Total (30L + 30P)= 60 Periods

REFERENCE BOOKS:	
1.	Meenakshi Raman and Sangeeta Sharma. Professional English. Oxford University Press, New Delhi, 2019.
2.	Krishna Mohan, Meera Bannerji. Developing Communication Skills. Macmillan India Ltd, Delhi, 1990.
3.	Sanjay Kumar, Pushp Lata. English Language and Communication Skills for Engineers. Oxford University Press, 2018.
E-RESOURCES:	
1.	https://learnenglish.britishcouncil.org/
2.	https://www.bbc.co.uk/learningenglish

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	comprehend the main ideas, key details and inferred meanings of technical texts	Understand
CO2	use language effectively at technical and professional contexts	Apply
CO3	apply the academic and functional writing skills in formal and informal communicative contexts	Apply
CO4	interpret pictorial representation of statistical data and charts	Apply

COURSE ARTICULATION MATRIX

COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				1					1	3		1	1	
CO2				1					1	3		2	2	
CO3				2					1	3		1	1	
CO4				3					1	3		1	1	
Avg				**1.75**					**1**	**3**		**1.25**	**1.25**	

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22MA101	MATRICES, CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS B.E. (Common to all Branches Except EEE)			Semester		I
PREREQUISITES		**Category**	**BS**	**Credit**		**4**
Basic 12^{th} level Matrices, Differential Calculus, Integral Calculus and ODE		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**1**	**0**	**4**

Course Learning Objectives	
1	To know the use of matrix algebra needed by engineers for practical applications.
2	To understand effectively both the limit definition and rules of differentiation.
3	To familiarize in solving maxima and minima problems in two variables.
4	To obtain the knowledge of multiple integration and their related applications.
5	To obtain the knowledge to solve second order differential equations with constant and variable coefficients.

Unit I	**MATRICES**	**9**	**3**	**0**	**12**
System of linear equations – Characteristic equation of a Matrix – Eigenvalues and Eigenvectors – Properties – Cayley-Hamilton theorem (excluding proof) – Diagonalization of Matrices - Reduction of quadratic form to canonical form by orthogonal transformation.					
Unit II	**DIFFERENTIAL CALCULUS**	**9**	**3**	**0**	**12**
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules -Maxima and Minima of the function of a single variable.					
Unit III	**FUNCTIONS OF SEVERAL VARIABLES**	**9**	**3**	**0**	**12**
Partial derivatives – Euler's theorem for homogeneous functions – Total Derivatives –Jacobians – Maxima, Minima and Saddle point – Method of Lagrangian multipliers – Taylor's series.					
Unit IV	**MULTIPLE INTEGRALS**	**9**	**3**	**0**	**12**
Multiple integrals- Double integrals – Change of order of integration in double integrals – Change of variables (Cartesian to Polar) – Application to Areas – Evaluation of Triple integrals – Application to volumes.					
Unit V	**ORDINARY DIFFERENTIAL EQUATIONS**	**9**	**3**	**0**	**12**
Second order linear differential equations with constant and variable coefficients –Cauchy-Euler equation and Cauchy-Legendre's linear equation - Method of variation of parameters –Simultaneous first order linear equations with constant coefficients.					
					Total (45L+15T) = 60 Periods

Text Books:	
1	Grewal. B.S, "Higher Engineering Mathematics", 43^{rd} Edition, Khanna Publications, Delhi, 2015.
2	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 3^{rd} Edition, Narosa Publications, New Delhi, 2007.
Reference Books:	
1	James Stewart, "Essential Calculus", 2^{nd} edition, Cengage Learning, New Delhi, 2014.
2	P. Kandasamy, K. Thilagavathy and K. Gunavathy," Engineering Mathematics (For I year B.E., B. Tech)", 9^{th} Edition, S. Chand & Co. Ltd. New Delhi, 2010.
3	Srimanta pal and Subath.C. Bhumia, "Engineering Mathematics", Oxford University Publications, New Delhi, 2015.
4	Erwin Kreyszig, "Advanced Engineering Mathematics", 9^{th} Edition, John Wiley & Sons, 2007.
5	Siva Ramakrishna Das.P, Ruknmangadachari.E. "Engineering Mathematics", 2^{nd} Edition, Pearson, Chennai & Delhi, 2013.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Learn the fundamental knowledge of Matrix theory.	Understand
CO2	Use both the limit definition and rules of differentiation to differentiable functions.	Apply
CO3	Apply differentiation to solve maxima and minima problems.	Apply
CO4	Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to a change of order and change of variables.	Apply
CO5	Apply various techniques in solving differential equations.	Apply

COURSE ARTICULATION MATRIX														
COs/ POs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PS O2**
CO1	**3**	**2**		**2**									**2**	
CO2	**3**	**2**		**2**									**2**	
CO3	**3**	**2**		**2**									**2**	
CO4	**3**	**2**		**2**									**2**	
CO5	**3**	**2**		**2**									**2**	
Avg	**3**	**2**		**2**									**2**	
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**														

22PH101	ENGINEERING PHYSICS			SEMESTER I			
PREREQUISITES		**CATEGORY**		**BS**	**Credit**		**4**
Basic theoretical knowledge in Physics		**Hours/Week**		**L**	**T**	**P**	**TH**
				3	**1**	**0**	**4**

Course Objectives:

1.	Principle, working and industrial applications of LASER and optical fiber
2.	Basic concepts of quantum physics and matter waves
3.	Mode of transmission of heat by conduction mechanism with experimental illustrations
4.	Basics of crystal structure, types of crystal and its defects
5.	Principle, working and industrial applications of LASER and optical fiber

UNIT I	ULTRASONICS AND ACOUSTICS	9	3	0	12

ULTRASONICS: Introduction – Production - Magnetostriction effect – Magnetostriction generator – Piezoelectric effect – Piezoelectric generator –Detection of ultrasonic waves- Properties – Acoustical grating– Velocity measurement–Industrial applications- Drilling, welding, soldering and cleaning –SONAR – Medical applications (Qualitative).
ACOUSTICS OF BUILDINGS: Introduction –Reverberation and reverberation time - Factors affecting acoustics of buildings and their remedies – Absorption co–efficient – Basic requirements for the acoustically good auditorium.

UNIT II	LASER AND FIBER OPTICS	9	3	0	12

LASER: Stimulated absorption, spontaneousemission and stimulated emission –Population inversion – Pumping methods – Types of laser- Nd–YAG, CO_2laser – Industrial and medical applications (Qualitative)
FIBER OPTICS: Principle of optical fiber – Structure and classification of optical fiber – Critical angle - Numerical aperture – Acceptance angle – Fiber optic communication (Block diagram).

UNIT III	THERMAL PHYSICS	9	3	0	12

Modes of transmission of heat - Conduction – Convection – Radiation – Thermal conductivity – Coefficient of thermal conductivity and its unit –Thermal conduction through compound media in series – Determination of thermal conductivity - Searle’s method for good conductors, Lee’s disc method for Bad conductors – Thermal insulating materials – Thermal insulation in buildings.

UNIT IV	QUANTUM PHYSICS	9	3	0	12

Matter waves – experimental evidence - Davisson and Germer experiment – Schroedinger’s wave equation - Time independent and dependent equations – Physical significance of wave function – Particle in a one-dimensional box – Electron Microscope (Qualitative).

UNIT V	CRYSTAL PHYSICS	9	3	0	12

Lattice – Unit cell – Bravais lattice – Number of atoms per unit cell, atomic radius, coordination number, packing factor– Crystal growth techniques: Bridgman, Czochralski techniques. Crystal imperfections - Point defects – Schottky defect, Frenkel defect – Line defects – Edge dislocation, Screw dislocation – Planar defects – Grain boundaries, Twin boundaries.

Total (45L+15T) = 60 Periods

Text Books:

1.	Arumugam M, ‘Engineering Physics’, Anuradha publishers, 2019
2.	Rajendran V. and Marikani A, ‘Engineering Physics’, PHI Learning Pvt., India, 2018.
3.	Palanisamy P.K, ‘Engineering Physics’, SCITECH Publications, 2018.
4.	Ragavan V, ‘Material science and engineering’, Prentice hall of India Pvt Ltd, NewDelhi, 2004.
5.	Introduction to crystal growth, Principles and Practice, H.L. Bhat, Taylor and Francis, 2015 edition

Reference Books:

1.	Gaur R.K. and Gupta S.L, ‘Engineering Physics’, Dhanpat Rai publishers, 2012.
2.	Arthur Beiser, ‘Concepts of Modern Physics’, Tata McGraw Hill Publishing Co. Ltd, sixth Edition, 2019.
3.	Gerd keiser, ‘Optical fiber communications’, Tata McGraw Hill Publishing Co. Ltd, 5th Edition, 2017.
4.	Orazio Svelto, David C. Hanna, ‘Principles of Lasers’, Springer Science & Business Media, LLC, 2010.

E-Reference

1	https://nptel.ac.in/courses/115105129
2	https://nptel.ac.in/courses/115107095

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's TaxonomyMapped**
CO1	The principle, production of ultrasonics and its engineering applications.	Apply
CO2	The principle and applications of laser and optical fiber.	Understand
CO3	The basic concept of quantum physics.	Remember
CO4	The various modes involved in heat transmission and thermal insulating materials.	Analyze
CO5	The basics of crystal structure, crystal defects and crystal growth techniques.	Evaluate

COURSE ARTICULATION MATRIX														
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	1						2		
CO2	2	3	1	1	2	1						2		
CO3	3	2	1	1								1		
CO4	3	2	1	1	2		1					1		
CO5	2	2	1	1	2							1		
Avg	**2.6**	**2.2**	**1**	**1**	**1.75**	**1**	**1**					**1.4**		
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22CY101	ENGINEERING CHEMISTRY				Semester		I
PREREQUISITES		**Category**	**BS**	**Credit**			**4**
Basic Chemistry		**Hours/Week**	**L**	**T**		**P**	**TH**
			3	**1**		**0**	**4**

Course Learning Objectives

1	Basic Principles of Spectroscopy and their applications.
2	Knowledge of different methods for water analysis and purification & Nanomaterials and its application.
3	Various adsorption techniques and basic knowledge of Phase equilibria.
4	Principles of electrochemistry, electrochemical cells, corrosion, and its control.
5	Basis of polymer preparations and applications and enhancement of the quantity and quality of fuels.

Unit I	SPECTROSCOPIC TECHNIQUES	9	3	0	12

Beer-Lambert's law (problem) -UV visible spectroscopy: Principle, Chromophores, auxochrome, electronic transitions and instrumentation (No applications). IR spectroscopy: Principles -instrumentation and applications of IR in H_2O, and CO_2.

Flame photometry -principle -instrumentation -estimation of sodium by flame photometer. Atomic absorption spectroscopy -principles -instrumentation -estimation of nickel by atomic absorption spectroscopy.

Unit II	WATER TECHNOLOGY AND NANOTECHNOLOGY	9	3	0	12

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water – Reverse Osmosis.

Nano chemistry – preparations and properties of nanomaterials – nanorods – nanowires – nanotubes – carbon nano tubes and their application.

Unit III	SURFACE CHEMISTRY AND PHASE EQUILIBRIA	9	3	0	12

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich ‘s adsorption isotherm – Langmuir‘s adsorption isotherm.

Phase rule: Introduction, definition of terms with examples, one component system -water system – reduced phase rule – thermal analysis and cooling curves – two component systems – lead-silver system – Pattinson process.

Unit IV	ELECTROCHEMISTRY	9	3	0	12

Electrode Potential- Oxidation and Reduction Potentials - Electrochemical series – Significance and application - Electrochemical cell, Cell potential, derivation of Nernst equation for single electrode potential, numerical problems on E, E_0, and E_{cell} - numerical problems.

Electrochemical theory of corrosion with respect to iron. Factors influencing the corrosion rate: physical state of the metal, nature of the metal, area effect, over voltage, pH, temperature, and nature of the corrosion product. Types of corrosion: galvanic series; (i) Differential aeration corrosion- oxygen concentration cell, (ii) Stress corrosion- explanation-caustic embrittlement. Corrosion control by i) Cathodic protection- sacrificial anode and impressed current methods i) Protective coatings-metal coatings-galvanizing and tinning.

Unit V	POLYMERS AND FUELS	9	3	0	12

Polymers – definition – polymerization – types – addition and condensation polymerization – free radical polymerizatio mechanism – plastics, classification – preparation, properties and uses of PVC, Teflon, polycarbonate, polyurethane, nylon-6,6 PET – Rubber- vulcanization of rubber, synthetic rubbers – butyl rubber, SBR – biopolymers – Nylon-2-Nylon-6 and PHBV

Fuels - classification with examples, calorific value-classification (HCV & LCV), determination of calorific value of solid and liquid fuels using Bomb calorimeter- Petroleum cracking -fluidized bed catalytic cracking. Knocking in IC engine, its ill effects and prevention of knocking. Anti-knocking agent: Leaded and unleaded petrol.

Total (45L+15T) = 60 Periods

Text Books:	
1	S. S. Dara and S. S. Umare, ―A Textbook of Engineering Chemistry ‖ S. Chand & Company LTD, New Delhi, 2015
2	P. C. Jain and Monika Jain, ―Engineering Chemistry ‖ Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3	S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry ‖ Wiley India PVT, LTD, New Delhi, 2013.
Reference Books:	
1	Friedrich Emich, ―Engineering Chemistry ‖ Scientific International PVT, LTD, New Delhi, 2014.
2	Prasanta Rath, ―Engineering Chemistry ‖ Cengage Learning India PVT, LTD, Delhi, 2015.
3	Shikha Agarwal, ― Engineering Chemistry-Fundamentals and Applications ‖ Cambridge University Press, Delhi, 2015.
E- References :	
1	www.onlinecourses.nptel.ac.in/
2	www.ePathshala.nic.in

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Recall the basic principles of spectroscopy and their applications	Remember
CO2	Paraphrase the different methods for water analysis & purification and Nanomaterial & its applications	Understand
CO3	Apply the various adsorption techniques and basic knowledge of Phase equilibria	Apply
CO4	Integrate the principles of electrochemistry, electrochemical cells, corrosion, and its control	Create
CO5	Assess the basis of polymer preparations & applications and enhancement of the quantity & quality of fuels.	Evaluate

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	3		3									3	1
CO2	3	2		1		2							3	1
CO3	3	1		1									2	1
CO4	2	1		1		2							2	3
CO5	3	2		3		2							1	1
Avg	2.8	1.8		1.8		1.2							2.2	1.4

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22CS101	PROBLEM SOLVING AND C PROGRAMMING (Common to CSE, ECE, Civil, Mechanical and Metallurgy)		SEMESTER		I
PREREQUISITES		**CATEGORY**	**ES**	**Credit**	**3**
NIL		**Hours/week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To use general problem-solving techniques to device solutions to problems
2.	To understand the input-output relations of software involved in developing and converting a C program to a executable code.
3.	To provide complete knowledge about the programming concepts of C language.

UNIT I	**SYSTEM SOFTWARE, PROBLEM SOLVING, AND C PROGRAMMING**	**9**	**0**	**0**	**9**

High level programming language – Machine level language – Role of system software (Editor, Compiler, Assembler, Linker, Loader, and Operating System) in developing and executing a C program
C Programming: Character Set – Case sensitivity – Identifiers – Keywords –Literals – Data types – Declaration statement– Variables and their associated information– Formatted and unformatted console input-output statements – Type conversion – Operators – Precedence and Associativity – Pre-processor directives (#include and #define) – the main() function.
General problem-solving Techniques: Algorithm – Flow-chart – Pseudocode – Developing solutions for problems involving only operators and writing their equivalent C programs

UNIT II	**CONTROL STATEMENTS**	**9**	**0**	**0**	**9**

General problem-solving Techniques: Representing Decision making: if-else statement – switch-case statement – Looping statements: for loop, while loop and do-while loop – Branching statements: break and continue with Algorithm, Flow-chart, and Pseudocode.
C Programming: Decision Making: if-else statement – switch-case statement – Looping statements: for loop, while loop and do-while loop – Branching statements: break and continue – Nesting
Developing solutions for problems involving control statements using General problem-solving Techniques and their equivalent C programs

UNIT III	**ARRAYS, POINTERS, AND STRINGS**	**9**	**0**	**0**	**9**

One-dimensional and two-dimensional Arrays: Declaration – Initialization – Processing – Pointers: Declaration – Initialization – Processing – Relation between pointers and arrays – Strings – String operations – C Library support for String handling
Developing solution for problems involving arrays, pointers and strings using General problem-solving Techniques and their equivalent C programs

UNIT IV	**FUNCTIONS**	**9**	**0**	**0**	**9**

Function – Library functions and user-defined functions – Function prototypes and function definitions – Parameter passing mechanisms –Recursion – Storage classes – Working with multiple source files
Developing solution for problems involving functions using General problem-solving Techniques and their equivalent C programs.

UNIT V	**STRUCTURES, UNIONS AND FILE**	**9**	**0**	**0**	**9**

Structure: declaration – definition –Structure within a structure – Passing structures to functions – Array of structures – Pointers to structures – Union – File operations: reading and writing/appending to binary and text files.

Total (45 L)= 45 Periods

Text Books:	
1.	Balagurusamy E, "Programming in ANSI C", Tata Mcgraw-Hill, 8th Edition, 2022.
2.	Yashavant P. Kanetkar, "Let Us C", BPB Publications, 2016.

Reference Books:	
1.	Venugopal, “Mastering C”, Second Edition, Tata McGraw-Hill Education. 2006
2.	R. G. Dromey, “How to solve it by computers”, Prentice Hall, 2007
3.	Greg Perry and Dean Miller, “C Programming Absolute Beginner’s Guide”, Third Edition, Que Publishing, 2013.
4.	Brain W. Kernighan and Ritchie Dennis, “The C Programming Language”, Second Edition, Pearson, 1988.
E-Reference:	
1.	https://www.learn-c.org/
2.	https://www.programiz.com/c-programming

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Explain the concepts of C programming and roles of system software in programming	Understand
CO2	Use general problem-solving techniques to develop solutions to problems	Apply
CO3	Apply the concepts of C programming to develop solutions by writing C programs	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2			1			2	2	3	2
CO2	3	3	2	2	2			1			2	2	3	2
CO3	3	3	2	2	2			1			2	2	2	2
Avg	**3**	**3**	**2**	**2**	**2**			**1**			**2**	**2**	**3**	2

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22MC102	தமிழர் மரபு B.E (Common to all Branches)		Semester I			
முன்நிபந்தனைகள்:		Category	HSMC	Credit		1
இலக்கணம் மற்றும் இலக்கியத்தின் அடிப்படைகள்		Hours/Week	L	T	P	TH
			1	0	0	1

பாடநெறி நோக்கங்கள்: மாணவர்களால்

1.	தமிழ் மொழி மற்றும் இலக்கியம் பற்றிய அறிவைப் பெற முடியும்.
2.	பாரம்பரியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் மற்றும் சிற்பக் கலைகள் பற்றி தெரிந்து கொள்ள முடியும்
3.	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் பற்றி அறிந்து கொள்ள முடியும்
4.	தமிழர்களின் ஒழுக்க நெறிமுறைகளைப் பற்றி தெரிந்து கொண்டு அதன்படி நடந்து கொள்ள முடியும்.
5.	பழங்கால இந்திய தேசிய இயக்கம் பற்றியும், இந்திய மக்களின் பன்பாட்டில் தமிழர்களின் பங்களிப்பு பற்றியும் நன்கு அறிந்து கொள்ள முடியும்.

அலகு I	மொழி மற்றும் இலக்கியம்	3	0	0	3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க்காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II	மரபு – பாறைஓவியங்கள்முதல்நவீன ஓவியங்கள் வரைசிற்பக்கலை	3	0	0	3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள்- குமரி முனையில் திருவள்ளுவர் சிலை- இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III	நாட்டுப்புறக்கலைகள்மற்றும்வீரவிளையாட்டுகள்	3	0	0	3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஒயிலாட்டம், தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின்விளையாட்டுகள்.

அலகு IV	தமிழர்களின்திணைக்கோட்பாடுகள்	3	0	0	3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V	இந்தியதேசியஇயக்கம்மற்றும்இந்தியபண்பாட்டிற்குத்த மிழர்களின்பங்களிப்பு	3	0	0	3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப்பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப்புத்தகங்களின் அச்சு வரலாறு.

Total= 15 Periods

Text Books:	
1	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியல் பணிகள் கழகம்)
2	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

பாடநெறி முடிவுகள்: இந்தப் படிப்பு முடிந்ததும், மாணவர்களால்		**Bloom's Taxonomy Mapped**
CO1	இந்திய மொழிகள், இந்திய மொழிக் குடும்பங்கள் பற்றியும் மற்றும் இலக்கியம், இலக்கியதின் வளர்ச்சி, தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்புகளை பற்றியும் அறிந்து கொண்டனர்.	Understanding
CO2	சிற்பக் கலைகளில் அடங்கியுள்ள பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை பற்றியும், தமிழர்களின் சமூக, பொருளாதார வாழ்வில் கோவில்களின் பங்கினை பற்றியும் தெரிந்து கொண்டனர்.	Understanding
CO3	தமிழர்களின் வாழ்வியல் முறைகளோடு ஒன்றிய நாட்டுபுறக் கலைகள் மற்றும் தமிழர்களின் வீர விளையாட்டுகளை பற்றி அறிந்து கொண்டனர்.	Understanding
CO4	சங்ககாலத்தில் தமிழர்கள் பின்பற்றிய தினைக் கோட்பாடுகள் பற்றி நடந்து கொண்டனர்.	Applying
CO5	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்க்குத் தமிழர்களின் பங்கினை பற்றியும் அறிந்து கொண்டனர்.	Understanding

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3			2				1			2		
CO2			3			2				1			2		
CO3			3			2				1			2		
CO4			3			2				1			2		
CO5			3			2				1			2		
Avg			**3**			**2**				**1**			**2**		

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

<table>
<tr><td>22MC102</td><td colspan="3">HERITAGE OF TAMILS</td><td colspan="2">Semester</td><td>I</td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>HS MC</td><td colspan="2">Credit</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">Basics of Tamil Language and Literature</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1.</td><td colspan="6">To Obtain the knowledge of Tamil Language and Literature</td></tr>
<tr><td>2.</td><td colspan="6">To familiarize with painting and Sculpture</td></tr>
<tr><td>3.</td><td colspan="6">To Know about the folks and martial arts</td></tr>
<tr><td>4.</td><td colspan="6">To understand the Thinai concept of Tamils</td></tr>
<tr><td>5.</td><td colspan="6">To know about the contribution of Tamils to Indian National Movement and Indian Culture.</td></tr>
<tr><td>Unit I</td><td colspan="2">LANGUAGE AND LITERATURE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.</td></tr>
<tr><td>Unit II</td><td colspan="2">HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.</td></tr>
<tr><td>Unit III</td><td colspan="2">FOLK AND MARTIAL ARTS</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.</td></tr>
<tr><td>Unit IV</td><td colspan="2">THINAI CONCEPT OF TAMILS</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.</td></tr>
<tr><td>Unit V</td><td colspan="2">CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.</td></tr>
<tr><td colspan="7" align="right">Total = 15 Periods</td></tr>
</table>

Text Books:	
1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology&TamilNadu Text Book and Educational Services Corporation, Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Learn the knowledge of Tamil Language and Literature	Understanding
CO2	Familiarize about painting and Sculpture	Understanding
CO3	Acquire the knowledge about folks and Martial arts	Understanding
CO4	Learn the knowledge of Thinai concepts of Tamils	Applying
CO5	Acquire the knowledge about contribution of Tamils to Indian national movement and Indian culture	Understanding

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3			2				1			2		
CO2			3			2				1			2		
CO3			3			2				1			2		
CO4			3			2				1			2		
CO5			3			2				1			2		
Avg			**3**			**2**				**1**			**2**		

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CS102	**COMPUTER PRACTICE AND C PROGRAMMING LABORATORY** (Common to CSE, ECE, EEE, Civil, Mechanical and Metallurgy)		**Semester**			**I**
PREREQUISITES		**Category**	**ES**	**Credit**		**1.5**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			0	**0**	**3**	**3**

Course Learning Objectives	
1	To provide basic knowledge to work with word processing applications
2	To provide basic knowledge to work with spread sheet applications
3	To promote the programming ability to develop C applications

EXPERIMENTS

1. Creating and Formatting documents.
2. Creating Tables and Manipulation
3. Using Equation Editor
4. Inserting Pictures, Shapes and Charts
5. Using Mail merge

B. Spread Sheet

6. Creating sheets, using built in functions and user-defined formulae
7. Creating different type of charts from data

C. Simple C Programming

8. Program using different operators
9. Program using Control statements.
10. Program using Loops, Array and Strings.
11. Program using Functions and pointers
12. Program using Structures and Files.

For programming exercises Algorithm, Flow chart and pseudo code are essential

Total (45 P)= 45 Periods

Course Outcomes: After the successful completion of the practical session, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Demonstrate the usage of features supported by word processing applications.	Apply
CO2	Demonstrate the usage of features supported by spread sheet applications.	Apply
CO3	Apply general programming techniques to develop digital solutions to problems	Apply
CO4	Implement solutions developed with general programming techniques in C programming language.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1										3				
CO2	3	3												
CO3	3	3	2	2	2	1	1	1			2	3	3	2
CO4	3	3	2	2	2	1	1	1			2	3	3	2
Avg	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**		**3**	**2**	**3**	**3**	**2**
3 / 2 /1 - indicatesstrengthofcorrelation (3-High,2-Medium,1-Low)														

22ME102	WORKSHOP MANUFACTURING PRACTICES				SEMESTER I	
PREREQUISITES		**Category**	**ES**	**Credit**		**2**
		Hours/Week	**L**	**T**	**P**	**TH**
			0	**0**	**4**	**4**

Course Learning Objectives

1	To understand the basics of safety measures taken in the laboratory.
2	To provide exposure to the students with hands-on experience on various basic engineering practices in Civil and Mechanical Engineering.
3	To know about the various fitting joints and lathe operation.
4	To gain knowledge in welding and fitting operation.
5	To understand the fabrication of various models using sheet metals.

LIST OF EXPERIMENTS

1. Introduction to Safety measures and First aid.
2. Study of Lathe, drilling machine -Welding methods and equipment- Casting process and tools- Sheet metal and fitting tools- Carpentry tools and joints.
3. Fitting: V-fitting, square fitting, Curve fitting.
4. Lathe: Facing, turning, taper turning and knurling.
5. Welding: BUTT, LAP and T- joints.
6. Foundry: Greensand preparation- mould making practice.
7. Sheet metal: Cone, tray, cylinder.
8. Carpentry: CROSS, T and DOVETAIL joints.
9. Drilling: simple exercises.

Total (60P) = 60 Periods

Reference Books:

1	Bawa, H.S, “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, 2007.
2	Jeyachandran.K, Natarajan.K and Balasubramanian.S, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
3	Jeyapoovan.T, SaravanaPandian.M, and Pranitha.S, “Engineering Practices Lab Manual”, Vikas Publishing House Pvt. Ltd, 2006.
4	Dr.P.Kannan, Mr.T.Satheeskumar&Mr.K.Rajasekar, “Engineering practices laboratory” Mnual first edition 2017.
5	Dr. V. Rameshbabu “Engineering practices laboratory” VRB publication pvt ld.

E-Reference:

1	https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-me14/
2	https://nptel.ac.in/courses/112107083

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Familiarize the working of various equipment and safety measures.	Understand
CO2	Prepare fitting of metal and wooden pieces using simple fitting and carpentry tools manually.	Apply
CO3	Prepare the mould cavity by using proper moulding tools in foundry section.	Apply
CO4	Fabrication of components using welding, lathe and drilling machine.	Apply
CO5	Make the model using sheet metal works.	Apply

COURSE ARTICULATION MATRIX														
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						3								
CO2		3		2	1									
CO3		3		2	1									
CO4		3		2	1									
CO5		3		2	1									
Avg		**3**		**2**	**1**	**3**								
3/2/1 – indicates strength of correlation (3- High, 2- Medium, 1- Low)														

<table>
<tr><td>22MA202</td><td colspan="4">LINEAR ALGEBRA AND LINEAR PROGRAMMING PROBLEMS</td><td colspan="2">SEMESTER</td><td>II</td></tr>
<tr><td colspan="3">PREREQUISTIES</td><td>CATEGORY</td><td>BS</td><td colspan="2">Credit</td><td>4</td></tr>
<tr><td colspan="3" rowspan="2">Basic 12th level knowledge of Matrices and Determinants, Vectors and graphical drawing.</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
<tr><td>1.</td><td colspan="7">To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.</td></tr>
<tr><td>2.</td><td colspan="7">To understand the concepts of vector space, linear transformations and diagonalization.</td></tr>
<tr><td>3.</td><td colspan="7">To apply the concept of inner product spaces in orthogonalization.</td></tr>
<tr><td>4.</td><td colspan="7">To acquire knowledge to find the solution of LPP using graphical and simplex methods.</td></tr>
<tr><td>5.</td><td colspan="7">To solve the transportation and assignment models of LPP.</td></tr>
<tr><td>UNIT I</td><td colspan="3">VECTOR SPACES</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="8">Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.</td></tr>
<tr><td>UNIT II</td><td colspan="3">LINEAR TRANSFORMATION AND DIAGONALIZATION</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="8">Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformation - Eigenvalues and eigenvectors - Diagonalizability.</td></tr>
<tr><td>UNIT III</td><td colspan="3">INNER PRODUCT SPACES</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="8">Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.</td></tr>
<tr><td>UNIT IV</td><td colspan="3">INTRODUCTION TO LINEAR PROGRAMMING</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="8">Linear programming – formulation, solution by graphical and simplex methods (Primal- Penalty, Two Phase), Special cases- Dual Simplex method- Principles ofDuality.</td></tr>
<tr><td>UNIT V</td><td colspan="3">LINEAR PROGRAMMING EXTENSIONS</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="8">Transportation models (Minimizing and Maximizing Problems) – Balanced and unbalanced problems- Initial Basic feasible solution by North-West Corner rule, Least cost and Vogel’s approximation methods- Check for optimality: Solution by Modified Distribution method – Assignment models (Minimizing and Maximizing Problems)- Balanced and Unbalanced Problems- Solution by Hungarian and Branch and Bound Algorithms - Travelling salesman problem.</td></tr>
<tr><td colspan="8" align="right">Total (45L+15T) = 60 Periods</td></tr>
</table>

<table>
<tr><td colspan="2">Text Books:</td></tr>
<tr><td>1.</td><td>Gilbert Strang, “Linear Algebra and its Applications”, 4th edition, Cengage Learning, New Delhi, 2014.</td></tr>
<tr><td>2.</td><td>Taha, H.A., “Operations Research – An Introduction”, 10th Edition, Pearson Education Edition, Asia, New Delhi,2019.</td></tr>
<tr><td colspan="2">Reference Books:</td></tr>
<tr><td>1.</td><td>D.Poole, “Linear Algebra, A Modern introduction”, 4th Edition, Brooks, 2014.</td></tr>
<tr><td>2.</td><td>V.Krishnamurthy, V.P. Mainra and J.L. Arora, “An Introduction to Linear Algebra”, East-West press, Reprint 2005.</td></tr>
<tr><td>3.</td><td>R. Paneer Selvam, “Operations Research”, 2nd Edition, Prentice Hall of India, 2002.</td></tr>
</table>

4.	A. M. Natarajan, P. Balasubramanian, A. Tamilarasi, “Operations Research”, Pearson Education, Asia, 2005.
5.	Prem Kumar Gupta, D.S. Hira, “Operations Research”,3rd Edition, S. Chand & Company Ltd, New Delhi, 2012.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s TaxonomyMapped**
CO1	:	Use the concepts of vector space and subspaces.	Apply
CO2	:	Apply the concept of linear transformations in diagonalizability.	Apply
CO3	:	Illustrate the concept of inner product spaces in orthogonalization	Understand
CO4	:	Solve LPP by using Graphical and Simplex methods.	Apply
CO5	:	Obtain the solution of Transportation and Assignment models.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	1									2	
CO2	3	2	1	1									2	
CO3	3	2	1	1									2	
CO4	3	2	1	2									2	
CO5	3	2	1	2									2	
Avg	**3**	**2**	**1**	**1.4**									**2**	

3/2/1 – indicates strength of correlation (3- High, 2- Medium, 1- Low)

<table>
<tr><td>22HS201</td><td colspan="3">UNIVERSAL HUMAN VALUES</td><td colspan="3">SEMESTER</td><td>II</td></tr>
<tr><td colspan="3">PRE-REQUISITE:</td><td>Category</td><td>HS</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="3" rowspan="2">1.Introduction of Universal Human Values</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
<tr><td>1.</td><td colspan="7">Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.</td></tr>
<tr><td>2.</td><td colspan="7">Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.</td></tr>
<tr><td>3.</td><td colspan="7">Strengthening of self-reflection.</td></tr>
<tr><td>4.</td><td colspan="7">Development of commitment and courage to act.</td></tr>
<tr><td>UNIT I</td><td colspan="3">BASIC CONCEPTS OF HUMAN VALUES</td><td>6</td><td>3</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Course Introduction - Need, Basic Guidelines, Content and Process for Value Education. Purpose and motivation for the course, recapitulation from Universal Human Values-I. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario Method to fulfil the above human aspirations- understanding and living in harmony at various levels.</td></tr>
<tr><td>UNIT II</td><td colspan="3">UNDERSTANDING HARMONY IN THE HUMAN BEING</td><td>6</td><td>3</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Understanding Harmony in the Human Being - Harmony in Myself! Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’ Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer) Understanding the characteristics and activities of ‘I’ and harmony in ‘I’ Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Health.</td></tr>
<tr><td>UNIT III</td><td colspan="3">UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY</td><td>6</td><td>3</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.</td></tr>
<tr><td>UNIT IV</td><td colspan="3">UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE</td><td>6</td><td>3</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Understanding Harmony in the Nature and Existence - Whole existence as Coexistence. Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence.</td></tr>
<tr><td>UNIT V</td><td colspan="3">HOLISTIC UNDERSTANDING OF HARMONY</td><td>6</td><td>3</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Implications of the above Holistic Understanding of Harmony on Professional Ethics. Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics, Strategy for transition from the present state to Universal Human Order.</td></tr>
<tr><td colspan="8" align="right">Total (30L + 15T) = 45 Hours</td></tr>
</table>

Reference Books:	
1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
Reference Books:	
1.	JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3.	The Story of Stuff (Book)
4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5.	Small is Beautiful - E. F Schumacher.
6.	Slow is Beautiful - Cecile Andrews
7.	Economy of Permanence - J C Kumarappa
8.	Bharat Mein Angreji Raj - PanditSunderlal
9.	Rediscovering India - by Dharampal
10.	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11.	India Wins Freedom - Maulana Abdul Kalam Azad
12.	Vivekananda - Romain Rolland (English)
13.	Gandhi - Romain Rolland (English)

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Become more aware of themselves, and their surroundings (family, society, nature) and become more responsible in life	Evaluate
CO2	Handle problems with sustainable solutions, while keeping human relationships and human nature in mind	Apply
CO3	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society)	Evaluate
CO4	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	Apply

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			1			1		2		1		3	2	
CO2			1			3		1		1		3	1	
CO3			1			2		1		1		3	1	
CO4			2			1		1		1		3	1	
Avg			1.25			1.75		1.25		1		3	1.25	
3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)														

22CS201	DIGITAL PRINCIPLES AND SYSTEM DESIGN				SEMESTER			II
PREREQUISITES			**CATEGORY**	**ES**	**Credit**			**3**
NIL			**Hours/Week**	**L**	**T**		**P**	**TH**
				3	**0**		**0**	**3**

Course Objectives:

1.	To comprehend digital languages, Boolean laws and Boolean functions
2.	To understand the design of fundamental combinational and sequential circuits of a computing device
3.	To analyze and design combinational and sequential circuits

UNIT I	**BOOLEAN ALGEBRA AND LOGIC GATES**	**9**	**0**	**0**	**9**

Number systems – Decimal – Binary – Octal – Hexadecimal – Binary Arithmetic – Binary codes – Boolean algebra and theorems – Boolean functions – Simplifications of Boolean functions using Karnaugh map and Quine-Mc-cluskey method – logic gates.

UNIT II	**COMBINATIONAL LOGIC**	**9**	**0**	**0**	**9**

Combinational circuits – Analysis and design procedures – Circuits for arithmetic operations – Half Adder – Full Adder – Half Subtractor – Full Subtractor – Adder-Subtractor – Carry Look ahead adder – Decimal Adder – Binary Multiplier – Magnitude Comparator – Code conversion circuits

UNIT III	**MSI COMBINATIONAL LOGIC & SYNCHRONOUS SEQUENTIAL LOGIC**	**9**	**0**	**0**	**9**

Decoders – Encoders – Multiplexers – De-multiplexers – Realizing Boolean Functions with Multiplexers – Sequential circuits – Latches – SR latch – Flip flops – D Flip flop – JK Flip Flop – T Flip Flop – Analysis and Design Procedures – State reduction and state assignment – Transition table – Circuit Design

UNIT IV	**MEMORY AND PROGRAMMABLE LOGICS**	**9**	**0**	**0**	**9**

Registers – Shift Registers – Ripple Counters – Synchronous Counters – Counters with unused states – Ring Counter – Johnson Counter – Random Access Memory – Memory Decoding – Error Detection and Correction – Read only Memory – Programmable Logic Array – Programmable Array Logic

UNIT V	**ASYNCHRONOUS SEQUENTIAL LOGIC**	**9**	**0**	**0**	**9**

Analysis and Design procedure for asynchronous sequential circuits – Reduction of state and flow tables – Race Free State assignment – Hazards.

Total (45 L) = 45 Periods

Text Book:

1.	M.Morris Mano and Michael Ciletti, “Digital Design with an Introduction to the Verilog HDL”, Fifth Edition, Pearson Education, 2013.

Reference Books:

1.	Stephen Brown and Zvonko Vranesic, “Fundamentals with Digital Logic Design with VERILOG”, Third Edition, McGraw-Hill Education 2014.
2.	Donald D.Givone, “Digital Principles and Design”, McGraw Hill Higher Education,2003.
3.	Charles H.Roth, Jr and Larry L. Kinney “Fundamentals of Logic Design” Seventh Edition, Jaico Publishing House, 2014.

E-References:	
1.	https://nptel.ac.in/courses/117105080/
2.	https://nptel.ac.in/courses/117106086/

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply Boolean laws to derive simplified Boolean function and implement the circuit with logic components.	Apply
CO2	Reproduce the existing design of combinational or sequential circuits of a computing device and scale them in size	Uderstand
CO3	Analyze and design simple combinational or sequential circuits	Amalyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2										3	1	
CO 2	3	2			3							3	1	
CO 3	3	2			3							3	3	
Avg	**3**	**2**			**3**							**3**	**1.6**	

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22EE101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Common to Civil Engineering, Mechanical Engineering, and Computer Science and Engineering)			Semester		II
PREREQUISITES		**Category**	**ES**	**Credit**		**4**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**1**	**0**	**4**

Course Learning Objectives

1	To understand and analyze basic electric circuits.
2	To study working principle of electrical machines and transformer.
3	To study basics of electronic devices and operational amplifier.
4	To understand the concepts of electrical installations.

Unit I	**DC CIRCUITS**	**9**	**3**	**0**	**12**
Electrical circuit elements (R, L and C) - Voltage and current sources - Ohm's law and Kirchhoff's laws- Series and parallel circuits - Analysis of simple electrical circuits with DC excitation using fundamental laws – Superposition theorem, Thevenin's and Norton's theorems.					
Unit II	**AC CIRCUITS**	**9**	**3**	**0**	**12**
Introduction to single phase AC circuits - Representation of sinusoidal waveforms, peak and RMS values, phasor representation- Analysis of single-phase AC circuits consisting of RL, RC, RLC combinations (series and parallel): real power, reactive power, apparent power and power factor. Three phase AC circuits, voltage and current relations in star and delta connections.					
Unit III	**ELECTRICAL MACHINES AND TRANSFORMERS**	**9**	**3**	**0**	**12**
DC Motor: Construction, operation, types and applications, Speed control of DC shunt motor - Construction and working of three-phase induction motors - Working of single-phase induction motor and its applications – Transformers: Ideal and practical transformer, Construction and working, losses and efficiency in transformers, Introduction to three phase transformers.					
Unit IV	**BASICS OF ELECTRONICS SYSTEM**	**9**	**3**	**0**	**12**
Introduction - Basic structure of semiconductors devices- PN junction diode, Zener diode and V-I characteristics- BJT – CE, CB, CC configuration and working principle. Operational Amplifier-principle of operation, Characteristics, Applications: Inverting Amplifier, non inverting amplifier, summing amplifier and differential amplifier.					
Unit V	**ELECTRICAL INSTALLATIONS**	**9**	**3**	**0**	**12**
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB - Types of wires and cables – Earthing - Basics of house wiring tools and components, types of house wiring – Batteries: Principle characteristics-Types and its applications - Introduction to UPS and SMPS.					
Total (45L+15T) = 60 Periods					

Text Books:

1	Muthu Subramaniyam, R., Salivaganan, R., and Muralidharan, K. A., "Basic Electrical and Electronics Engineering", Second Edition, Tata McGraw Hill, 2010.
2	Kothari, D. P., and Nagrath, I. J., "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3	Kulshreshtha, D.C., "Basic Electrical Engineering", Tata McGraw Hill, 2009.

Reference Books:

1	Bobrow, L. S., "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2	Hughes, E., "Electrical and Electronics Technology", Pearson, 2010.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Analyze the DC circuits using fundamental laws and theorems.	Analyze
CO2	Analyze the single and three phase AC circuits.	Analyze
CO3	Recognize the working principle of electrical machines and transformers.	Understand
CO4	Recognize the fundamentals and characteristics of diode, BJT and operational amplifier.	Understand
CO5	Demonstrate the concept of electrical installations.	Apply

COURSE ARTICULATION MATRIX

COs\ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1									1	1		
CO 2	1	1									1	1		
CO 3	1										1	1		
CO 4	1										1	1		
CO 5	1										1	1		
Avg	**1**	**1**									**1**	**1**		

3/ 2/ 1 – indicates strength of correlation (3- High, 2-Medium, 1-Low)

<table>
<tr><td>22ME101</td><td colspan="3">ENGINEERING GRAPHICS AND DESIGN</td><td colspan="2">Semester</td><td>II</td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>ES</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">Students should know about the basics of drawings.
Students should be able to construct geometric shapes</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>1</td><td>0</td><td>4</td><td>5</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To impart knowledge on graphical skills for communications of concepts, ideas and design of engineering products and to provide exposure to design.</td></tr>
<tr><td>2</td><td colspan="6">To expose them to existing national standards related to technical drawings.</td></tr>
<tr><td>3</td><td colspan="6">To understand the basics of points, lines, planes and solids.</td></tr>
<tr><td>4</td><td colspan="6">To understand the basics of the surface of an object.</td></tr>
<tr><td>5</td><td colspan="6">To expose them to isometric and perspective views of simple solids.</td></tr>
<tr><td>Unit I</td><td colspan="2">PROJECTION OF POINTS, LINES AND PLANE SURFACES</td><td>3</td><td>0</td><td>12</td><td>15</td></tr>
<tr><td colspan="7">General principles of orthographic projection- Projection of points, located in all quadrants – Projection of straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.</td></tr>
<tr><td>Unit II</td><td colspan="2">PROJECTION OF SOLIDS</td><td>3</td><td>0</td><td>12</td><td>15</td></tr>
<tr><td colspan="7">Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular to one reference plane and also inclined to one reference plane by change of position method.</td></tr>
<tr><td>Unit III</td><td colspan="2">SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES</td><td>3</td><td>0</td><td>12</td><td>15</td></tr>
<tr><td colspan="7">Sectioning of above solids in a simple vertical position by cutting planes inclined to one reference plane and perpendicular to other – solids inclined position with cutting planes parallel to one reference plane- Obtaining true shape of the section.
Development of lateral surfaces of simple and truncated solids – Prisms, pyramids cylinders and cones- Development of lateral surfaces of solids with square and cylindrical cutouts, perpendicular to the axis.</td></tr>
<tr><td>Unit IV</td><td colspan="2">ORTHOGRAPHIC AND ISOMETRIC PROJECTION</td><td>3</td><td>0</td><td>12</td><td>15</td></tr>
<tr><td colspan="7">Orthographic Projection - Visualization concepts and Freehand sketching - Visualization principles - Representation of three-dimensional objects - Layout of views - Freehand sketching of multiple views from pictorial views of objects.
Principles of isometric projection – isometric scale - isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.</td></tr>
<tr><td>Unit V</td><td colspan="2">PERSPECTIVE PROJECTION</td><td>3</td><td>0</td><td>12</td><td>15</td></tr>
<tr><td colspan="7">Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.</td></tr>
<tr><td colspan="7" align="right">Total (15L+60T) = 75 Periods</td></tr>
</table>

<table>
<tr><td colspan="2">Text Books:</td></tr>
<tr><td>1</td><td>Bhatt, N.D.,Panchal V M and Pramod R. Ingle, “Engineering Drawing”, Charotar Publishing House, 53rd Edition,</td></tr>
<tr><td>2</td><td>Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015</td></tr>
</table>

Reference Books:	
1	Agrawal, B. and Agrawal C.M., “Engineering Drawing”, Tata McGraw, N.Delhi, 2008.
2	Gopalakrishna, K. R., “Engineering Drawing”, Subhas Stores, Bangalore, 2007.
3	Natarajan, K. V., “A text book of Engineering Graphics”, 28th Ed., Dhanalakshmi Publishers, Chennai, 2015.
4	Shah, M. B., and Rana, B. C., “Engineering Drawing”, Pearson, 2nd Ed., 2009.
5	Venugopal, K. and Prabhu Raja, V., “Engineering Graphics”, New Age, 2008.
E-References	
1.	https://nptel.ac.in/courses/112102304
2.	https://home.iitk.ac.in/~anupams/ME251/EDP.pdf
3.	https://static.sdcpublications.com/pdfsample/978-1-58503-610-3-1.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Familiarize with the fundamentals and standards of engineering graphics.	Understand
CO2	Ability to understand the fundamental concepts of projection of points, lines and planes.	Analyze
CO3	Project the solids and section of solids.	Analyze
CO4	Familiarize and develop the lateral surfaces of solids	Analyze
CO5	Visualize and project the orthographic, isometric and perspective sections of simple solids.	Analyze

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PS O2**
CO1	3	1											3	1
CO2	3	1											3	1
CO3	3	1											3	1
CO4	3	1											3	1
CO5	3	1											3	1
Avg	**3**	**1**											**3**	**1**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**														

22MCIN01	ENGINEERING SPRINTS			Semester		II
PREREQUISITES		**Category**	**EE**	**Credit**		**1**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			0	**0**	**2**	**2**

Course Learning Objectives	
1	To Strengthen conceptual understanding of fundamental engineering concepts.
2	To Spark curiosity in students Minds.
3	To focus on teaching through a problem-solving approach using Street Fight Engineering principles pioneered.
4	To foster the growth of functional independence and self-driven learning habits.
5	To maximize the interest levels towards learning - as students aspire to create meaningful changes in the world.

Unit I	**STREET FIGHTING ENGINEERING**	**0**	**6**	**0**	**6**
Why street fight engineering - How to street fight engineering - Decode real-world problems - Observe key patterns - relationship study - Derive actionable inferences - Perform data - driven insights - Generate concepts and case studies.					
Unit II	**PROGRAMMING PARADIGM**	**0**	**6**	**0**	**6**
Need for programming - Outside box thinking to solve problems- Need for algorithms and data structures - Flowcharts & Algorithms - Memory Allocation - Conditions and loops - Creating effective functions - Case studies - Visual Programming - Types of programming languages & paradigms - Getting started with development - Build & test an algorithm - Best practices.					
Unit III	**BRAINS OF MACHINES**	**0**	**6**	**0**	**6**
Key innovations in Tesla Electric car - Case study - Brains of Electric cars - Tran disciplinary systems - Adapting Tran disciplinary systems to Accelerate Innovation - Idea Hexagon - Exercise to think of new innovations using Idea Hexagon - Brains of Digital camera.					
Unit IV	**MACHINES THAT MAKE-UP THE WORLD**	**0**	**6**	**0**	**6**
Basics of Electronics passive components - Need for sensors & Actuators - Analyzing & Understanding electronic circuits - How to Build a Basic Custom Hardware - Boot loader & its purposes.					
Unit V	**ENGINEERING THE REAL WORLD**	**0**	**6**	**0**	**6**
Real-world as systems - Introducing to Systems Thinking - Stock and Flow Diagrams - System Traps - Intervening circuits - Living in a World of Systems.					
					Total = 30 Periods

Text Books:	
1	Sanjoy Mahajan - Street Fighting Mathematics
2	Donald Knuth - The Art of Computer Programming
3	Think like a programmer - An introduction to creative problem solving
4	Thinking in Systems - A Primer

Reference Books:	
1	Learning to code : How to think like a programmer
2	How to find innovative ideas : Ramesh Raskar's note
3	Case Study ; How Tesla changed the auto industry
4	Ultimate Guide : How to develop a new electronic hardware product

Course Outcomes: Upon completion of this course, the students will be able to:		Blooms Taxonomy Level
C01	Apply street fight engineering concepts	Apply
C02	Construct Flowchart & block diagrams for algorithms	Create
C03	Apply the idea Hexagon Tool to understand basic electronics for building basic hardware	Apply
C04	Examine real-world problems with a system view	Anayze

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	2	0	0	0	0	0	0	0	2	2	2
CO2	3	3	3	2	3	0	0	0	0	0	0	0	3	3	2
CO3	1	2	2	1	1	0	0	0	0	0	0	0	2	2	2
CO4	3	3	3	2	2	0	0	0	0	0	0	0	3	3	3
CO5	2	3	3	3	3	0	0	0	0	0	0	0	3	3	3
AVG	**2.2**	**2.8**	**2.6**	**2**	**2.2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2.6**	**2.6**	**2.4**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

<table>
<tr><td>22MC201</td><td colspan="2">தமிழரும் தொழில்நுட்பமும்
B.E (Common to all Branches)</td><td colspan="3">Semester</td><td>II</td></tr>
<tr><td colspan="2">முன்நிபந்தனைகள்:</td><td>Category</td><td>HS MC</td><td colspan="2">Credit</td><td>1</td></tr>
<tr><td colspan="2" rowspan="2">இலக்கணம் மற்றும் இலக்கியத்தின் அடிப்படைகள்</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="7">பாடநெறி நோக்கங்கள்: மாணவர்களால்</td></tr>
<tr><td>1.</td><td colspan="6">நெசவுத் தொழிலின் நன்மைகள், அதன் பயன்கள், பானைத் தொழில் நுட்பத்தைப் பற்றி நன்கு அறிந்து கொள்ள முடியும்.</td></tr>
<tr><td>2.</td><td colspan="6">கட்டிடம் கட்டுதல் மற்றும் கட்டிடத் தொழிலுள்ள நுட்பங்கள் பற்றி அறிந்து கொள்ள முடியும்.</td></tr>
<tr><td>3.</td><td colspan="6">உற்பத்தி தொழில் நுட்பம், இரும்பு, உலோகம், கனிமம், தொழிற்சாலைகள் பற்றி அறிந்து அவற்றின் பயன்பாடுகளை வெளிப்படுத்த முடியும்.</td></tr>
<tr><td>4.</td><td colspan="6">வேளாண்மை மற்றும் நீர் பாசன முறைகள், தொழில் நுட்பம், ஏர் உழுதல் போன்ற பண்டைய கால நெறி முறைகளைப் பற்றி தெரிந்து நடைமுறைப் படுத்த முடியும்.</td></tr>
<tr><td>5.</td><td colspan="6">இன்றைய கால கட்டத்தில் உள்ளவாறு அறிவியல் வளர்ச்சி, கணினித் தமிழ் பற்றி தெரிந்து கொண்டு அறிவை விரிவாக்க முடியும்.</td></tr>
<tr><td>அலகு I</td><td colspan="2">நெசவு மற்றும் பானை தொழில்நுட்பம்</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">சங்க காலத்தில் நெசவுத் தொழில் - பானை தொழில் நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்- பாண்டங்களில் கீறல் குறியீடுகள்</td></tr>
<tr><td>அலகு II</td><td colspan="2">வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்- சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள்- நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டகமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றம் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ சாரோசெனிக் கட்டிடக் கலை.</td></tr>
<tr><td>அலகு III</td><td colspan="2">உற்பத்தித் தொழில் நுட்பம்</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சிடித்தல் - மணி உருவாக்கம் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.</td></tr>
<tr><td>அலகு IV</td><td colspan="2">வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">அனை, ஏரி, குளங்கள், மதகு, - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.</td></tr>
<tr><td>அலகு V</td><td colspan="2">அறிவியல் தமிழ் மற்றும் கணித்தமிழ்</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென் பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.</td></tr>
<tr><td colspan="7">Total = 15 Periods</td></tr>
</table>

Text Books:	
1	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியல் பணிகள் கழகம்)
2	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3	கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

பாடநெறி முடிவுகள்: இந்தப் படிப்பு முடிந்ததும், மாணவர்களால்		**Bloom's Taxonomy Mapped**
CO1	சங்காலத்தில் இருந்த நல்ல தொழில்களையும் கைவிணை கலைகளால் ஏற்படும் நன்மைகளையும் பற்றி அறிந்து கொண்டனர்.	Understanding
CO2	கட்டிடங்கள் மற்றும் வீட்டுப்பொருட்களை வடிவமைப்பது, சங்காலத்தில் இருந்த கோவில்களை பற்றி அறிந்து கொண்டனர்	Understanding
CO3	உலோகவியல், இரும்பு தொழிற்சாலைகள், தொல்லியல் சான்றுகள், உற்பத்தி தொழல் நுட்பத்தை பற்றி அறிந்து கொண்டனர்.	Applying
CO4	பழங்காலத்தில் வோளண்மை, நீர்பாசனம், மீன் வளம், கால்நடை பராமரிப்பு, அறிவுசார் சமுகம் பற்றி அறிந்து கொண்டனர்.	Applying
CO5	அறிவியல் தமிழன் வளர்ச்சி, கணித்தமிழ் வளர்ச்சி, மென்பொருள் உருவாக்கம், இணைய கல்வி கழகம், இணையத்தில் தமிழ் அகராதிகள் பற்றி அறிந்து கொண்டனர்.	Understanding

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1			3			2						1	2	
CO2			3			2						1	2	
CO3			3			2						1	2	
CO4			3			2						1	2	
CO5			3			2						1	2	
Avg			**3**			**2**						**1**	**2**	

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22MC201	TAMILS AND TECHNOLOGY			Semester		II
PREREQUISITES		**Category**	**HS MC**	**Credit**		**1**
Basics of Tamils Language and Literature		**Hours/Week**	**L**	**T**	**P**	**TH**
			1	**0**	**0**	**1**

1.	To Obtain the knowledge of weaving and ceramic technology
2.	To familiarize about design and construction technology during sangam age and British period
3.	To know about the manufacturing technologices
4.	To obtain the knowledge of agriculture and irrigation technology
5.	To know about the development of Scientific Tamil and Tamil computing

Unit I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**	**0**	**0**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.					
Unit II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**	**0**	**0**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- ThirumalaiNayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.					
Unit III	**MANUFACTURING TECHNOLOGY**	**3**	**0**	**0**	**3**
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.					
Unit IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**	**0**	**0**	**3**
Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.					
Unit V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**	**0**	**0**	**3**
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.					
Total = 15 Periods					

Text Books:	
1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies)
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology&TamilNadu Text Book and Educational Services Corporation, Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Obtain the knowledge about weaving and ceramic technology.	Understatnding
CO2	Familiarize about design and construction technology during sangam age and British period	Understatnding
CO3	Understanding about the manufacuturing technologies	Applying
CO4	Acquire the skills in agriculture and irrigation technology	Applying
CO5	Acquire the knowledge about the development of Scientific Tamils and Tamil computing.	Understatnding

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1			3			2						1	2	
CO2			3			2						1	2	
CO3			3			2						1	2	
CO4			3			2						1	2	
CO5			3			2						1	2	
Avg			**3**			**2**						**1**	**2**	

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

<table>
<tr><td>22NC201</td><td colspan="5">NCC COURSE-I (Only for NCC Students)</td><td colspan="2">Semester</td><td>II</td></tr>
<tr><td colspan="4">PREREQUISITES</td><td>Category</td><td>NC</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="4" rowspan="2">NIL</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="9">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="8">To maintain the unity and disciplines to the students</td></tr>
<tr><td>Unit I</td><td colspan="4">NCC GENERAL & NATIONAL INTEGRATION AND AWARENESS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Aims, Objectives and Org of NCC – Incentives to NCC cadets – Duties of NCC Cadets – NCC Camps: Types & Conduct; National Integration: Importance and Necessity – Factors affecting National Integration – Unity in Diversity – Threats to National Security.</td></tr>
<tr><td>Unit II</td><td colspan="4">PERSONALITY DEVELOPMENT & LEADERSHIP DEVELOPMENT</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Personality Development Capsule -Self Awareness Empathy, Creative& Creative Thinking, Decision Making - Communication Skills - Group Discussion - Stress emotions, Change Your Mindset, Inter Personal Relations& Team work, Time Managements, Civil Sense - Career Counselling, SSB Procedures & Interview Skills; Leadership Capsule - Traits, Indicators, Motivation, Ethics &Honour code - Case Studies-Shivaji, APG Abdul Kalam & Deepa Malik, MaharanaPratap, Ratan Tata, KiranMajumdar, Jhansi Ki Rani, Narayan Murty, PrakashPadukone, Tipu Sultan, Rabindranath Tagore.</td></tr>
<tr><td>Unit III</td><td colspan="4">DISASTER MANAGEMENT AND HEALTH & HYGIENE</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Disaster Management Capsule- SochVichar, Types - Organisation, Capability & Role of NCC Cadets – Fire Service & Fire Fighting – Initiative Training, Organisation Skills, Do's and Don'ts – Natural Disasters, Man Made Disasters; Health & Sanitation – First aid in Common Medical Emergencies, Treatment & Care of Wounds – Introduction to Yoga & Exercises.</td></tr>
<tr><td>Unit IV</td><td colspan="4">PRINCIPLES OF FLIGHT & GENERAL SERVICE KNOWLEDGE</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Laws of Motion – Glossary Terms – Bernoulli's Principle – Aerofoil – Forces acting on Aircraft – Lift & Drag – Flaps & Slats – Stall – Thrust; Armed Forces & IAF Capsule – Modes of Entry in IAF, Civil Aviation – Aircraft Recognition – Latest Trends & Acquisitions.</td></tr>
<tr><td>Unit V</td><td colspan="4">NAVIGATION, AEROENGINES, AIRCOMPAIGNS & AIRMANSHIP</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Requirements of Navigation – Glossary terms – Maps – Map Reading; Basic Theory – Types of Engines – Piston Engines – Jet Engines – Turbo Prop Engines; Indo Pak war 1971 – Operation Safed Sagar – Famous Air Heroes; Airmanship – Airfield Layout – Rules of the Air – Circuit Procedures – ATC RT Procedures – Aviation Medicine - Survival.</td></tr>
<tr><td colspan="9">Total = 45 Periods</td></tr>
</table>

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Acquired knowledge about the history of NCC, its organization, incentives of NCC, duties, different NCC camps	Analyze
CO2	Understand the concept of national integration and its importance	Understand
CO3	Understand the importance disaster management and health and hygiene.	Understand
CO4	Understand the importance principal of Flight and knowledge about armed services.	Understand
CO5	Understand and learn the importance of navigation, Aero engines & Airmanship work.	Understand

22EN102	PROFESSIONAL SKILLS LABORATORY					SEMESTER II			
PREREQUISTIES			**CATEGORY**		**HS**	**Credit**		**1**	
Basic language skills listening, speaking, reading and writing			**Hours/Week**		**L**	**T**	**P**	**TH**	
					0	**0**	**2**	**2**	

COURSE OBJECTIVES	
1.	To enable learners to improve their reading skills
2.	To make learners show variations while reading
3.	To assist learners to acquire speaking competency in English
4.	To enable learners to strengthen their fluency in speaking

UNIT I	**NARRATION**	**0**	**0**	**6**	**0**
Reading – Reading a short story – learning pronunciation, intonation, splitting of sentences to form meaningful units. Speaking – Narrating a story without any help of handouts.					
UNIT II	**PRESENTATION**	**0**	**0**	**6**	**0**
Reading – Reading a poem – learning the skill of reciting, appreciate rhyme and music, change in tone as per the emotion of the poem. Speaking – Power-point presentation on a general topic.					
UNIT III	**SHORT SPEECH**	**0**	**0**	**6**	**0**
Reading – Reading newspaper article – learning vocabulary and language pattern of official communication. Speaking - Oral presentation on a topic from basic engineering pertained to their branch.					
UNIT IV	**ORGANIZING EVENTS**	**0**	**0**	**6**	**0**
Reading – Reading dialogue scripts – learning expression, tone, stress and co-operative reading. Speaking –Proposing welcome address, vote of thanks and organizing events					
UNIT V	**DESCRIBING PROCESS**	**0**	**0**	**6**	**0**
Reading – Reading technical description of gadgets – learning the different parts of devices. Speaking – Describing a process – everyday technical activities like taking print outs, purchasing equipment for a company booking a hall for meeting etc					
					Total (30P)= 30 Periods

REFERENCE BOOKS:	
1.	Reading Fluency. Switzerland, MDPI AG, 2021.
2.	McJacobs, Wade. Dare to Read: Improving Your Reading Speed and skills. Sustralia, Friesen Press, 2021
3.	Hoge, A. J. Effortless English: Learn to Speak English Like a Native. United States, Effortless English LLC, 2014.
E-RESOURCES:	
1.	https://www.talkenglish.com/
2.	https://www.readingrockets.org/

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	read passages fluently with good pronunciation	Remember
CO2	develop an expressive style of reading	Create
CO3	make effective oral presentations in technical and general contexts	Create
CO4	excel at professional oral communication	Evaluate

COURSE ARTICULATION MATRIX														
COs /POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1				1					2	3		1	1	
CO2				1					2	3		1	1	
CO3				2					2	3		1	1	
CO4				2					2	3		1	3	
Avg				**1.5**					**2**	**3**		**1**	**1.5**	
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22PH103	PHYSICS LABORATORY				SEMESTER		II
PREREQUISTIES		**CATEGORY**	**BS**	**Credit**			**1.5**
NIL		**Hours/Week**	**L**	**T**		**P**	**TH**
			0	**0**		**3**	**3**

Course Objectives:

1.	To handle different measuring instruments.
2.	To understand the basic concepts of interference, diffraction, heat conduction and to measure the important parameters.

LIST OF EXPERIMENTS

1. Newton's rings – Determination of radius of curvature of a Plano convex lens.
2. Carey Foster's bridge – Determination of specific resistance of the material.
3. Poiseuille's flow – Determination of the Coefficient of viscosity of a liquid.
4. Spectrometer – Grating – Normal incidence – Determination of Wavelength of Mercury lines.
5. Lee's disc – Determination of thermal conductivity of a Bad conductor.
6. Ultrasonic interferometer – Determination of velocity of Ultrasonic Waves in Liquid.
7. Non-uniform bending – Determination of young's modulus of the wooden bar.
8. Determination of Band gap of a given semiconductor.
9. Determination of Wavelength of laser using grating and determination of particle size using Laser.
10. Determination of Acceptance angle and Numerical Aperture of fiber.

Total (45P) = 45 Periods

Text Books:	
1.	C. S. Robinson, Dr. Ruby Das, ' A Textbook of Engineering Physics Practical', Laxmi Publication Pvt. Ltd., 2016.
2.	S. Panigrahi, 'Engineering Practical Physics', Cengage Learning India, 2015.
Reference Books:	
1.	M.N. Srinivasan, 'Text Book of Practical Physics', Sultan Chand & Sons, 2013
2.	Singh Harman, 'B.Sc. Practical Physics', S Chand & Company Ltd, 2022.
E-References:	
1.	https://nptel.ac.in/courses/115105110
2.	https://nptel.ac.in/courses/115105120

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Handle different measuring instruments and to measure different parameters.	Apply
CO2	Calculate the important parameters and to arrive at the final result based on the experimental measurements.	Analyze

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2		3	3				3	1		2		
CO2	3	2		2	1				2			1		
Avg	**3**	**2**		**2.5**	**2**				**2.5**	**1**		**1.5**		

3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)

22CY102	CHEMISTRY LABORATORY			SEMESTER		II
PREREQUISTIES		**CATEGORY**	**BS**	**Credit**		**1.5**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			0	**0**	**3**	**3**

Course Objectives:

1. To gain practical knowledge by applying theoretical principles and performing the following experiments.

LIST OF EXPERIMENTS

1. Estimation of hardness of Water by EDTA
2. Estimation of Copper in brass by EDTA
3. Estimation of Alkalinity in water
4. Estimation of Chloride in water sample (Iodimetry)
5. Estimation of Iron content in the given salt by using external indicator
6. Conductometric titration of Strong Acid and Strong Base
7. Conductometric titration of Mixture of acids and Strong base
8. Determination of strength of Iron by Potentiometric method
9. Estimation of Iron by Spectrophotometry
10. Estimation of Copper by Colorimeter
11. Determination of molecular weight and degree of Polymerization by Viscometry
12. Determination of pKa of the given weak acid by pH meter
13. Estimation of the amount of given HCl using pH meter

Total (45P) = 45 Periods

E-References:	
1.	www.scuolab.com/en/chemistry/
2.	www.onlinelabs.in/chemistry
3.	www.virtuallabs.merlot.org/vl_chemistry

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	To summarize the applicability of the practical skill gained in various fields.	Understand
CO2	To calculate the composition of brass quantitatively and the molecular weight of polymers.	Apply
CO3	To understand the principle and applications of conductometric and pH titrations, spectrometer, and potentiometric titrations.	Understand

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	1		3									2	
CO2	1	2		3									2	
CO3	2	2		3									2	
Avg	**1.3**	**1.7**		**3**									**2**	

3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)

22EE102	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY			SEMESTER			II
PREREQUISTIES		Category	ES		Credit		1.5
		Hours/Week	L	T		P	TH
			0	0		3	3

Course Objectives:

1.	To impart hands on experience in use of measuring instruments, testing in transformers, and house wiring practices

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's laws.
2. Verification of superposition theorem.
3. Measurement of three-phase power in three-phase circuits.
4. Determination of losses in single phase transformer.
5. Demonstration of cut-out sections of DC and Induction machines: (squirrel cage rotor).
6. Speed control of DC shunt motor.
7. Study of basic safety precautions, measuring instruments – voltmeter, ammeter, multi-meter, and electrical components.
8. VI Characteristics of PN junction diode.
9. Staircase wiring.
10. Wiring for fluorescent lamp.

Total (45 P) = 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Analyse DC and AC circuits.	Analyze
CO2	Calculate various losses in transformer.	Analyze
CO3	Recognise the parts of single-phase and three phase induction motors.	Understand
CO4	Demonstrate the characteristics of electron devices.	Understand
CO5	Practice electrical connections by wires of appropriate ratings.	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1									1	1		
CO2	1	1									1	1		
CO3	1										1	1		
CO4	1										1	1		
CO5	1										1	1		
Avg	**1**	**1**									**1**	**1**		
3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)														

SEMESTER-III

<table>
<tr><td>22MA303</td><td colspan="2">PROBABILITY AND NUMERICAL METHODS</td><td colspan="3">Semester</td><td>III</td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>BS</td><td colspan="2">Credit</td><td>4</td></tr>
<tr><td colspan="2" rowspan="2">Basic 12th Level knowledge of Statistics solving equations, Matrices, ODE and PDE.</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To obtain the knowledge of standard distribution.</td></tr>
<tr><td>2</td><td colspan="6">To understand the statistical averages and fitting of curve.</td></tr>
<tr><td>3</td><td colspan="6">To gain the knowledge of significance test for large and small samples.</td></tr>
<tr><td>4</td><td colspan="6">To obtain the knowledge about numerical solution of equations.</td></tr>
<tr><td>5</td><td colspan="6">To acquire knowledge of numerical interpolation, differentiation and integration.</td></tr>
<tr><td>UNIT I</td><td colspan="2">STANDARD DISTRIBUTION</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="7">Binomial, Poisson, Exponential, Gamma and Normal Distributions and their properties - Chebyshev’s inequality. Joint distributions – Marginal and Conditional distributions – Correlation, Regression and rank correlation.</td></tr>
<tr><td>UNIT II</td><td colspan="2">BASIC STATISTICS</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="7">Measures of Central tendency: Moments, Skewness and Kurtosis, Curve fitting by the method of Least Squares –Fitting of straight lines, second degree parabolas and curves reducible to linear forms.</td></tr>
<tr><td>UNIT III</td><td colspan="2">TEST OF HYPOTHESIS</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="7">Test of significance: Large Sample tests for Single proportion, difference of proportion, single mean and difference of means-Small Sample test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.</td></tr>
<tr><td>UNIT IV</td><td colspan="2">SOLUTION OF EQUATIONS</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="7">Numerical solutions of non-linear algebraic equations by Secant, Bisection and Newton- Raphson Methods- Solution of system of equations by Gauss Elimination,LU decomposition for systems of linear equations and Gauss Seidel iterative methods.</td></tr>
<tr><td>UNIT V</td><td colspan="2">INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION</td><td>9</td><td>3</td><td>0</td><td>12</td></tr>
<tr><td colspan="7">Interpolation using Newton’s Forward and Backward formulae. Interpolation with unequal intervals: Newton’s divided difference and Lagrange’s formulae. Numerical Differentiation and Integration: Trapezoidal rule and Simpson’s 1/3 rule, Simpson’s 3/8 rule.</td></tr>
<tr><td colspan="7" align="right">Total (45+15) = 60 Periods</td></tr>
</table>

Text Books:	
1	Veerarajan T, “Probability and Random Process (With Queuing theory)”, 4th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2016.
2	Jay, L. Devore, “Probability and Statistics for Engineering and Sciences”,8th edition, Cengage Learning, New Delhi, 2012.
3	Kandasamy. P, Thilagavathy. K, Gunavathi. K, “Numerical Methods”, S. Chand & Co., New Delhi, 2005.
Reference Books:	
1	Freund John, E. and Miller, Irwin, “Probability and Statistics for Engineering”, 5th Edition, Prentice Hall, 1994.
2	Jain M.K, Iyengar, K & Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, New Age International (P) Ltd, Publishers 2003
3	Gupta, S.C. and Kapoor, V.K. “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2015.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Apply the knowledge of standard distribution.	Understand
CO2	Learn about statistical averages and fitting the curves by Least Square Method.	Understand
CO3	Use the Large and small sample tests.	Apply
CO4	Solve equations by using numerical techniques.	Apply
CO5	Acquire the techniques of interpolation, Numerical differentiation and integration.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2									2	
CO2	3	2		2									2	
CO3	3	2		2									2	
CO4	3	2		2									2	
CO5	3	2		2									2	
Avg	**3**	**2**		**2**									**2**	
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22CS301	COMPUTER ORGANIZATION ANDARCHITECTURE			Semester		III
PREREQUISITES		**Category**	**PC**	**Credit**		**3**
Digital Principles and System Design		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basic structure and operations of digital computer and to learn the working of different arithmetic operations
2	To understand the different types of processor control and the concept of pipelining and to study the hierarchical memory system including cache memory and virtual memory
3	To understand the different ways of communication with I/O devices and standard I/O interfaces

UNIT I	INTRODUCTION	9	0	0	9

Functional units ,Basic Operational Concepts, Bus Structure ,Memory Locations and Addresses, MemoryOperations, Instruction and Instruction Sequencing, Addressing modes.

UNIT II	ARITHMETIC UNIT	9	0	0	9

Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, BoothAlgorithm, Fast Multiplication, Integer Division, Floating point number operations.

UNIT III	PROCESSOR UNIT AND PIPELINING	9	0	0	9

Fundamental Concepts, Execution of Instruction, Multi Bus Organization, Hardwired control, Micro programmed control, Basic Concepts of pipelining, Data Hazards, Instruction Hazards, Data path & Control Considerations.

UNIT IV	MEMORY SYSTEMS	9	0	0	9

Basic Concepts, Semiconductor RAM, ROM, Cache memory, Improving Cache Performance, Virtual memory,Memory Management requirements, Secondary Storage Device.

UNIT V	INPUT AND OUTPUT ORGANIZATION	9	0	0	9

Accessing I/O devices, Programmed I/O, Interrupts, Direct Memory Access, Interface circuits, Standard I/OInterfaces (PCI, SCSI, USB).

Total (45 L)= 45 Periods

Text Books:

1	Carl Hamacher V.,Zvonko G.Vranesic, Safwat G. Zaky, " Computer organization ", Tata McGraw Hill,5th Edition, 2008

Reference Books:

1	Patterson and Hennessey, "Computer Organization and Design ". The Hardware/Software interface,Harcourt Asia Morgan Kaufmann, 3rd Edition, 2007
2	Hayes, "Computer Architecture and Organization ", 3rd edition,Tata McGraw Hill, 2006
3	Heuring V.P., Jordan H.F., " Computer System Design and Architecture ", 6th edition ,Addison Wesley,2008

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the working principles of Computer components	Understand
CO2	Design the arithmetic and processing units	Create
CO3	Analyze the various computer components	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	1	1				3	3	2	2
CO2	2	2	3	3	3	1	1				1	3	2	2
CO3	2	2	3	3	3	1	1				3	3	2	2
Avg	**2.3**	**2.3**	**3**	**3**	**3**	**1**	**1**				**2.3**	**3**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CS302	SOFTWARE ENGINEERING				SEMESTER		III
PREREQUISITES		CATEGORY			PC	Credit	3
NIL		Hours/Week			L	T	P	TH
					3	0	0	3

Course Objectives:

1.	To understand the different life cycle models and requirements collection process
2.	To understand design and development principles in the construction of software systems
3.	To learn the various software testing techniques and methods used for project management

UNIT I	SOFTWARE PROCESS	9	0	0	9
Introduction-The software process-software Engineering Practice-A generic process model-prescriptive process models-specialized process models-unified process-Personal and Team Process Models –processtechnology-product and process-Agility-Agile Process-Extreme Programming(XP)-Other Agile Process Models					
UNIT II	**UNDERSTANDING REQUIREMENTS**	**9**	**0**	**0**	**9**
Requirements Engineering -Establishing the Groundwork -Eliciting Requirements -Developing Use Cases - Building the Requirements Model -Negotiating Requirements - Validating Requirements-Requirements Analysis - Scenario-Based Modeling - UML Models That Supplement the Use Case -Data Modeling Concepts- Class-Based Modeling.					
UNIT III	**DESIGN CONCEPTS AND PRINCIPLES**	**9**	**0**	**0**	**9**
Design within the Context of Software Engineering - The Design Process - Design -The Design Model - Software Architecture - Architectural Genres - Architectural Styles -Architectural Design -Assessing AlternativeArchitectural Designs -Architectural Mapping Using Data Flow.					
UNIT IV	**TESTING**	**9**	**0**	**0**	**9**
A Strategic Approach to Software Testing - Strategic Issues -Test Strategies for Conventional Software - Test Strategies for Object-Oriented Software - Test Strategies for WebApps - Validation Testing –System- -The Art of Debugging- White Box Testing-Basis Path Testing-Control Structure Testing-Black Box Testing-Model Based Testing-Object Oriented Testing Strategies-Object Oriented Testing Methods-Testing Concepts for WebApps-The Testing Process.					
UNIT V	**SOFTWARE PROJECT MANAGEMENT**	**9**	**0**	**0**	**9**
The Management Spectrum - The People - The Product - The Process -The WHH Principle - Metrics in the Process and Project Domains - Software Measurement - Metrics for Software Quality - Integrating Metrics within the Software - Metrics for Small Organizations - Establishing a Software Metrics Program - Decomposition - Empirical Estimation Models - Specialized Estimation Techniques -The Make/Buy Decision .					
	Total (45 L)= 45 Periods				

Text Book	
1.	Roger S.Pressman, “Software engineering- A practitioner’s Approach”, McGraw- Hill International Edition, 7th edition, 2010.
Reference Books:	
1.	PankajJalote- “An Integrated Approach to Software Engineering, Narosa Publications”, Third Edition,2008.
2.	James F Peters and WitoldPedryez, “Software Engineering – An Engineering Approach”, John Wiley andSons, New Delhi, 2000.
3.	Ian Sommerville, “Software engineering”, Pearson education Asia, 6th edition, 2006.
E-References:	
1.	Software Engineering NPTEL video lectures by Prof.N.L. Sarda, Prof. Umesh Bellur, Prof.R.K.Joshi andProf.Shashi Kelkar, Department of Computer Science & Engineering ,IIT Bombay.

COURSE OUTCOMES Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify and describe the different life cycle models and requirement collection process.	Understand
CO2	Design and develop software systems	Create
CO3	Apply the various testing techniques for project management	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	2	1	1				2	3	3	2
CO 2	3	3	3	2	2	1	1				2	3	3	2
CO 3	3	3	3	2	2	1	1				2	3	3	2
Avg	**3**	**3**	**3**	**2**	**2**	**1**	**1**				**2**	**3**	**3**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CS303	DATA STRUCTURES AND ALGORITHMS			SEMESTER			III
PREREQUISITES			**CATEGORY**	**PC**	**Credit**		**3**
Problem Solving and C Programming			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To understand the concepts of ADTs
2.	To learn linear data structures and non-linear data structures
3.	To understand concepts about searching, sorting and hashing techniques

UNIT I	LINEAR DATA STRUCTURES – LIST	9	0	0	9

Abstract Data Types (ADTs) – List ADT - Array based Implementation - Linked List Implementation – Singly Linked Lists -Circularly Linked Lists - Doubly-Linked Lists - Applications of Lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT II	LINEAR DATA STRUCTURES –STACKS AND QUEUES	9	0	0	9

Stack ADT - Operations - Applications of Stacks - Evaluating Arithmetic Expression - Conversion of infix to postfix Expression - Queue ADT - Operations - Circular Queue - DeQueue - Applications of Queue.

UNIT III	NON-LINEAR DATA STRUCTURES – TREES	9	0	0	9

Tree ADT – Tree traversals – Binary Tree ADT – Expression Trees – Applications of Trees – Binary Search Tree ADT – Threaded Binary Trees- AVL Trees – B-Tree – Heaps - Operations of Heaps - Max Heap - Min Heap - Applications of Heap.

UNIT IV	NON-LINEAR DATA STRUCTURES – GRAPHS	9	0	0	9

Definition – Representation of Graphs –Types of Graphs - Graph Traversals - Breadth First Search - Depth First Search - Application of Graph Structures: Shortest Path Problem: Dijkstra’s Algorithm - MinimumSpanning Trees: Prim’s Algorithm - Kruskal’s Algorithms.

UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	9	0	0	9

Searching: Linear Search - Binary Search - Sorting Algorithms - Insertion Sort - Selection Sort - Bubble Sort - Quick Sort - Merge Sort - Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

Total (45 L) =45 Periods

Text Book:

1.	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 4th edition, Pearson Education, 2013.

Reference Books:

1.	Seymour Lipschutz, “Data Structures With C”, (Schaum`s Outline Series) Published by Tata McGraw-Hill Education Pvt. Ltd., 2015
2.	Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, “Fundamentals of Data Structures In C”, Second Edition, Silicon Press, 2012.
3.	Amol M. Jagtap, Ajit S. Mali ,”Data Structures using C: A Practical Approach for Beginners”,CRC Press,2021.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Implement various abstract data types for linear data structures.	Create
CO2	Apply the different non-linear data structures to solve real world problems.	Apply
CO3	Critically analyze the various sorting, searching and hashing techniques.	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2	1	1				2	3	3	2
CO2	3	3	3	2	2	1	1				2	3	3	2
CO3	3	3	3	2	2	1	1				2	3	3	2
Avg	**3**	**3**	**3**	**2**	**2**	**1**	**1**				**2**	**3**	**3**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CS304	OPERATING SYSTEMS					SEMESTER III	
PREREQUISITES			**CATEGORY**	**PC**	**Credit**		**3**
NIL			Hours/Week	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To understand the structure and functions of Operating systems
2.	To understand the process concepts and scheduling algorithms
3.	To understand the concept of process synchronization and deadlocks
4.	To learn various memory management schemes
5.	To illustrate various file systems and disk management strategies

UNIT I	INTRODUCTION AND OPERATING SYSTEM STRUCTURES	9	0	0	9

What Operating System Do, Operating System Structure, Operating System Operations; Process Management, Memory Management, Storage Management, Protection and Security; Operating System Structures - Operating System Services, User and Operating System Interface, System Calls, Types of System Calls.

UNIT II	PROCESS MANAGEMENT	9	0	0	9

Process Concepts, Process Scheduling, Operation on Processes; Interprocess Communication- Shared Memory Systems- Message Passing Systems; Threads - Overview, Multithreading Models, Threading Issues; CPU Scheduling - Basic Concepts, Scheduling Criteria, Scheduling Algorithms – First-Come First-Served, Shortest-Job-First,Priority, Round-Robin, Multilevel Queue, Multilevel Feedback Queue.

UNIT III	PROCESS SYNCHRONIZATION AND DEADLOCKS	9	0	0	9

Background, The Critical Section Problem (software based solution and hardware based solution), Semaphores, Classical Problem of Synchronization, Monitors; Deadlocks - System Model, Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

UNIT IV	MEMORY MANAGEMENT	9	0	0	9

Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with Paging, Structure of the Page Table; Virtual Memory – Background, Demand Paging, Page Replacement.

UNIT V	FILE SYSTEM AND MASS-STORAGE STRUCTURE	9	0	0	9

File System Structures - File System Implementation: Directory Implementation, Allocation Methods, Free Space Management; Mass-Storage Structure – Overview of Mass-Storage Structure, Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure; Case study: Linux system.

Total (45 L) =45 Periods

Text Book:

1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, Ninth Edition, John Wiley & Sons (ASIA) Pvt. Ltd, 2018.

Reference Books:

1.	Harvey M. Deitel, “Operating Systems”, Pearson Education, 3rd edition 2018.
2.	Andrew S. Tanenbaum, “Modern Operating Systems”, Prentice Hall of India, 3rd edition 2015.
3.	William Stallings, “Operating Systems: Internals and Design Principles”, Prentice Hall of India, 7th edition, 2015.
4.	D M Dhamdhere, “Operating Systems: A Concept-Based Approach”, Tata Mc-graw Hill Publishing, 3rd edition, 2017.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the components and functionalities of the operating system.	Understand
CO2	Apply various Services and Concepts of operating system to real time applications.	Apply
CO3	Analyze the issues related to operating system and provide sutiable solutions.	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	1	2		1				1	3	2	1
CO 2	3	3	2	1	2		1				1	3	2	1
CO 3	3	3	2	1	2		1				1	3	2	1
Avg	**3**	**3**	**2**	**1**	**2**		**1**				**1**	**3**	**2**	**1**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22MCIN02	INNOVATION SPRINTS				SEMESTER III			
PREREQUISITES			**CATEGORY**		**EE**	**Credit**		**1**
			Hours/Week		**L**	**T**	**P**	**TH**
					0	**0**	**2**	**2**

Course Objectives:

1.	To understand the fundamentals of Design thinking & apply in ideating solutions for real-world problems.
2.	To solve challenges through problem curation, problem validation and customer discovery problems.

UNIT I	**CHALLENGE CURATION**	**3**	**0**	**0**	**3**
Introduction: Design Thinking Principles - Design Thinking Values - Design Thinking Methods - Challenge impact setting - Framing the design challenge.					
UNIT II	**CUSTOMER-CENTRIC INNOVATION**	**3**	**0**	**0**	**3**
Understanding Customer needs - Empathy building techniques - gap analysis - adoption barriers - observations and insights - Translating Insights into Innovation Opportunities					
UNIT III	**IDEA GENERATION**	**3**	**0**	**0**	**3**
Identifying pains & gains - crafting value proposition - Ideation - Divergent Thinking - Ideation methods- Rules of brainstorming - Managing risks - Concept of minimum usable prototypes - Generating solution concepts					
UNIT IV	**PROTOTYPING**	**3**	**0**	**0**	**3**
Prototyping concepts -- Palm Pilot Experiment - Fake it before make it - Prototyping - The Law of Failure - Building a Prototype - Testing the Prototypes.					
UNIT V	**PITCH & PRESENTATION**	**3**	**0**	**0**	**3**
Science of Storytelling - the blueprint for storytelling - Pitch Script - Pitch Presentations - Best practices to creating a compelling pitch - communication fundamentals					
					Total (15L) = 15 Periods

Text Books:

1.	Tim Brown (2019), "Change by Design: How design thinking transforms organizations and inspires innovation"
2.	Jan Chipchase& Simon Steinhardt (2013), "Hidden in Plain Sight: How to Create extraordinary Products for Tomorrow's Customers", Harper Business 2013
3.	Christian Madsbjerg&Mikkel B. Rasmussen (2014), "The Moment of Clarity", Harvard Business Review Press
4.	IdrisMootee (2013), Design Thinking for Strategic Innovation, Willey
5.	Alexander Osterwalder, Value Proposition Design: How to Create Products and Services Customers Want (Strategyzer) - John Wiley & Sons, 2014

Reference Books:

1.	avoia. Alberto, 2009 The Pretotyping Manifesto -
2.	https://sites.google.com/a/pretotyping.org/www/the-pretotyping-manifesto
3.	Jazz Factory, All about Presentations - http://blog.jazzfactory.in/
4.	Pretotyping Methodology - https://www.pretotyping.org/methodology.html

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Identify real-world problems	Understand
CO2	Apply the challenge curation techniques to real-world problems.	Apply
CO3	Analyze the problems and generate solutions to address the challenges	Analyze
CO4	Build solutions using pertotyping tools & techniques	Apply
CO5	Develop an innovation pitch to effectively communicate the idea to solve the identified problem	Analyze

COURSE ARTICULATION MATRIX														
CO/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1		3				2	1		2					
CO2		3		2					2					
CO3			3	2					2					
CO4	2		3					1	2					
CO5									2	3				
Avg	**0.4**	**1.2**	**1.2**	**0.8**	**0**	**0.4**	**0.2**	**0.2**	**2**	**0.6**				
3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)														

22NC301	NCC COURSE-II (Only for NCC Students)				SEMESTER III		
PREREQUISITES		**Category**	**NC**	**Credit**			**3***
NIL		**Hours/Week**	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Objectives:

1. To maintain the unity and disciplines to the students

UNIT I	SOCIAL SERVICE & COMMUNITY DEVELOPMENT	9	0	0	9

Basic of social service and it's need - Rural Development Program – NGOs Roles & Contribution – Drug abuse and Trafficking – Civic Responsibilities – Causes & prevention of AIDS/HIV – Counter Terrorism – Corruption – Social Evil – RTI & RTE – Traffic Control Organization – Anti Drunken Driving.

UNIT II	GENERAL AWARENESS & ADVENTURE	9	0	0	9

General Knowledge – Logical & Analytical Reasoning - Modes of Entry to Army, CAPF, Police – SSB Procedure; Para Sailing – Slithering – Rock climbing – Cycling and Trekking.

UNIT III	AEROENGINES & NAVIGATION	9	0	0	9

Introduction to aero engines and its type – Components of aero engines – Principles of Propulsion – Basic Terminology – Jet engines – Brayton Cycle – Turbo prop engines and its types; Requirements of Navigation - Lines on Earth – Maps and its types - Symbols used in map – Scales of map – Map reading procedure and its aids.

UNIT IV	AIRFRAME & METEOROLOGY	9	0	0	9

Aircraft Control – Primary and Secondary –Fuselage – Main Plain and Tail Plain – Ailerons, Elevators& Rudders –Landing Gear; Importance of METT in Aviation – Atmosphere – Clouds and Precipitation – Flying Hazards.

UNIT V	FLIGHT INSTRUMENTS & AEROMODELLING	9	0	0	9

Airspeed Indicator – Altimeter – Artificial Horizon – Radar and Its Type – Instruments Battery Test, Compass; History of Aero Modeling – Basic Materials & Tools – Types of Aero Modelling – Flying/Building of Aero Models – General Safety Procedure.

Total = 45 Periods

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Acquired knowledge about social and legal responsibilities.	Understand
CO2	Understand the adventure activities and verbal training on defense examinations.	Understand
CO3	Understand the technical knowledge on aero engines and map reading.	Understand
CO4	Understand the structure and control of an aircraft.	Understand
CO5	Understand and learn the importance of avionic instruments on aircraft control.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											3	1
CO2	3	3	2	3									3	2
CO3	3	2	3	1		2							3	2
CO4	3	2	2	2									3	2
CO5	3					1							3	3
Avg	**3**	**1.6**	**1.4**	**1.2**		**0.6**							**3**	**2**

3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)

22CS305	OPERATING SYSTEMS LABORATORY					SEMESTER III
PREREQUISITES		CATEGORY	PC	Credit		2
C Programming		Hours/Week	L	T	P	TH
			0	0	4	4

Course Objectives:

1.	To understand and implement basic services, functionalities of the operating system
2.	To analyze CPU Scheduling Algorithms
3.	To implement the concept of deadlock, memory management schemes and page replacement schemes
4.	To analyze file allocation methods

EXPERIMENTS

(Implement the following on LINUX platform. Use C for high level language implementation)

1.	Basics of UNIX Commands
2.	Shell programming
3.	Write programs using the following system calls of operating system: fork, exec, getpid, exit,wait, close
4.	Implementation of CPU scheduling algorithms: FCFS & SJF
5.	Implementation of CPU scheduling algorithms: Round Robin & Priority
6.	Implement the Producer – Consumer problem using semaphores
7.	Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance
8.	Implementation of memory management schemes (First fit, Best fit & Worst fit)
9.	Implement page replacement algorithms (FIFO , LRU & Optimal)
10.	Implementation of File allocation techniques

Total (P)= 60 Periods

Reference Book:

1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, Ninth Edition, John Wiley & Sons (ASIA) Pvt. Ltd, 2018.

E-References:

1.	https://www.unixtutorial.org/basic-unix-commands
2.	http://mally.stanford.edu/~sr/computing/basic-unix.html

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom’s Taxonomy Mapped
CO1	Demonstrate the fundamental UNIX commands	Understand
CO2	Implement various commands using Shell Programming	Apply
CO3	Apply various functionalities of operating system to solve problems.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	2		1				1	2	1	1
CO2	2	2	2	1	2		1				1	2	1	1
CO3	3	3	2	1	2		1				1	3	2	1
Avg	**2.3**	**2.3**	**2**	**1**	**2**		**1**				**1**	**2.3**	**1.3**	**1**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CS306	DATA STRUCTURES AND ALGORITHMS LABORATORY					SEMESTER III	
PREREQUISITES		**CATEGORY**	**PC**	**Credit**		**2**	
C Programming		**Hours/Week**	**L**	**T**	**P**	**TH**	
			0	**0**	**4**	**4**	

Course Objectives:

1.	To understand about writing algorithms and step by step approach in solving problems with the help of fundamental data structures using C.
2.	To write and execute programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, search trees.
3.	To write and execute write programs in C to implement various sorting and searching methods.

EXPERIMENTS

1.	Implementation of List (Single, Double)
2.	Implementation of Stack
3.	Implementation of Queue
4.	Implementation of Binary Search Tree
5.	Implementation of Tree Traversal
6.	Implementation of Heap Tree
7.	Implementation of Breadth First Search Techniques
8.	Implementation of Depth First Search Techniques
9.	Implementation of Dijkstra’s Algorithm
10.	Implementation of Sorting Techniques (Internal Sort- Bubble sort, Quick Sort & External Sorting: Merge Sort)
11.	Implementation of Searching Techniques (Linear Search & Binary Search)
	Total (P)= 60 Periods

Reference Book:

1.	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 4th edition, Pearson Education, 2013.

E-References:

1.	https://www.sanfoundry.com/c-programming-examples-data-structures/
2.	https://www.mygreatlearning.com/blog/data-structures-using-c/

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Design various linear data structures such as stacks, queue and list.	Create
CO2	Design various linear and non-linear data structures such trees and graphs.	Create
CO3	Demonstrate various sorting and searching techniques.	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	2	1	1				2	3	3	2
CO 2	3	3	3	2	2	1	1				2	3	3	2
CO 3	3	3	3	2	2	1	1				2	3	3	2
Avg	**3**	**3**	**3**	**2**	**2**	**1**	**1**				**2**	**3**	**3**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22MA401	DISCRETE MATHEMATICS			SEMESTER			IV
PREREQUISTIES			**CATEGORY**	**BS**	**Credit**		**4**
			Hours/Week	**L**	**T**	**P**	**TH**
				3	**1**	**0**	**4**

Course Objectives:

1.	To develop an understanding of the Logics.
2.	To make the student acquire knowledge in Combinatorics.
3.	To acquaint the student with the concept of Graphs and Graph models.
4.	To make the student acquire sound knowledge in Algebraic structures.
5.	To familiarize with lattices and Boolean algebra.

UNIT I	LOGIC AND PROOFS	9	3	0	12

Propositional Logics- Propositional equivalences- Predicates and Quantifiers- Nested Quantifiers- Rules of inference - Introduction to Proofs – Proof methods and strategy.

UNIT II	COMBINATORICS	9	3	0	12

Mathematical induction- Strong induction and well ordering – The basics of counting-The Pigeonhole principle- permutations and Combinations – Recurrence relations- Solving linear recurrence relations using generating functions – Inclusion-Exclusion Principle and its applications.

UNIT III	GRAPHS	9	3	0	12

Graphs and graph models- Graph terminology and special types of graphs- Matrix representation of graphs and graph isomorphism- Connectivity- Euler and Hamilton Paths.

UNIT IV	ALGEBRAIC STRUCTURES	9	3	0	12

Algebraic systems – semi groups and monoids- Groups- Subgroups- homomorphisms- Normal subgroup and coset-Lagrange’s theorem- definitions and examples of Rings and Fields

UNIT V	LATTICES AND BOOLEAN ALGEBRA	9	3	0	12

Partial ordering – Posets- Lattices as Posets- Properties of Lattices- Lattices as algebraic systems- sub lattices – Direct product and Homomorphisms- some special lattices – Boolean algebra.

Total (45L+15T) = 60 Periods

Text Books:

1.	Kennath H Rosen, “Discrete Mathematics and its applications”,7th Edition, Tata McGraw Hill Pub.Co.Ltd., New Delhi, Special Indian Edition, 2011.
2.	Tremblay J. P and Manohar “Discrete Mathematical Structures with applications to Computer science”, 30thReprint, Tata McGraw Hill Pub.Co.Ltd., New Delhi, 2011.

Reference Books:

1.	Ralph. P. Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”,4thEdition, Pearson Education, New Delhi, 2007.
2.	Thomas Koshy, “Discrete Mathematics with Applications”, Elsevier Publications, 2006.
3.	Seymour Lipschutz and Marc Lipson, “Discrete Mathematics” Schaum’s Outlines, 3rd Edition, Tata McGraw Hill Pub.Co.Ltd., New Delhi, 2010.
4.	Dr.G.C. Sharma, Dr. Madhu Jain, “Advance Discrete Mathematics”,2ndEdition, Laxmi Publications(P) Ltd, 2011.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Acquired knowledge of the concepts needed to test the logic of a program.	Understand
CO2	Have an understanding in identifying structures on many levels.	Understand
CO3	Be aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science and the counting principles.	Understand
CO4	Be exposed to concepts and properties of algebraic structures such as groups, rings and fields.	Remember
CO5	Familiar with Lattices and Boolean algebra.	Understand

COURSE ARTICULATION MATRIX														
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2									2	
CO2	3	2	2	2									2	
CO3	3	2	2	2									2	
CO4	3	1	1	1									2	
CO5	3	1	2	1									2	
Avg	**3**	**1.6**	**1.8**	**1.6**									**2**	
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22CS401	DESIGN AND ANALYSIS OF ALGORITHMS				SEMESTER	IV
PREREQUISITES:		**CATEGORY**	**PC**	**Credit**		**3**
Data Structures and Algorithms		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	Learn the algorithm analysis techniques.
2.	Become familiar with the divide-and-conquer and greedy algorithm design techniques.
3.	Become familiar with the dynamic programming design techniques.
4.	Become familiar with the backtracking design techniques for a problem.
5.	Understand the limitations of Algorithmic power.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

The Role of Algorithms in Computing - Analysing Algorithms - Designing Algorithms. Growth of Functions: Asymptotic Notations – Standard notations and common functions. Recurrences: The Substitution Method – The Recursion-tree Method – The Master Method.

UNIT II	**DIVIDE-AND-CONQUER AND THE GREEDY METHOD**	**9**	**0**	**0**	**9**

Divide and Conquer: General Method– Binary Search– Finding Maximum and Minimum – Merge Sort - Quick Sort.
Greedy Algorithms: General Method – Container Loading – Knapsack Problem – Tree Vertex Splitting - Job Sequencing with Deadlines – Minimum-Cost Spanning Trees (Prim’s and Kruskal’s Algorithm).

UNIT III	**DYNAMIC PROGRAMMING**	**9**	**0**	**0**	**9**

Dynamic Programming: General Method – Multistage Graphs – All-Pair Shortest Paths - Optimal Binary Search Trees – 0/1 Knapsack – Travelling Sales Person Problem.

UNIT IV	**BACKTRACKING**	**9**	**0**	**0**	**9**

Backtracking: General Method – 8 Queens Problem – Sum of Subsets – Graph Coloring – Hamiltonian Cycles – Knapsack problems.

UNIT V	**GRAPH TRAVERSALS AND BRANCH AND BOUND**	**9**	**0**	**0**	**9**

Graph Traversals: Techniques for Graphs (BFS and DFS) - Connected Components and Spanning Trees – Biconnected components.
Branch and Bound: General Methods (FIFO & LC) – 0/1 Knapsack problem – Introduction to NP-Hard and NP-Complete Problems - Basic concepts, Cook’s Theorem.

Total(45 L)=45 Periods

Text Books:

1.	T. H. Cormen, C. E. Leiserson, R.L.Rivest, and C. Stein, "Introduction to Algorithms", Second Edition, Prentice Hall of India Pvt. Ltd, 2003.(Unit I)
2.	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/C++, Second Edition, Universities Press, 2007. (Units II to V)

Reference Books:

1.	Anany Levitin, “Introduction to the Design and Analysis of Algorithm”, Pearson Education Asia, Third edition, 2011.
2.	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "The Design and Analysis of Computer Algorithms", Pearson Education, 1999.

COURSE OUTCOMES: Upon completion of the course,the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyse the time and space complexity of different algorithms.	Analyze
CO2	Apply appropriate design technique for a problem.	Apply
CO3	Modify existing algorithms to improve efficiency.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	1	2		1			1	1	3	3	2
CO2	3	3	3	1	2		1			1	1	3	3	2
CO3	3	3	3	1	2		1			1	1	3	3	2
Avg	**3**	**3**	**3**	**1**	**2**		**1**			**1**	**1**	**3**	**3**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CS402	THEORY OF COMPUTATION					SEMESTER IV
PREREQUISITES		CATEGORY	PC	Credit		3
NIL		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To understand different computational models
2.	To comprehend the properties of computational models

UNIT I	AUTOMATA	9	0	0	9

Introduction to Formal Proof - Additional Forms of Proof - Inductive Proof - Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon transitions (ε - NFA) – Proof of Equivalence: DFA and NFA – DFA and ε - NFA – NFA and ε - NFA.

UNIT II	REGULAR EXPRESSIONS AND LANGUAGES	9	0	0	9

Regular Expression (RE) – FA and Regular Expressions – Application of RE – Algebraic Laws - Proving languages not to be regular – Closure properties of regular languages – Decision properties of regular languages – Equivalence and minimization of Automata.

UNIT III	CONTEXT-FREE GRAMMAR AND LANGUAGES	9	0	0	9

Context-Free Grammar (CFG) – Parse Trees – Ambiguity in grammars and languages – Definition of the Pushdown automata – Languages of a Pushdown Automata – Equivalence of Pushdown automata and CFG, Deterministic Pushdown Automata – Normal Forms for Context-Free Grammars - Pumping Lemma for Context-Free Languages.

UNIT IV	PROPERTIES OF CONTEXT-FREE LANGUAGES AND TURING MACHINES	9	0	0	9

Closure Properties of Context-Free Languages – Decision Properties of Context-Free Languages - Turing machines – Turing machines as acceptor – Turing machines as a Computing Device – Programming Techniques for Turing Machines – Extensions to the Basic Turing Machine – Restricted Turing Machines

UNIT V	UNDECIDABILITY AND INTRACTABLE PROBLEMS	9	0	0	9

Language That Is Not Recursively Enumerable–Undecidable Problem That Is Recursively Enumerable – Undecidable Problems About Turing Machines – The Classes P and NP – An NP-Complete Problem – A Restricted Satisfiability Problem

Total (45 L)= 45 Periods

Text Book:

1.	J.E.Hopcroft, R.Motwani, J.D.Ullman, "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education,2008.

Reference Books:

1.	Dexter C. Kozen, "Automata and Computability", Springer Publishers, 2007.
2.	John. C. Martin, "Introduction to languages and the theory of computation", Tata McGrawHill, 2003.
3.	Peter Linz, "An introduction to formal language and automata", Narosa publishers, 2002.
4.	Kamala Kritivasan and R.Rama,"Introduction to Formal Languages, Automata Theory and Computation", Pearson Publishers, 2009.

E-References:

1.	https://nptel.ac.in/courses/106104028/
2.	http://www.nptelvideos.in/2012/11/theory-of-computation.html
3.	http://infolab.stanford.edu/~ullman/ialc.html

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Develop a computational model to recognize regular language or context free language	Create
CO2	Establish equivalence among computational models of equivalent capacities.	Apply
CO3	Recall the procedures involved in the construction of computational models.	Remember

COURSE ARTICULATION MATRIX

COs /POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2		2	1	1					3	2	2
CO2	3	3	2		2	1	1					3	2	2
CO3	3	3	2		2	1	1					3	2	2
Avg	**3**	**3**	**2**		**2**	**1**	**1**					**3**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CS403	OBJECT ORIENTED PROGRAMMING USING C++			SEMESTER IV			
PREREQUISITES		**CATEGORY**	**PC**	**Credit**			**3**
C Programming		**Hours/Week**	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Objectives:

1.	To understand object oriented programming concepts, generic programming and Exception handling.
2.	To apply object oriented programming concept for problem solving
3.	Design solutions to real world problems using object oriender concepts.

UNIT I	INTRODUCTION	9	0	0	9

Procedure oriented programming paradigm - Object oriented programming paradigm - Basic concepts of object oriented programming, benefits of OOP, application of OOP - C++ fundamentals –structure of C++ program, tokens, data types - Operators and expressions - Control structures - Functions.

UNIT II	CLASSES AND OBJECTS	9	0	0	9

Classes and objects - friend functions- constructors and destructors- Operator overloading – binary and unary operator overloading using member function and friend function - Type conversions.

UNIT III	INHERITANCE AND VIRTUAL FUNCTIONS	9	0	0	9

Inheritance – defining derived classes, types, virtual base classes, abstract classes, constructor in derived classes - Pointers-pointers to objects, this pointer, pointer to derived classes - Virtual functions.

UNIT IV	TEMPLATES AND EXCEPTION HANDLING	9	0	0	9

Generic Classes – class template, class templates with multiple parameters - Generic Functions - function templates, function templates with multiple parameters, member function templates - Exception handling – basics, exception handling mechanism, rethrowing an exception – Exception handling options – understanding terminate() and unexpected() – the uncaught_exception() function – bad_exception().

UNIT V	CONSOLE I/O AND FILE HANDLING	9	0	0	9

C++ Stream Classes – unformatted I/O operations, formatted console I/O operations, manipulators - Files-classes for file operation, opening and closing a file, detecting end of file, files modes, sequential file operations, random file operations.

Total (45 L) =45 Periods

Text Book:

1.	E. Balagurusamy “Object –Oriented Programming with C++” Sixth Edition Tata McGraw-Hill (Unit I -V).

Reference Books:

1.	Herbert Schildt, "The Complete Reference C++", Fifth Edition, Tata McGraw Hill.
2.	Bjarne Stroustrup, “The C++ programming language”, Fourth Edition Addison Wesley.
3.	K.R. Venugopal, Rajkumar Buyya “Mastering in C++” Second Edition, Tata McGraw Hill.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Familiarize the object oriented programming concepts, Generic Programming and handling exceptions.	Understand
CO2	Develop Object Oriented Programming concepts for problem solving.	Apply
CO3	Create solutions to real world problems using Object Oriented Concepts.	Create

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	1		1				2	2	3	2
CO 2	3	3	3	2	1		1				2	2	3	2
CO 3	3	3	3	2	1		1				2	2	3	2
Avg	**3**	**3**	**3**	**2**	**1**		**1**				**2**	**2**	**3**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CS404	MICROPROCESSORS AND MICROCONTROLLERS				SEMESTER		IV
PREREQUISITES		CATEGORY	ES	Credit			3
NIL		Hours/Week	L	T		P	TH
			3	0		0	3

Course Objectives:

1.	To understand the architecture of 8086 microprocessor
2.	To learn the design aspects of I/O and Memory Interfacing circuits
3.	To interface microprocessors with supporting chips
4.	To study the Architecture of 8051 microcontroller and design a microcontroller based system

UNIT I	THE 8086 MICROPROCESSOR	9	0	0	9

Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assemblerdirectives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II	8086 SYSTEM BUS STRUCTURE	9	0	0	9

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III	I/O INTERFACING	9	0	0	9

Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

UNIT IV	MICROCONTROLLER	9	0	0	9

Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set –Addressing modes – Assembly language programming.

UNIT V	INTERFACING MICROCONTROLLER	9	0	0	9

Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation –Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

Total (45 L)= 45 Periods

Text Books:

1.	Yu-Cheng Liu, Glenn A.Gibson, ―Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design, Second Edition, Prentice Hall of India, 2007. (UNIT I- III)
2.	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, ―The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Second Edition, Pearson education, 2011. (UNIT IV-V)

Reference Books:

1. A.K.Ray,K.M.Bhurchandi,|Advanced Microprocessors and Peripherals —3rd edition, Tata McGrawHill,2012
2. Doughlas V.Hall, - Microprocessors and Interfacing, Programming and Hardware,TMH,2012
3. Douglas V.Hall, “Microprocessors And Interfacing Programming and Hardware”, Tata McGraw Hill, 2003
4. “Microcontrollers: Architecture, Programming, Interfacing and System Design”, Raj Kamal, Pearson Education, 2005.

E-Reference:

1. https://onlinecourses.nptel.ac.in/noc18_ec03/preview, (Prof. Santanu Chattopadhyay,IIT KHARAGPUR)

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Understand and execute programs based on 8086 microprocessor.	Understand
CO2	Construct Memory Interfacing circuits.	Apply
CO3	Develop I/o interface circuit	Apply
CO4	Design and implement 8051 microcontroller based systems.	Create

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2									2		2	
CO 2	2	2	2	2									2	
CO 3	2	2	2	2									2	
Avg	**2**	**2**	**2**	**2**							**2**		**2**	

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22MCIN03	DESIGN SPRINTS					SEMESTER IV	
PREREQUISITES		**CATEGORY**	**EE**	**Credit**		**1**	
		Hours/Week	**L**	**T**	**P**	**TH**	
			0	**0**	**2**	**2**	

Course Objectives:	
1.	Develop key skill areas essential for a product designer from the perspective of design, its inherent complexity and supports them with tools & techniques to prototype rapidly.
2.	To enable the participants to visualize the experience for a user.
3.	To learn the roles & responsibilities of a designer in creating and shaping experiences for the user.
4.	The participants shall learn through the lenses of system thinking of how existing products work.
5.	Learn to select & apply various practice tools to aid them in rapid prototyping

UNIT I	**DESIGN FUNDAMENTALS**	**3**	**0**	**0**	**3**
Introduction to Visual Design, History and Modernism, Design Thinking methodology, seven elements of design, principles of design, principles of good design, designing a product and a service					
UNIT II	**SYSTEM THINKING AND REVERSE ENGINEERING**	**3**	**0**	**0**	**3**
System Thinking for Engineering Problem Solving, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components - Re-Engineering a complex system					
UNIT III	**USER INTERFACE & USER EXPERIENCE**	**3**	**0**	**0**	**3**
Introduction to UI/UX, Human-Computer interface, user-centered Design Principles, User research techniques, UX Design workflow, Information Architecture, UI Components, need for UI prototyping, Wireframes					
UNIT IV	**MECHANICAL PROTOTYPING**	**3**	**0**	**0**	**3**
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Introduction - Working with Fusion 360 - 3D Modeling - 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing					
UNIT V	**ELECTRONIC & SOFTWARE PROTOTYPING**	**3**	**0**	**0**	**3**
Introduction to Lumped Circuits - Electronic Prototyping - Tinker CAD - Designing in KI CAD - PCB design - Source code management and version control - GitHub - GitHub Actions - GitBash - Continuous Integration - Platform as service - Heroku - Build Packs					
					Total (15L) = 15 Periods

Text Books:	
1.	Thinking in systems - Donella Meadows, 2015
2.	Rapid Prototyping And Engineering Applications: A Toolbox For Prototype Development - Frank W.Liou, 2007
3.	Rapid Prototyping Technology: Selection And Application - COOPER K. G, 2001
Reference Books:	
1.	https://thesystemsthinker.com/wp-content/uploads/2016/03/Introduction-to Systems-Thinking-IMS013Epk.pdf
2.	https://formlabs.com/blog/ultimate-guide-to-prototyping-tools-for-hardware-and product-design/
3.	https://docs.kicad-pcb.org/
4.	https://www.tinkercad.com/learn/circuits
5.	https://docs.github.com/en/free-pro- team@latest/actions/guides

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Understand the elements and principles of product and service design	Apply
CO2	Apply system thinking concepts in reverse engineering	Apply
CO3	Apply user research techniques to meet the UX needs of a customer and design a visual prototype	Apply
CO4	Develop prototyping models using the tools from mechanical prototyping models	Apply
CO5	Develop prototyping models using the tools from electrical and software prototyping methods	Apply

COURSE ARTICULATION MATRIX														
CO/ POs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3		1						2					
CO2	2	3							2					
CO3	3		1						2					
CO4			3	2	3				2					
CO5	2		2		1				2					
Avg	**2**	**0.6**	**1.4**	**0.4**	**0.8**				**2**					
3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)														

22CYMC01	ENVIRONMENTAL SCIENCE			SEMESTER IV			
PREREQUISTIES		CATEGORY		MC	Credit		0
Basic Science		Hours/Week		L	T	P	TH
				2	0	1	3

Course Objectives:

1.	To learn the concept of non-conventional energy systems.
2.	To explore the environmental impact assessment and to learn about the consequence of different types of pollutants.
3.	To have an ancient wisdom drawn from Vedas.
4.	To acquire activity-based knowledge to preserve environment.
5.	To learn about conservation of water and its optimization.

ENVIRONMENTAL AWARENESS	30	0	0	30

Various types of traditional power Plant --Advantage and Disadvantage of conventional Power Definition of non-conventional energy sources Plants – Conventional vs. Non-conventional power generation. – Types of non-conventional energy sources - India's current energy resources and their long-term viability – India’s Energy requirement and management.

Solar Energy Basics- Solar Thermal Energy- Solar Photovoltaic Energy- Benefits and Drawbacks -Effects on the environment and safety. Wind turbine power and energy- India's wind energy potential- Wind turbine types. Environmental benefits and impacts of offshore wind energy.

Air pollution- Sources, effects, control, air quality standards, air pollution act, air pollution measurement. Water Pollution-Sources and its remedy, Soil Pollution-Sources and its remedy, disposal of solid waste. Greenhouse gases – effect, acid rain. Noise pollution reduction. Aspects of pollution from various power plants.

ENVIRONMENTAL ACTIVITIES	0	0	15	15

Group activity on water management – Group discussion on recycle of waste (4R’s)- Slogan making contest – Poster making event – Expert lecture on environmental awareness – Imparting knowledge on reduction of electricity usage. Identification and segregation of biodegradable and non-biodegradable waste – Campus cleaning activity – Plantation of trees in the college campus and local waste lands – Identification of varieties of plants and their usage – Shutting down the fans and ACs of the campus for an hour.

Total (30L+15P) = 45 Periods

Text Books:

1.	Elements of Environmental science and Engineering, P.Meenakshi, Prenitce — Hall of India, New Delhi, 2009.
2.	A Textbook of Environmental Chemistry and Pollution Control: (With Energy, Ecology, Ethics and Society), Revise Edition, Dr. S.S. Dara, D.D. Mishra Published by S. Chand & Company Ltd, 20 14.

Reference Books:

1.	Introduction to Environmental Engineering and Science, Gilbert M. Masters; Wendell P. Ela Publisher: Prentice-Ha India, 3rd Edition, 2008.
2.	Environmental Science, F;ldren D. Enger, Bredley F.Smith, WCD McGraw Hill 14"' Edition 2015.

E-Reference

1	www.onlinecourses.nptel.ac.in/
2	www.ePathshala.nic.in

COURSE OUTCOMES: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	**:**	To identify about the major renewable energy systems and will investigate the environmental impact of various energy sources as well as the consequences of various pollutants.	Analyze
CO2	**:**	Predict the methods to conserve energy and ways to make optimal use of the energy for the future.	Apply

COURSE ARTICULATION MATRIX														
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1		1	3			3	1	1				1		
CO2		1	3			3	1	1				1		
Avg		**1**	**3**			**3**	**1**	**1**				**1**		
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22CS405	OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY			SEMESTER		IV
PREREQUISITES		**CATEGORY**	**PC**	**Credit**		**2**
C Programming		**Hours/Week**	**L**	**T**	**P**	**TH**
			0	**0**	**4**	**4**

Course Objectives:

1.	To write programs using control structures and functions
2.	To apply Object Oriented Programming concepts
3.	To implement Template functions and classes
4.	To develop program with Exceptions
5.	To implement program using File

EXPERIMENTS

1.	Programs using control structures.
2.	Programs Using Functions • Implementation of Functions with default arguments • Implementation of Call by Value, Call by Address and Call by Reference • Implementation of Function Overloading
3.	Programs using Class • Class with primitive data members • Class with pointers as data members • Class with static member functions • Class with friend function
4.	To implement Compile time Polymorphism • Constructors and Destructors • Operator Overloading - Unary and Binary Operators. • Type conversions
5.	To implement Inheritances • Single inheritance • Multiple inheritance • Hierarchical inheritance • Virtual Base Classes
6.	To implement Runtime Polymorphism
7.	To implement Templates • Function templates • Class templates
8.	To implement Exception Handling Mechanism • Handling pre-defined exceptions • Handling user-defined exceptions
9.	File Handling • Sequential Access • Random Access
	Total (60 P)= 60 Periods

Reference Book:	
1.	E. Balagurusamy “Object –Oriented Programming with C++” Sixth Edition Tata McGraw-Hill.
E-References:	
1.	https://www.tutorialspoint.com/basic-concepts-of-object-oriented-programming-using-cplusplus
2.	https://www.simplilearn.com/tutorials/cpp-tutorial/oops-concepts-in-cpp

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Construct programs using Object Oriented Programming concepts	Apply
CO2	Build Generic Programming	Apply
CO3	Develop program for handling exceptions	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	3	2					3	3	3	2
CO 2	3	3	3	2	3	2					3	3	3	2
CO 3	3	3	3	2	3	2					3	3	3	2
Avg	**3**	**3**	**3**	**2**	**3**	**2**					**3**	**3**	**3**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CS406	MICROPROCESSOR AND MICROCONTROLLER LABORATORY			SEMESTER			IV
PREREQUISITES			CATEGORY	ES	Credit		2
NIL			Hours/Week	L	T	P	TH
				0	0	4	4

Course Objectives:

1.	Introduce ALP concepts and features
2.	Write ALP for arithmetic and logical operations in 8086 and 8051
3.	Differentiate Serial and Parallel Interface
4.	Interface different I/Os with Microprocessors

EXPERIMENTS

8086 Programs using kits

1.	Basic arithmetic and Logical operations
2.	Move a data block without overlap
3.	Code conversion, decimal arithmetic and Matrix operations.
4.	String manipulations
5.	Sorting and searching
6.	Counters and Time Delay

Peripherals and Interfacing Experiments

7	Traffic light control
8.	DC and Stepper motor control
9.	Digital clock
10.	Keyboard and Display
11.	Interfacing and Programming 8259 and 8253
12.	Serial interface and Parallel interface
13.	A/D and D/A interface and Waveform Generation

8051 Experiments using kits and MASM

14.	Basic arithmetic and Logical operations
15.	Square and Cube program, Find 2’s complement of a number
16.	Unpacked BCD to ASCII
17.	Programs for Sum of Elements in an Array operation

Total (60 P)= 60 Periods

LAB EQUIPMENT FOR HARDWARE (A BATCH OF 30 STUDENTS):	
1.	8086 development kits–30 nos
2.	Interfacing Units–Each 10 nos
3.	8051 Microcontroller kits–30 nos

COURSE OUTCOMES: Upon completion of the course ,the students will be able to:		**Bloom'sTaxonomy Mapped**
CO1	Write ALP Programmes for fixed and Floating Point and Arithmetic	Apply
CO2	Interface different I/O switch processor	Apply
CO3	Generate waveforms using Microprocessors	Apply
CO4	Execute Programs in 8051	Apply
CO5	Establish serial and parallel interface	Apply

COURSE ARTICULATIONMATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		2										2	1
CO2		2	2								2		2	
CO3	1	2	2								2			
CO4	2	2	2										2	2
CO5		2		2							2			1
Avg	**1.3**	**2**	**2**	**2**							**2**		**2**	**1.3**

3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)

22CS501	DATABASE MANAGEMENT SYSTEMS			SEMESTER V		
PREREQUISITES		**Category**	**PC**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the fundamentals of data models, SQL queries and relational databases.
2	To make a study of database design using ER Diagram and normalize and impart knowledge in transaction processing.
3	To make the students to understand the file operations and indexing and familiarize the students with advanced databases

UNIT I	RELATIONAL DATABASES	9	0	0	9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQLfeatures – Embedded SQL– Dynamic SQL.

UNIT II	DATABASE DESIGN	9	0	0	9

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III	TRANSACTION MANAGEMENT	9	0	0	9

Transaction Processing– ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Timestamp Ordering – Database Recovery – Recovery Concepts - Deferred Update- Immediate Update- Shadow Paging- ARIES recovery algorithm.

UNIT IV	DATA STORAGE AND QUERY PROCESSING	9	0	0	9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Types of Single Level Ordered Indices – Multilevel Indices-Dynamic Multilevel Indices Using B-Trees and B+Trees –Static Hashing – Dynamic Hashing – Query Processing Overview –Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V	ADVANCED DATABASES	9	0	0	9

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL – XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Data Warehousing and Data Mining - information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

Total (45 L) =45 Periods

Text Book:

1.	Abraham Silberschatz, Henry F.Korth and S.Sundarshan “Database System Concepts”, Sixth Edition,Tata McGraw Hill, 2011.

Reference Books:

1.	Ramez Elamassri and Shankant B-Navathe, “Fundamentals of Database Systems”, Sixth Edition,Pearson Education, 2011.
2.	C.J. Date, “An Introduction to Database Systems”, Eighth Edition, Pearson Education Delhi, 2008.

3.	Raghu Ramakrishnan, ―Database Management Systems, Fourth Edition, McGraw-Hill College Pu blications, 2015.
4.	G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011.
E-References:	
1.	Lecture Series on Database Management System by Dr.S.Srinath, IIT Bangalore, nptl

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Comprehend the basic concepts of the database and relational data models and Write SQL queries	Evaluate
CO2	Design a database using ER diagrams and map ER into Relations and normalize the relations and Summarize the transaction management and recovery management techniques adopted in database management system	Create
CO3	Describe and analyze the general idea of data storage, indexing techniques and query processing and Develop a simple database for applications	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	3	3				3	3	3	3	3
CO 2	3	3	3	3	3	3				3	3	3	3	3
CO 3	3	3	3	3	3	3				3	3	3	3	3
Avg	**3**	**3**	**3**	**3**	**3**	**3**				**3**	**3**	**3**	**3**	**3**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CS502	JAVA PROGRAMMING					SEMESTER V		
PREREQUISITES			**Category**	**PC**	**Credit**		**3**
Object Oriented Programming using C++			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives

1	To familiarize and apply the Object Oriented concepts and java features
2	To write the standalone applications and applet applications
3	To build simple chart application and Database Connectivity

UNIT I	INTRODUCTION TO JAVA	9	0	0	9

Fundamentals of object oriented programming- Java features, comparing Java with C and C++,Java environment; Overview of java language - Java program structure, Java tokens, Java statements, implementing Java program, Java Virtual Machine, command line arguments; constants, variables and data types - Operators and expressions - Decision making – branching and looping - Arrays and Strings.

UNIT II	JAVA FEATURES	9	0	0	9

Classes, Objects, methods – Inheritances – Interface – Packages - Exception handling - Multithreaded programming - Exploring java.lang– primitive types, wrapper classes ; Exploring java.io - java I/O classes and interfaces, files, stream classes, byte streams, character stream.

UNIT III	APPLET AND EVENT HANDLING	9	0	0	9

Applet class- two types of applets, Applet basics, Applet architecture, Applet skeleton, simple Applet display method – Passing parameters to Applet; Event handling – two event handling Mechanisms, delegation event model, event classes, sources of events, event listener interfaces; Introduction to AWT - AWT classes, windows fundamentals, working with frame Windows, creating a frame window in an Applet, creating a windowed program, working with graphics, working with color, working with fonts.

UNIT IV	AWT AND SWING CONTROLS	9	0	0	9

AWT - AWT controls, Layout Managers, Menu Bars and Menus, Dialog Boxes, FileDialogs; Swings-JApplet,JLabel and ImageIcon, JTextField, Swing Buttons, JTabbedPane, JScrollPane, JList, JComboBox, Trees, JTables.

UNIT V	NETWORKING AND JDBC	9	0	0	9

Networking - Networking Basics, Inet Address, TCP/IP Client Sockets, URL, URL Connection, TCP/IP Server Sockets, Datagrams; Design of JDBC - JDBC drivers; JDBC programming concepts - Databaseconcepts, making connection, executing SQL commands, managing connections, statements, and result sets; Query execution - Prepared Statements.

Total (45 L) =45 Periods

Text Books:

1.	Patric Naughton , Herbert Schildt, “The Complete Reference Java 2” , Twelfth edition, Tata McGraw Hill,2021.
2.	E. Balaguruswamy, “Programming with Java”, Sixth Edition, Tata McGraw Hills, 2019.

Reference Books:

1.	Cay S. Horstmann, Gary Cornell “ Core Java 2”, Twelfth Edition, Pearson Education,2021.
2.	Graham Hamilton , Rick Cattell, Maydene Fisher ,”JDBC Database access with Java”.
3.	Paul Deitel and Harvey Deitel, “Java How to Program”, Tenth Edition, Pearson Prentice Hall.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiarize and apply the Object Oriented concepts and Java features	Apply
CO2	Build the standalone applications and applet applications	Create
CO3	Develop simple chart application and Database Connectivity	Create

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	3	2					3	3	3	2
CO 2	3	3	3	2	3	2					3	3	3	2
CO 3	3	3	3	2	3	2					3	3	3	2
Avg	**3**	**3**	**3**	**2**	**3**	**2**					**3**	**3**	**3**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CS503	COMPUTER NETWORKS			SEMESTER V			
PREREQUISITES			CATEGORY	PC	Credit		3
NIL			Hours/Week	L	T	P	TH
				3	0	0	3

Course Objectives:	
1.	To study the concepts of data communications and functions of different ISO/OSI reference architecture
2.	To understand the error detection and correction methods and also the types of LAN
3.	To study the concepts of subnetting and routing mechanisms
4.	To understand the different types of protocols and congestion control
5.	To study the application protocols and network security

UNIT I	DATA COMMUNICATIONS AND PHYSICAL LAYER	9	0	0	9
Data Communication; Networks- Physical Structures (Types of Connections, Physical Topology),Categories of Networks, Interconnection of Networks: Internetwork;Protocols and Standards; Network Models-The OSI Model, Layers in the OSI Model,Addressing;Transmission media-Guided Media, Unguided Media.					
UNIT II	DATA LINK LAYER	9	0	0	9
Introduction-Types of errors, Redundancy, Detection versus Correction, Modular Arithmetic; Block Coding-Error Detection and Correction (VRC, LRC, CRC, Checksum, Hamming Code);Data link Control- Flow Control (Stop- and-Wait, Sliding Window),Error Control (Automatic Repeat Request, Stop-and-wait ARQ, Sliding Window ARQ), HDLC; Local Area Networks- Ethernet, Token Bus, Token Ring, FDDI.					
UNIT III	NETWORK LAYER	9	0	0	9
Network Layer services-Packet Switching-Network Layer Performance-IPv4 addresses-IPv6 addressing- Subnetting-Bridges-Gateways- Routers-Routing Algorithm-Distance Vector Routing, Link State Routing.					
UNIT IV	TRANSPORT LAYER	9	0	0	9
Duties of the Transport layer-User Datagram Protocol-Transmission Control Protocol- Congestion Control and Quality of Service-Congestion, Congestion Control, Quality of Service, Techniques to improve QoS.					
UNIT V	APPLICATION LAYER	9	0	0	9
Domain Name System- Domain Name Space, DNS in the Internet; Electronic Mail- FTP- SNMP- HTTP- World Wide Web.					
					Total (45 L) =45 Periods

Text Book:	
1.	Behrouz A.Ferouzan, “Data Communications and Networking”, 4th Edition, Tata McGraw-Hill, 2017.
Reference Books:	
1.	Andrew S. Tanenbaum, “Computer networks “PHI, 4th edition 2008
2.	William Stallings,” Data and computer communications”, 10th edition, PHI, 2012
3.	Douglas E. comer,” Internetworking with TCP/IP-Volume-I”, 6th edition,PHI, 2008

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom’s Taxonomy Mapped
CO1	Understand the fundamental concepts of networking and working principles of various communication protocols.	Understand
CO2	Apply the various functionalities of OSI layers in real time applications	Apply
CO3	Analyze the various network issues in different layers and provide suitable solutions.	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	1	2	2						1	3	2	1
CO 2	3	3	1	2	2						1	3	2	1
CO 3	3	3	1	2	2						1	3	2	1
Avg	**3**	**3**	**1**	**2**	**2**						**1**	**3**	**2**	**1**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CS504	PRINCIPLES OF COMPILER DESIGN			SEMESTER V			
PREREQUISITES		**CATEGORY**		**PC**	**Credit**		**3**
Theory of Computation		**Hours/Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To explore the principles involved in the design and construction of compilers.
2.	To understand the algorithms used in the development of compilers.

UNIT I	INTRODUCTION TO COMPILER & LEXICAL ANALYSIS	9	0	0	9

Compiler – Phases of a compiler – Grouping of Phases – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of tokens – Finite Automata (FA) – Regular Expression (RE) to Automata – Minimizing states of DFA.

UNIT II	SYNTAX ANALYSIS	9	0	0	9

Role of the parser – Context-Free Grammars – Top Down parsing – Recursive Descent Parsing – Predictive Parsing – Bottom-up parsing – Operator Precedence Parsing – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser.

UNIT III	SYNTAX DIRECTED TRANSLATION & INTERMEDIATE CODE GENERATION	9	0	0	9

Syntax Directed Definitions - Evaluation Orders for Syntax Directed Definitions – Construction of Syntax Trees – Intermediate languages – Syntax Tree, Three Address Code, Types and Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure calls.

UNIT IV	CODE GENERATION	9	0	0	9

Issues in the design of a code generator – The target machine – Run-time storage management – Basic Blocks and Flow Graphs – Transformations on Basic Blocks – Next-use Information – DAG representation of Basic Blocks -A simple Code generator – Register allocation and assignment.

UNIT V	CODE OPTIMIZATION AND RUN TIME ENVIRONMENTS	9	0	0	9

Introduction – Principal Sources of Optimization – Peephole Optimization - Optimization of basic Blocks – Loops in Flow graphs – Reducible Flow graphs – Introduction to Global Data Flow Analysis – Data flow analysis of structured programs

Total(45 L)=45 Periods

Text Book:

1.	Alfred Aho, Monica S Lam, Ravi Sethi and Jeffrey D Ullman, “Compilers Principles, Techniques and Tools”, Pearson Education Asia, Second Edition, 2017.

Reference Books:

1.	Keith D Cooper and Linda Torczon, “Engineering a Compiler”, Third Edition, Elsevier Publication, 2022.
2.	J.P. Bennet, “Introduction to Compiler Techniques”, Second Edition, Tata McGraw-Hill, 2003.

E-References:

1.	https://nptel.ac.in/courses/106108113/
2.	https://doc.lagout.org/programmation/C/Modern % 20Compiler%20Implementation%20in%20C%20%5BAppel%201997-12-13%5D.pdf
3.	https://nptel.ac.in/courses/106104072/

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Illustrate the operation of a compiler phases.	Understand
CO2	Compute the information to perform the task of a compiler phase.	Analyze
CO3	Recall the principles and algorithms involved in compiler construction.	Remember

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		2	1	1					3	2	2
CO2	3	3	2		2	1	1					3	2	2
CO3	3	3	2		2	1	1					3	2	2
Avg	**3**	**3**	**2**		**2**	**1**	**1**					**3**	**2**	**2**

3 / 2 /1 – indicates strength of correlation (3-High, 2-Medium, 1-Low)

22MCIN04	IDEATION SPRINTS				SEMESTER V		
PRE-REQUISITE:			**Category**	**EE**	**Credit**		**1**
			Hours/Week	**L**	**T**	**P**	**TH**
				0	**0**	**2**	**2**

Course Objectives:	
1.	To offer a systematic and structured process to hack a solution using available tools & resources
2.	To identify the challenge/opportunity, derive insights from the customer/user interviews, & build a solution and validate the technical feasibility of the solution
3.	To build the PoC for proposed solution & pitch to user/customer for validation.

UNIT I	**INNOVATION 101**	**0**	**0**	**6**	**6**
Difference between a startup and a small business enterprise - Idea worth prototyping -Risk of innovations - Defining &validating hypothesis through Product Innovation Hypothesis (PIH) & Forge Innovation Rubric (FIR)					
UNIT II	**PROBLEM VALIDATION & CUSTOMER DISCOVERY**	**0**	**0**	**6**	**6**
Tools and techniques of the managed innovation process (iTOOLS - innovation toolkit) -Customer-Centric Innovation: Customer-centric design thinking and validate the problem scenario, its significance, severity, and incidence - Discover & identify the right buyer beneficiary/Customer - rigorous Gap analysis of the existing solution - Adoption barriers of the solutions.					
UNIT III	**DESIGNING & CRAFTING VALUE PROPOSITION**	**0**	**0**	**6**	**6**
Understand Customer Jobs, Pains & gains - Design Product/Service - Define & quantify Value Proposition -Build a compelling value proposition.					
UNIT IV	**MUP SOLUTION CONCEPT EXPLORATION & DESIGN GENERATION**	**0**	**0**	**6**	**6**
Solution: Concept Generation, Concept Assessment, Solution, Capability, Usability, and Feasibility- MUP Design and Technology Block Diagrams- Bill of Materials Generation - BoM Optimization					
UNIT V	**PROOF OF CONCEPT DEVELOPMENT & DEMONSTRATION**	**0**	**0**	**6**	**6**
Proof-of-Concept design - hack to build PoC with critical features -Test PoC for technical feasibility test deliver of Value proposition - Innovation Brief documentation (Proposal) - Demonstrate a PoC;					
					Total = 30 Periods

Text Books:	
1.	Tim Brown, Change by Design:How design thinking transforms organizations and inspires innovation – HarperCollins e-books, 2009
2.	Alexander Osterwalder, Value Proposition Design: How to Create Products and Services Customers Want (Strategyzer) - John Wiley & Sons, 2014
3.	Ulrich Karl and Eppinger Steven D, Product Design and Development - McGraw Hill, 5th edition, 2020
4.	Blank Steve, Four Steps to Epiphany: Successful strategies for products that win, KS Ranch, 5th edition, 2013
Reference Books:	
1.	Everything you need about value proposition: https://blog.forgeforward.in/everything-you-need-to-know-about-value-proposition-7247493c940c
2.	Test your Value Proposition:http://businessmodelalchemist.com/2012/09/test-your-value-proposition-supercharge-lean-startup-and-custdev-principles.html
3.	Valuation Risk versus Validation Risk in Product Innovations:https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253ca8624
4.	User Guide for Product Innovation Rubric: https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd
5.	Innovation Risk Diagnostic - Product Innovation Rubric: https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356

6.	Evaluating Product Innovations - proof, potential, & progress: https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Apply a scientific method to understand the inherent risks of product innovation	L3: Applying
CO2	Apply innovation tools & techniques to validate the problem scenario and to assess the market potential of product innovation;	L3: Applying
CO3	Design solution concept based on the proposed value by exploring various alternate solutions to achieve value-price fit;	L6: Creating
CO4	Demonstrate technical skills by applying technology to build and demonstrate proof of concept for the solution proposed;	L2: Understanding
CO5	Develop skills to articulate the solution concept into a proposal for grants.	L3: Applying

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	1	0	0	0	0	0	0	0	2	2	3
CO2	2	3	3	2	2	0	0	0	0	0	0	0	3	3	3
CO3	2	2	3	1	1	1	0	0	1	1	0	0	3	2	2
CO4	3	3	3	2	2	0	0	0	0	0	0	0	3	3	3
CO5	3	3	3	3	3	0	0	0	0	0	0	0	3	3	3
AVG	**2.4**	**2.8**	**2.8**	**1.8**	**1.8**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**2.8**	**2.6**	**2.8**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

22MC301	INDIAN CONSTITUTION					SEMESTER V
PREREQUISITES		CATEGORY	MC	Credit		0
NIL		Hours/Week	L	T	P	TH
			2	0	0	0

(Common to all branches)

Course Objectives:

1.	learn the salient features of the Indian Constitution
2.	list the Fundamental Rights and Fundamental Duties
3.	present a systematic analysis of all dimensions of Indian Political System
4.	understand the power and functions of the Parliament, the Legislature and the Judiciary

UNIT I		**6**	**0**	**0**	**6**
Union and its Territory – Citizenship–Fundamental Rights–Directive Principles of State Policy–Fundamental Duties					
UNIT II		**6**	**0**	**0**	**6**
The Union–The States–The Union Territories–The Panchayats–The Municipalities					
UNIT III		**6**	**0**	**0**	**6**
The Co-operative Societies–The scheduled and Tribal Areas–Relations between the Union and the States–Finance, Property, Contracts and Suits–Trade and Commerce within the territory of India					
UNIT IV		**6**	**0**	**0**	**6**
Services under the Union, the States – Tribunals – Elections– Special Provisions –Relating to certain Classes					
UNIT V		**6**	**0**	**0**	**6**
Languages–Emergency Provisions – Miscellaneous–Amendment of the Constitution					

Total (6L) = 30 Periods

Text Books:	
1.	SubhashC.Kashyap, Our Constitution, National Book Trust, 2017
2.	Durga Das Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
3.	M.V.Pylee, Constitutional History of India, S.Chand publishing, 2010
4.	Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, 1999

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	understand the emergence and evolution of the Indian Constitution	Understand
CO2	explain the key concepts of Indian Political System	Understand
CO3	describe the role of constitution in a democratic society.	Remember
CO4	present the structure and functions of the Central and State Governments, the Legislature and the Judiciary	Understand

22CS505	DATABASE MANAGEMENT SYSTEMS LABORATORY			SEMESTER V			
PREREQUISITES		**CATEGORY**		**PC**	**Credit**		**2**
NIL		**Hours/Week**		**L**	**T**	**P**	**TH**
				0	**0**	**4**	**4**

Course Objectives:

1.	Learn to create and use a database.
2.	Be familiar with a query language.
3.	Have hands-on experience on DDL, DML and DCL commands.
4.	Familiarize advanced SQL queries.
5.	Be Exposed to different applications.

LIST OF EXPERIMENTS

1.	Create a relational database system using DDL commands with constraints.
2.	Update the database system using DML commands.
3.	Query the database using simple and complex queries.
4.	Create and update views.
5.	High level programming language extensions (Control structures, Procedures and Functions).
6.	Create triggers.
7.	Create assertions and indexes.
8.	Use of front end tools to manipulate the database.
9.	Generate reports using a reporting tool.
10.	Database Design and implementation of an application system. (Suggested Mini Project)
	Total(60 P)=60Periods

COURSEOUTCOMES: Upon completion of the course, the students will be able to :		**Bloom'sTaxonomy Mapped**
CO1	Build tables, construct relationships among them and retrieve data with simple and complex queries.	Create
CO2	Build various constraints, triggers and indexes on the tables.	Create
CO3	Design and implement a database and to integrate into a simple application.	Create

COURSE ARTICULATION MATRIX													
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	2	1			1	3	3	3	3
CO2	3	3	3	3	2	2	1			1	3	3	3	3
CO3	3	3	3	3	2	2	1			1	3	3	3	3
Avg	**3**	**3**	**3**	**3**	**2**	**2**	**1**			**1**	**3**	**3**	**3**	**3**
3 / 2 /1 - indicatesstrengthofcorrelation (3-High,2-Medium,1-Low)														

22CS506	JAVA PROGRAMMING LABORATORY					SEMESTER V
PREREQUISITES	**CATEGORY**	**PC**	**Credit**		**2**	
Object Oriented Programming using C++	**Hours/Week**	**L**	**T**	**P**	**TH**	
		0	**0**	**4**	**4**	

Course Objectives:

1.	To implement object oriented programming concepts and java features
2.	To build Java standalone applications and applet applications
3.	To develop simple chat applications and database connectivity applications

EXPERIMENTS

1.	Program using Control structures
2.	Program using arrays and strings
3.	Program using Java Classes and Objects
4.	Program to implement inheritance
5.	Program to implement interface
6.	Program to create packages and import the package
7.	Program to create own Exceptions and catch the exceptions
8.	Program to implement the Multiple threads
9.	Program to implement File operations
10.	Program to create a simple applet application
11.	Program to create application the AWT controls with events
12.	Program to create application with Layouts
13.	Program to create application the Swings controls with events
14.	Program to implement a simple chat using Sockets programming
15.	Program to implement a simple chat using Datagrams.
16.	Program to implement JDBC connectivity

Total (60 P)= 60 Periods

Course Outcomes: After the successful completion of the practical session, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Implement object oriented programming concepts and java features	Apply
CO2	Develop Java standalone applications and applet applications	Create
CO3	Build simple chat applications and database connectivity applications	Create

COURSE ARTICULATION MATRIX														
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	3	2					3	3	3	2
CO 2	3	3	3	2	3	2					3	3	3	2
CO 3	3	3	3	2	3	2					3	3	3	2
Avg	**3**	**3**	**3**	2	**3**	2					**3**	**3**	**3**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22EN401	PLACEMENT AND SOFT SKILLS LABORATORY			SEMESTER V			
PREREQUISITES		**CATEGORY**		**HS**	**Credit**		**2**
1. Basic knowledge in reading skill and writing skill 2. Basic ability in listening skill and speaking skill		**Hours/Week**		**L**	**T**	**P**	**TH**
				0	**0**	**4**	**4**

COURSE OBJECTIVES:

1.	To develop the students' confidence and help them to attend interviews successfully
2.	To express opinions, illustrate with examples and conclude in group discussions
3.	To acquire knowledge to write error free letters and prepare reports
4.	To enhance the employability and soft skills of students

UNIT I	**WRITING SKILLS**	**0**	**0**	**12**	**12**
Letter seeking permission to go on industrial visit, Letter of invitation, Resume and cover letter, Job application, E-mail writing, Report writing, progress in project work					
UNIT II	**SPEAKING SKILLS**	**0**	**0**	**12**	**12**
Welcome address and vote of thanks, Analysing and presenting business articles, Power point presentation, Presenting the visuals effectively, Group discussion, Participating in group discussions, Understanding group dynamics, Brain-storming the topics					
UNIT III	**SOFT SKILLS**	**0**	**0**	**12**	**12**
Employability and career skills, Self-introduction, Introducing oneself to the audience, introducing the topic, Interview skills, Interview etiquette, Dress code, Body language, Attending job interviews					
UNIT IV	**VERBAL ABILITIES**	**0**	**0**	**12**	**12**
Error Spotting, Listening Comprehension, Reading comprehension, Rearranging Jumbled sentences, Vocabulary					
UNIT V	**REASONING ABILITIES**	**0**	**0**	**12**	**12**
Series completion, Analogy, Classification, Coding-Decoding, Blood relations, Seating Arrangements, Directional Sense, Venn Diagram, Logical reasoning, Statements and Conclusions					
					Total (60P)= 60 Periods

REFERENCE BOOKS:

1.	Campus Recruitment Complete Reference, Praxis Groups (5th edition), Hyderabad, 2017.
2.	John Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, 2004.
3.	R.S. Aggarwal. A Modern Approach to Verbal & Non-Verbal Reasoning. 2018 S Chand Publication, 2018

E-REFERENCES:

1.	https://prepinsta.com/
2.	https://www.indiabix.com/

LIST OF EXERCISES:

1) Cover Letter and Resume
2) Letter Writing
3) Email Writing
4) Report Writing
5) Power point Presentation
6) Self-Introduction
7) Job Interview
8) Group Discussion
9) Welcome Address
10) Vote of Thanks
11) Presentation of Business Article
12) Jumbled Sentences
13) Error Spotting
14) Reading Comprehension
15) Series completion
16) Analogy
17) Coding-decoding
18) Blood relations
19) Seating arrangements
20) Logical reasoning

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	participate in group discussion and interview confidently	Apply
CO2	develop adequate soft skills and career skills required for the workplace	Create
CO3	make effective presentations on given topics	Create
CO4	apply their verbal ability and reasoning ability in campus interviews	Apply

COURSE ARTICULATION MATRIX

COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				1					2	3		1	1	
CO2				2					2	3		1	2	
CO3				2					1	3		1	1	
CO4				1					2	3		1	2	
Avg				**1.5**					**1.75**	**3**		**1**	**1.5**	

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22CS601	MINI PROJECT			SEMESTER VI		
PREREQUISITES	**CATEGORY**	**EEC**	**Credit**		**3**	
NIL	**Hours/Week**	**L**	**T**	**P**	**TH**	
		0	**0**	**6**	**6**	

The objective of mini project work is to enable the students, to work in convenient groups of not more than four members in a group, on a project involving some design and fabrication work or theoretical and experimental studies related to the respective engineering discipline.

Every project work shall have a project guide. Six periods per weeks shall be allotted in the time table for this important activity. These hours shall be utilized by the student to receive directions from the respective guide and also to present periodical presentation to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature-survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.The continuous assessment and semester evaluation may be carried out as specified in the guidelines to be issued time to time.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Discover potential research areas in the field of Computer Science.	Analyze
CO2	Understand, Compare, and contrast the several existing solutions for the problems identified.	Understand
CO3	Formulate, and propose a plan for creating a solution for the research identified.	Create
CO4	Implementation of the solution as a team, take responsibility, and excel within a team both technically and ethically.	Apply
CO5	Interpret the results, and able to prepare report, present the findings of the work conducted.	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	3	2	2	1	3	3	3	3	3	3
CO2	3	3	3	2	3	2	2	1	3	3	3	3	3	3
CO3	3	3	3	2	3	2	2	1	3	3	3	3	3	3
CO4	3	3	3	2	3	2	2	1	3	3	3	3	3	3
CO5	3	3	3	2	3	2	2	1	3	3	3	3	3	3
Avg	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**3**	**3**	**3**	**3**	**3**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

PROTOSEM COURSES SYLLABUS

22PSPE01	COMPUTATIONAL HARDWARE		Semester			VI
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To learn basic concepts of Embedded Systems by familiarizing the functionalities of embedded platforms with development boards.
2	To understand the core concepts of GPIO Pins, Functionality of peripherals, Selection of I/O devices , Usage of Internal functions, and Communication protocols.
3	To familiarize the current technologies and protocols used in the Internet of Things (IoT) and to learn the Cloud services.

Unit I	**BASICS OF EMBEDDED SYSTEM**	**9**	**0**	**0**	**9**

Embedded Platform: Architecture and working - Factors for Microcontroller/Microprocessor selection. Arduino - Boards and schematics – Toolchain - Setup and Configuration - Input/Output Configurations and Access - Libraries - Digital I/O - ADC - Analog I/O - Timers, Interrupts - Pulse Width Modulation - Display: 7-segment , LCD , OLED.

Unit II	**BASICS OF RASPBERRY PI**	**9**	**0**	**0**	**9**

Raspberry Pi: Raspberry pi Board - Processor - Setup and Configuration - Installing Python IDLE using Command Terminal - General Purpose I/O Pins - Protocol Pins - GPIO Access - Pulse Width Modulation - Network Libraries - Web services - Twitter APIs - Twitter Bot - Interfacing pi with camera modules.

Unit III	**SENSORS AND ACTUATORS**	**9**	**0**	**0**	**9**

Interfacing of Sensors and Actuators - Sensors: Introduction, Characteristics: Analog - Potentiometer, Temperature Sensor, Soil Moisture Sensor, LDR - Digital - PIR Sensor, Smoke Sensor, Infrared - Sensor, Ultra- Sonic Sensor. Actuators - Introduction, Characteristics and working with relay, DC motors, Servo motor, Stepper motor and its drivers.

Unit IV	**COMMUNICATION PROTOCOLS**	**9**	**0**	**0**	**9**

Protocols - Wired: RS232 Standard - UART, SPI, I2C - Comparative study of wired protocols - Implementation of wired Serial Communication protocols Wireless: Standards - Bluetooth, RF - Comparative study of wireless protocols - Implementation of wireless Serial Communication protocols.

Unit V	**INTERNET OF THINGS**	**9**	**0**	**0**	**9**

Definition and Architecture of IoT, Building blocks of IoT, Programming with IoT protocols - MQTT, CoAP - Connecting embedded target board to Web, Basics networking in IoT: creating a web page - Creating a server on target board - Controlling I/O peripherals from the webpage, Embedded Application Development, Creating communication between different nodes - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services.

Total = 45 Periods

Text Books:

1	Raj Kamal, “ Embedded Systems - SoC, IoT, AI and Real-Time Systems”, 4th Edition, McGraw Hill, 2020.
2	Mohit Arora, “Embedded System Design”, 1st Edition, Learning Bytes Publishing, 2016.
3	Elecia White, “Making Embedded Systems”, 1st Edition, Shroff/ O’ Reilly, 2012.
4	Jack Ganssle, “ The Firmware Handbook”, 1st Edition, Newnes, 2004.

Reference Books:	
1	https://juniorfall.files.wordpress.com/2011/11/arduino-cookbook.pdf
2	https://drive.google.com/file/d/13s0m3lHPEFP2f2aCuVNRWeBZNKXWKTW5/view?ts=6231cab 3
3	https://ptolemy.berkeley.edu/books/leeseshia/releases/LeeSeshia_DigitalV2_2.pdf 4.
4	https://www.riverpublishers.com/pdf/ebook/RP9788793519046.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand and implement the functions & Capabilities of embedded platforms for easy prototyping.	L2: Understanding
CO2	Identify the type of sensors and actuators for required applications.	L3: Applying
CO3	Develop communication between devices using different protocols.	L3: Applying
CO4	Develop IoT based systems with wireless network connections and accessing devices over cloud.	L3: Applying

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3								3	2	2
CO2	3	3	2	2	2								3	2	2
CO3	3	2	3	2	3								3	3	3
CO4	3	2	3	2	3								3	3	3
AVG	**3**	**2.25**	**2.75**	**2**	**2.75**								**3**	**2.5**	**2.5**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22PSPE02	CODING FOR INNOVATORS				Semester		VI
PREREQUISITES			Category	PE	Credit		3
			Hours/Week	L	T	P	TH
				3	0	0	3

Course Learning Objectives

1	To learn and express creativity using coding skills.
2	To gain knowledge of Python programming with hands-on experience.
3	To demonstrate a problem solving using OOPs concepts.
4	To learn basics of Linux by familiarizing the concepts of management and file structure.
5	To practise full stack development using cloud platform.

Unit I	PROGRAMMING PARADIGMS	9	0	0	9

Need for programming - Outside box thinking to solve problems - Need for algorithms and data structures - Flowcharts & Algorithms - Memory Allocation - Conditions and loops - Creating effective functions - Case studies - Visual Programming - Types of programming languages & paradigms - Getting started with development - Build & test an algorithm - best practices

Unit II	BASIC OF PROGRAMMING	9	0	0	9

Introduction to Python: statements, variables, functions, operators, modules, conditional statements, loop statements, Lists: list operations, traversing a list, slicing a list - Text Handling: Strings, string functions, conversion functions, Dictionaries - File Operations: File open, close, read, copy, word frequency, creating word histograms from text file.

Unit III	OOPS 5	9	0	0	9

OOPS- Why OOPS- verticals- implementation in python - Classes and Objects, Methods, Constructors and Destructors, Inheritance, Polymorphism, Abstraction, Encapsulation.

Unit IV	SOFTWARE DEVELOPMENT TO DELIVERY	9	0	0	9

Software Engineering - Life Cycle (Tools), Agile Methodologies - Framework - Why Frameworks - Software Testing(Tool Based) - Data Structures - Database Management System - A case study to experiment from Development to Deployment(D2D) - Source code management and version control - GitHub - GitHub Actions - GitBash - Continuous Integration - Platform as service - Heroku - Build Packs AWS- Anaconda

Unit V	OPERATING SYSTEMS	9	0	0	9

Introduction to Linux - Process Management - Process Scheduling - Memory Management - Storage Management - System calls - File System Structure - Multithreading - Multicore Programming - Deadlock Handling - Disk Structure - Disk Management - Dockers - Kubernetes

Total = 45 Periods

Text Books:

1	Zed A. Shaw, “Learn Python 3 the Hard Way”, 3rd edition, Addison-Wesley Professional, 2013.
2	Silberschatz Abraham, “Operating System Concepts”, 9th edition, John Wiley & Sons Inc (Sea)Pte Ltd, 2016.
3	Paul Barry, "Head-First Python", 2nd edition, O'Reilly Media, Inc, 2016.
4	Anton Spraul, “Think Like a Programmer”, 1st edition, No Starch Press, 2012.

E-References :	
1	https://www.geeksforgeeks.org/python-programming-language/
2	https://www.guru99.com/python-tutorials.html
3	https://www.tutorialspoint.com/python/python_tutorial.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the aspects of programming protocols	L2: Understanding
CO2	Develop optimized code for real-world problems	L3: Applying
CO3	Build full-stack development to deployment	L3: Applying
CO4	Demonstrate problem solving and continuous development	L2: Understanding

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	2	2	2	1	3								2	1	1
CO2	3	3	3	2	3								3	2	2
CO3	3	2	3	1	3								3	2	2
CO4	2	3	2	1	2							3	2	1	1
AVG	**2.5**	**2.5**	**2.5**	**1.25**	**2.75**							**3**	**2.5**	**1.5**	**1.5**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22PSPE03	INDUSTRIAL AUTOMATION			Semester		VI
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Acquire conceptual knowledge in Industrial Controllers by scaling of on-board devices and embedded board interfacing with various I/O peripherals.
2	Learn PLC by working on internal features and also interfacing with Sensors and actuators along HMI concept using SCADA and standard communication protocols.
3	To work with FPGA boards and RT controllers for reprogrammable embedded applications using LabVIEW
4	Understand the concepts and design electronics circuits

Unit I	INDUSTRIAL CONTROLLERS - I	9	0	0	9

Industrial Controllers - Introduction to RIO Controllers - Platform - Connection and Configuring controllers - Accessing onboard devices - Module SOM - Interfacing with Input and Output devices - Interfacing protocol based Analog and Digital sensors - Acquiring and Data Logging from sensors - Interfacing Actuators: Relay, DC Motor, Servo Motor - Creating standalone applications

Unit II	INDUSTRIAL CONTROLLERS - II	9	0	0	9

Industrial Controllers - II - PLC - Introduction - Mode of Operation - IEC 61131 Programming languages for PLC - Programming & sequence control - Instruction set - Scan Time - Timers - Counters - Interfacing with Input/Output devices - Interfacing with Sensors - Interfacing with Actuators - Interfacing with Human Machine Interface - Commissioning and operational safety of PLC - SCADA

Unit III	INDUSTRIAL COMMUNICATION PROTOCOLS	9	0	0	9

Serial Communication Protocols - I2C, SPI - Serial Field bus protocols CAN, PROFIBUS - Ethernet, HTTP, TCP/UDI, WiF, Cloud data logging. Multi-sensor communication, Data parsing between Embedded platforms. Comparative study of Industrial communication protocols - Implementation of Industrial Communication protocols.

Unit IV	FPGA AND RT CONTROLLER PROGRAMMING	9	0	0	9

Introduction to FPGA - Architecture - Operations in FPGA programming - FPGA Programming in LabVIEWand implementation in myRIO - Introduction to RT controllers - Architecture - Programming RT Controllers - Creating standalone applications.

Unit V	INDUSTRIAL CIRCUIT BOARD DESIGN	9	0	0	9

Designing basics circuits and to simulate in environment setup - Component selection - Creating libraries- Schematic design - Design rules, supply & communication track rules - Component and footprint editor -Understanding component package types - Test point creation for measurement - PCB Layout,placement rules - Footprint, 3D models, BoMs - Generating GERBER and output documentation

Total = 45 Periods

Text Books:	
1	Ed Doering, NI myRIO Project Essential Guide, National Instruments, 2016.
2	Willian Bolton, Programmable Logic Controllers, 6th edition, Newnes Publications, 2015
3	Richard Zurawski, Industrial Communication Technology Handbook, Second edition, CRC Press, 2014
4	Simon Monk, Make Your Own PCBs with EAGLE, McGraw Hill Education, 2014.
References Books:	
1	Jeffrey Travis, Jim Kring, LabVIEW for Everyone: Graphical Programming Made Easy and Fun,3rd edition, Prentice Hall
2	Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing,Fourth edition, Pearson Education, 2016
3	Michael J. Hamill, Industrial Communications and Control Protocols, PDH centre, 2016
4	Ema Design Automation, The Hitchhiker's Guide to PCB Design, First edition, Blurb Publishers,December 2021

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the usage of controllers in an industrial environment	L2: Understanding
CO2	Build Real-Time systems for Industrial embedded monitoring and controlling deterministic applications	L3: Applying
CO3	Communicate between devices at different levels using industrial protocols	L3: Applying
CO4	Understand the process involved in PCB design using EDA tools and fabricate it	L2: Understanding

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	3	2	2	1	3								3	2	2
CO2	3	3	3	2	3								3	3	3
CO3	3	2	3	2	3								3	3	3
CO4	3	2	3	2	3								3	3	2
AVG	3	2.25	2.75	1.75	3								3	2.75	2.5

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22PSOE01	APPLIED DESIGN THINKING				Semester		VI
PREREQUISITES		**Category**	**OE**	**Credit**			**3**
		Hours/Week	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Learning Objectives	
1	The course enables product innovators and early-stage startup founders to learn the customer development process
2	To familiarize with the tools & techniques & validate the inherent risks by linking their progress to customer-motivation, customer-commitment & customer-acceptance.
3	To learn the system thinking concepts by reverse engineering technique.

Unit I	**DESIGN THINKING PRINCIPLES**	**9**	**0**	**0**	**9**
Exploring Human – Centered Design – Understanding the innovation process, discovering areas of opportunity, interviewing &empathy –building techniques, Mitigate validate risk with FIR(Forge Innovation Rubric) – Case Studies.					
Unit II	**CUSTOMER-CENTRIC INNOVATION**	**9**	**0**	**0**	**9**
Importance of customer-centric innovation – Problem Validation and Customer Discovery – Understanding problem significance and problem incidence- Customer Validation. Target user, User persona & user stories. Activity : Customer development process – Customer interviews and field visit.					
Unit III	**APPLIED DESIGN THINKING TOOLS**	**9**	**0**	**0**	**9**
Concept of Minimum Usable Prototype(MUP) – MUP challenge brief – Designing & Crafting the value proposition – Designing and Testing Value Proposition: Design a compelling value proposition: Process, tools and techniques of Value Proposition Design.					
Unit IV	**CONCEPT GENERATION**	**9**	**0**	**0**	**9**
Solution Exploration, Concepts Generation and MUP design – Conceptualize the solution concept: explore, iterate and learn; build the right prototype: Assess capability, usability and feasibility. Systematic concept generation; evaluation technology alternatives and the solution concepts.					
Unit V	**SYSTEM THINKING & REVERSE ENGINEERING**	**9**	**0**	**0**	**9**
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components – Re-Engineering a complex system.					
Total = 45 Periods					

Text Books:	
1	Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2	Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
3	Proposition Design: How to Create Products and Services Customers Want, Wiley
4	Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute.
5	Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.

Reference Books:	
1	https://www.ideou.com/pages/design-thinking#process
2	https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253ca8624
3	https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356
4	https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
5	https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd6
6	https://blog.forgeforward.in/startup-failure-is-like-true-lie-7812cdfe9b85

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Define & treat various hypotheses to mitigate the inherent risks in product innovations	L1: Remembering
CO2	Design the solution concept based on the proposed value by exploring various alternate solutions to achieve value-price fit.	L6: Creating
CO3	Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching.	L3: Applying
CO4	Apply system thinking to reverse engineer a product/prototype and understand its internal correlations.	L3: Applying

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	3	2	1	1	1	1	1	1	1	2	2	3
CO2	2	2	3	2	2	1	1	1	1	1	1	1	3	3	2
CO3	1	2	2	1	1	3	1	1	3	3	1	1	1	1	1
CO4	2	3	3	3	3	2	2	1	2	2	1	1	3	3	3
AVG	**1.75**	**2.5**	**2.5**	**2.25**	**2**	**1.75**	**1.25**	**1**	**1.75**	**1.75**	**1**	**1**	**2.25**	**2.25**	**2.25**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22PSOE02	STARTUP FUNDAMENTALS			Semester		VI
PREREQUISITES		Category	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Learn the science of to transforming an innovative idea into high-growth enterprises.
2	To understand the basic concepts of IPR, and develop a patent draft for a potential IP

Unit I	ENTREPRENEURIAL MINDSET & METHOD	9	0	0	9

Introduction to Innovation-led, tech-powered entrepreneurship - Understand from research the attributes of an expert entrepreneur - Effectuation principles - Dealing with the unknowns - Case studies of startup failures.

Unit II	IDEA TO ENTERPRISE	9	0	0	9

Design and Planning of Product Concept - Business Model - Business Planning - Building Proof of Product and Value Testing - Target Market and Revenue Planning

Unit III	MINIMUM VIABLE BUSINESS	9	0	0	9

Framework for Minimum Viable Business - Disruptive Innovation - Theory of Disruption - Competitive advantage - Building proof of viable business model - Demystifying Scalability - Funding Opportunities

Unit IV	INTELLECTUAL PROPERTY	9	0	0	9

Introduction and the need for Intellectual Property Rights - IPR Genesis and Development - Copyright - Trademark - Trade Secret - Geographical Indicators - Industrial Designs - Types of Patent – Sample Patent Application - IPR in INDIA; Global trends - Patent fees

Unit V	PRIOR ART SEARCH AND PATENT DRAFTING	9	0	0	9

Prior Art Search - IP Licensing – IP Commercialization - IP Infringement- Case Study on Apple vsSamsung, Case study on basmati rice.

The invention as a concept - Keywords formation - Structure of patent - Key attributes in patent drafting -Drafting provisional specifications - Drafting complete specifications - Draft claims - Case studies onpatent drafting

Total = 45 Periods

Text Books:

1	Steven Blank and Bob Dorf, (2012), The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, K&S Ranch
2	Dr Saras Sarasvathy, (2008), Effectuation: Elements of Entrepreneurial Expertise, New Horizons in Entrepreneurship series.
3	Elizabeth Verkey, (2005), Law of Patents, Eastern Book Company
4	Prabuddha Ganguli, (2017), Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education; 1st edition

Reference Books:

1	WIPO Intellectual Property Handbook https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
2	https://assets.entrepreneur.com/static/20220301113822-Marketing.pdf
3	https://www.deluxe.com/blog/startup-fundamentals-guide/
4	https://www.forbes.com/sites/allbusiness/2018/07/15/35-step-guide-entrepreneurs-starting-a-business/?sh=69a6031e184b

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop an entrepreneurial mindset to identify, assess, shape & act on opportunities.	L3: Applying
CO2	Demonstrate the potential of an innovative idea to create economic value, as a startup	L2: Understanding
CO3	Understand the scientific process to explore a viable business model	L2: Understanding
CO4	Demonstrate knowledge on the fundamental concepts of Intellectual Property	L2: Understanding

COURSE ARTICULATION MATRIX

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	1	1	2	1	2	2	2	3	3	1	1	2
CO2	2	2	3	1	1	1	1	2	2	1	3	2	2	2	2
CO3	1	2	2	2	1	1	1	1	1	1	3	2	1	1	1
CO4	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1
AVG	**1.25**	**1.75**	**2**	**1.25**	**1**	**1.25**	**1**	**2**	**1.5**	**1.25**	**2.5**	**2**	**1.25**	**1.25**	**1.5**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22PSOE03	PROTOTYPE DEVELOPMENT			Semester		VI
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Learn to design a UI/UX design and develop an android application.
2	Provide working CAD model for prototype development.
3	Knowledge in hardware, 3D Printers and Laser cutters.
4	Acquire basic knowledge in designing electrical circuits and fabrication of electronic devices.

Unit I	**UI/UX**	**9**	**0**	**0**	**9**

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Colour theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives

Unit II	**APP DEVELOPMENT**	**9**	**0**	**0**	**9**

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

Unit III	**INDUSTRIAL DESIGN**	**9**	**0**	**0**	**9**

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing

Unit IV	**MECHANICAL RAPID PROTOTYPING**	**9**	**0**	**0**	**9**

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - **Mechanical Prototyping:** 3DPrinting and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

Unit V	**ELECTRICAL RAPID PROTOTYPING**	**9**	**0**	**0**	**9**

Electronic Prototyping: Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

Total = 45 Periods

Text Books:

1	Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)
2	Samar Malik, Autodesk Fusion 360 - The Master Guide.
3	Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition (2014)

E - References:

1	https://www.adobe.com/products/xd/learn/get-started.html
2	https://developer.android.com/guide
3	https://help.autodesk.com/view/fusion360/ENU/courses/
4	https://help.prusa3d.com/en/category/prusaslicer_204

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Create quick UI/UX prototypes for customer needs	L6: Creating
CO2	Develop web application to test product traction / product feature	L3: Applying
CO3	Develop 3D models for prototyping various product ideas	L3: Applying
CO4	Built prototypes using Tools and Techniques in a quick iterative methodology	L3: Applying

COURSE ARTICULATION MATRIX

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	2	3				1	1			2	1	1
CO2	3	3	3	2	3				1	1			3	2	2
CO3	3	2	3	2	3				1	1			3	2	2
CO4	3	2	3	2	3				1	1			3	2	2
AVG	**2.75**	**2.25**	**3**	**2**	**3**				**1**	**1**			**2.75**	**1.75**	**1.75**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22PSEE01	ROBOTICS				Semester		VI
PREREQUISITES			**Category**	**EE**	**Credit**		**3**
			Hours/Week	**L**	**T**	**P**	**TH**
				0	**0**	**6**	**3**

Course Learning Objectives	
1	Learn the fundamentals of ROS
2	Understand the requirements and choose the right sensors and actuators for the application development
3	Create Bot in the virtual environment and simulate it to know the functionalities of the system developed
4	Learn the basics of Robotics Vision System
5	Integrate ROS and Computer Vision to build systems for various use cases

Unit I	**INTRODUCTION TO ROBOT KINEMATICS**	**9**	**0**	**0**	**9**
Introduction to Robotics - Transformations - Forward Kinematics - Kinematics equations - Link transformations - Inverse Kinematics - Kinematic analysis - Numerical Inverse Kinematic Solutions - Analytical Inverse Kinematic Solutions					
Unit II	**SELECTION OF SENSORS AND ACTUATORS**	**9**	**0**	**0**	**9**
Introduction - Sensors & Actuators - Types - Selection criteria - Design considerations: Motor sizing - Selection of motors based on torque and speed characteristics - Hardware Interface & Assembly					
Unit III	**INTRODUCTION TO ROBOT OPERATING SYSTEM**	**9**	**0**	**0**	**9**
Introduction to ROS framework and prerequisites - Understanding communications in ROS - ROS Ecosystem - Introduction to ROS programming - ROS nodes, topics, messages - ROS services - ROS Tools and Utilities - URDF , Rviz - Simulation - Gazebo - ROS Motion					
Unit IV	**INTRODUCTION TO ROBOTICS VISION SYSTEM**	**9**	**0**	**0**	**9**
Image basics - Image Processing - Histograms - Gray scale, Color, Equalization - Smoothing andblurring/filtering - Averaging, Gaussian, Median, Bilateral - Thresholding - Simple, Adaptive, Otsu -Gradients and Edge detection - Laplacian, Sobel, Canny - Contours - Camera calibration					
Unit V	**INTEGRATION OF ROS AND COMPUTER VISION**	**9**	**0**	**0**	**9**
Introduction - Installation - CV Bridge - Image publisher node - Image subscriber node - Nodes buildingand launching - Building real world applications					
Total = 45 Periods					

Text Books:	
1	Introduction to Robotics: Mechanics and Control by John J Craig, Pearson Publishers.
2	Robot Operating System (ROS) for Absolute Beginners by Lentin Joseph, A press; Publishers (2018).
3	Learning OpenCV by Gary Bradski, Adrian Kaehler, O'Reilly Media, Inc.

Reference Books:	
1	https://www.intechopen.com/chapters/379
2	https://www.plantengineering.com/articles/eight-selection-criteria-for-actuation-components/
3	https://www.controleng.com/articles/tips-on-sensor-selection/
4	https://www.toptal.com/robotics/introduction-to-robot-operating-system
5	https://www.thomasnet.com/articles/automation-electronics/machine-vision-systems/
6	https://automaticaddison.com/working-with-ros-and-opencv-in-ros-noetic/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand kinematics considerations of robot	L2: Understanding
CO2	Selection of sensors and actuators according to application	L3: Applying
CO3	Utilize the ROS environment to simulate and communicate between robot	L3: Applying
CO4	Develop algorithms to extract features and data from image	L3: Applying
CO5	Utilize the open CV for robotic applications	L3: Applying

COURSE ARTICULATION MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2								3	3	2
CO2	3	3	2	1	2								3	3	3
CO3	3	2	3	2	3								3	3	3
CO4	3	3	3	2	3								3	3	2
AVG	**3**	**2.5**	**2.75**	**1.5**	**2.5**								**3**	**3**	**2.5**

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22CS701	CRYPTOGRAPHY AND NETWORK SECURITY				SEMESTER VII	
PREREQUISITES		**CATEGORY**	**PC**	**Credit**		**3**
Computer Networks		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

ourse Objectives:

1.	To understand the concepts of Cryptography Theories, Algorithms and Systems.
2.	To understand necessary Techniques and approaches to build secure mechanism in order to protect computer networks.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Security Trends - The OSI Security Architecture - Security Attacks -Security Services- Security Mechanisms - A model for Network Security- Classical Encryption techniques: Symmetric Cipher Model, Substitution Techniques - Transposition Techniques and Steganography.					
UNIT II	**SYMMETRIC KEY CRYPTOGRAPHY**	**9**	**0**	**0**	**9**
Mathematics of Symmetric Key Cryptography: Groups, Rings and Fields - Modular arithmetic-The Euclidean algorithm- Finite fields – Polynomial Arithmetic. Symmetric Key Cipher: Block Cipher Principles - Data Encryption Standard - Advanced Encryption Standard-Block Cipher Modes of Operation - RC4.					
UNIT III	**PUBLIC KEY CRYPTOGRAPHY**	**9**	**0**	**0**	**9**
Mathematics of Asymmetric Key Cryptography: Prime Numbers-Fermat's and Euler's Theorems -Testing of Primality - Euler 's totient function - Chinese Remainder Theorem -Discrete logarithms. Asymmetric Key Ciphers: Principles of Public Key Cryptosystems - The RSA Algorithms- Key Management – Diffie Hellman key exchange - Elliptic curve arithmetic-Elliptic curve cryptography.					
UNIT IV	**MESSAGE AUTHENTICATION AND APPLICATIONS**	**9**	**0**	**0**	**9**
Authentication Requirements- Authentication Functions- Message Authentication Codes - Hash Functions- Security of Hash functions and MACs- Secure Hash Algorithm - Digital signature -Authentication protocols -Digital Signature Standard. Authentication Applications: Kerberos - X.509 Authentication Service.					
UNIT V	**NETWORK SECURITY APPLICATIONS AND SYSTEM SECURITY**	**9**	**0**	**0**	**9**
Electronic Mail Security: Pretty Good Privacy, S/MIME. IP security: IP Security Overview - IP Security Architecture - Authentication Header - Encapsulating Security Payload. Web Security: Secure Socket Layer and Transport Layer Security - Secure Electronic Transaction. System Security: Intruders - Malicious software - Firewalls.					
					Total(45L)=45Periods

Text Book:

1.	William Stallings, "Cryptography and Network Security – Principles and Practices", Fourth Edition, 2006.

Reference Books:

1.	AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
2.	Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.

COURSEOUTCOMES: Upon completion of the course,the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the fundamentals of Network Security, Security Architecture and Various Encryption Techniques	Understand
CO2	Apply various cryptographic operations of Symmetric key and Asymmetric key Cryptography Algorithms	Apply
CO3	Apply various Authentication schemes to simulate different applications.	Apply
CO4	Understand the concept of Network security applications and System security standards.	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	-	3	3	-	-	-	-	2	2	3	3
CO2	3	3	3	-	3	3	-	-	-	-	2	2	3	2
CO3	3	3	3	-	3	3	-	-	-	-	2	2	3	3
CO4	3	3	3	-	3	3	-	-	-	-	2	2	3	3
Avg	**3**	**2.8**	**3**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**2.8**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CS702	PYTHON PROGRAMMING AND FRAMEWORKS				SEMESTER VII	
PREREQUISITES		CATEGORY	PC	Credit		3
Nil		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To Understand the basic concepts of Python programming.
2.	To Write programs using functions and different data structures.
3.	To Implement object oriented programming concepts.
4.	To Perform CRUD operations using cursor attributes.
5.	To Make use of python frameworks to provide data visualization.

UNIT I	BASICS CONCEPTS	9	0	0	9

Introduction - Variable, Expressions and Statements – Functions – Case Study: Interface Design – Conditional and recursion – Fruitful Functions: return values, parameters, local and global scope, function composition – Iteration Statements.

UNIT II	DATA STRUCTURES	9	0	0	9

Mutable vs immutable data types - Strings – String slices – Searching – looping and Counting – String methods – Case Study : word play – Lists – List operations, slices and methods- Dictionaries – Tuples – Case Study : Data Structure Selection – Files – Exception handling.

UNIT III	OBJECT ORIENTED PROGRAMMING	9	0	0	9

Classes and Objects–Classes and Functions – Classes and methods: Object-oriented features – __init__() method - __str__() method – Operator Overloading – Type-based dispatch– Polymorphism – Inheritance – Aggregation and Association.

UNIT IV	DATABASE INTEGRATION, ENVIRONMENT AND FRAMEWORKS	9	0	0	9

Python Database Integration: Need for database programming – Connect SQL Database – CRUD operations – Cursor Attributes. Python Environment and Frameworks: Anaconda – Jupyter notebook - NumPy: NumPy Arrays – Computation on NumPy Arrays – Aggregation – Sorting Arrays – Structured Arrays

UNIT V	DATA VISUALIZATION WITH PANDAS	9	0	0	9

Pandas Objects – Data Indexing and Selection – Operating on data – Handling missing data - Hierarchical Indexing – Concat and Append – Merge and Join –Aggregation and Grouping - Matplotlib: Line plots – Scatter Plots – Visualizing Errors – Density and Contour plots –Three Dimensional Plotting

Total(45L)=45Periods

Text Books:

1.	Allen B.Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, O'Reilly Media, 2016 for Units I,II,III.
2.	Jake Vander Plas, "Python Data Science Handbook Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016 for Units IV,V.

Reference Books:

1.	Bill Lubanovic, "Introducing Python Modern Computing in Simple Packages", 1st Edition, O'Reilly Media, 2014.

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom'sTaxonomy Mapped**
CO1	Understand the basic concepts of Python programming	Understand
CO2	Write programs using functions and different data structures	Apply
CO3	Implement object oriented programming concepts	Apply
CO4	Perform CRUD operations using cursor attributes	Apply
CO5	Make use of python frameworks to provide data visualization	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	1		1				3	3	3	2
CO2	3	3	3	2	1		1				3	3	3	2
CO3	3	3	3	2	1		1				3	3	3	2
CO4	3	3	3	2	1		1				3	3	3	2
CO5	3	3	3	2	1		1				3	3	3	2
Avg	**3**	**3**	**3**	**2**	**1**		**1**				**3**	**3**	**3**	**2**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CS703	MACHINE LEARNING					SEMESTER VII
PREREQUISITES		**CATEGORY**	**PC**	**Credit**		**3**
Statistics, Probability, Linear Algebra, Calculus, Programming Languages		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand machine learning basics.
2.	To comprehend the learning methods

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Data – Learning – Types of machine Learning – Supervised Learning – Machine Learning Process – Terminologies in machine learning – Testing Machine Learning Algorithms – Tuning data into probabilities – Some basic statistics –Bayes Classifier.					
UNIT II	**ARTIFICIAL NEURAL NETWORKS**	**9**	**0**	**0**	**9**
The brain and the neuron – neural networks – Perceptron – Linear Separability – Linear regression – Multilayer perceptron – Back propagation of errors - Multilayer perceptron in practice and its applications – Recipe for using Multilayer perceptron.					
UNIT III	**RADIAL BASIS FUNCTIONS, SPLINES AND DIMENSIONALITY REDUCTION**	**9**	**0**	**0**	**9**
Receptive fields – Radial basis function network – Interpolation and basis functions – Linear discriminant analysis – Principal component analysis and its relation to Multilayer perceptron – Kernel Principal component analysis – Factor analysis – Independent component analysis – Locally linear embedding – Isomap.					
UNIT IV	**IPROBABILISTIC LEARNING AND SUPPORT VECTOR MACHINES**	**9**	**0**	**0**	**9**
Gaussian mixture models – The Expectation-Maximization algorithm - Nearest neighbor methods – Nearest neighbor smoothing – efficient distance computation - distance measures – Support vector machine – optimal separation – kernels – Support vector machine algorithm – Extensions to Support vector machines.					
UNIT V	**TREE AND ENSEMBLE LEARNING**	**9**	**0**	**0**	**9**
Decision Trees – constructing decision trees – classification and regression trees – Applications of tree learning –Ensemble Learning –Boosting– Bagging – Random forests – Ways to combine classifiers.					
					Total(45 L)=45Periods

Text Books	
1.	Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Chapman and Hall/CRC Press, Second Edition, 2014
2.	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020
Reference Books:	
1.	Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, First Indian Edition, 2017.
2.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3.	Richard O. Duda, Peter E. Hart and David G. Stork. "Pattern Classification", Wiley, Second Edition, 2007.
4.	Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2006.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the machine learning fundamentals	Apply
CO2	Apply the learning techniques	Apply

COURSE ARTICULATIONMATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	3	2	2							1	1	2
CO2	1	3	3	2	2							1	3	3
Avg	**1**	**3**	**3**	**2**	**2**							**1**	**2**	**2.5**

3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)

22CS704	MOBILE COMPUTING					SEMESTER VII
PREREQUISITES		CATEGORY	PC	Credit		3
Computer Networks		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To understand the basic concepts of mobile computing
2.	To familiarize with the network protocol stack
3.	To acquire the basics of mobile telecommunication system
4.	To expose the Adhoc networks
5.	To gain the knowledge about different mobile platforms and application development

UNIT I	INTRODUCTION	9	0	0	9

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT II	MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER	9	0	0	9

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

UNIT III	MOBILE TELECOMMUNICATION SYSTEM	9	0	0	9

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS)

UNIT IV	MOBILE ADHOC NETWORKS	9	0	0	9

Adhoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Adhoc networks (VANET) – MANET Vs VANET – Security.

UNIT V	MOBILE PLATFORMS AND APPLICATIONS	9	0	0	9

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M-Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Total (45 L) =45Periods

Text Books:

1.	Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt. Ltd, New Delhi – 2012.

Reference Books:

1.	Jochen H. Schller, “Mobile Communications”, Second Edition, Pearson Education, New Delhi, 2007
2.	Dharma Prakash Agarval, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.
3.	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.
4.	William.C.Y.Lee,“Mobile Cellular Telecommunications-Analog and Digital Systems”, Second Edition,Tata Mc Graw Hill Edition ,2006.
5.	C.K.Toh, “AdHoc Mobile Wireless Networks”, First Edition, Pearson Education, 2002.
6.	Android Developers : http://developer.android.com/index.html
7.	Apple Developer : https://developer.apple.com/
8.	Windows Phone Dev Center : http://developer.windowsphone.com 9. BlackBerry Developer : http://developer.blackberry.com/

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basics of mobile telecommunication system	Understand
CO2	Analyze the various issues in different layers and provide suitable solutions.	Analyze
CO3	Understand mobile platform and develop mobile applications	Apply

COURSE ARTICULATIONMATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	2	2	1					2	2	1	2
CO2	2	2	3	2	2	1					2	2	1	2
CO3	2	2	3	2	2	1					2	2	1	2
Avg	**2**	**2**	**3**	**2**	**2**	**1**					**2**	**2**	**1**	**2**

3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)

22MG701	PRINCIPLES OF MANAGEMENT					SEMESTER VII
PREREQUISITES		**CATEGORY**	**HS**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To enable the students to study the various theories, processes, and functions of management.
2.	To apply theories to a business environment and planning process.
3.	To create a organization structure with effective process.
4.	To identify leadership roles in organizations.
5.	To describe elements of the communication process and processes of controlling and techniques.

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9	0	0	9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers -managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II	PLANNING	9	0	0	9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III	ORGANISING	9	0	0	9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority –centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV	DIRECTING	9	0	0	9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership –communication – process of communication – barrier in communication – effective communication–communication and IT.

UNIT V	CONTROLLING	9	0	0	9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

Total =45 Periods

Text Books:

1.	Harold Koontz & Heinz Weihrich ―Essentials of management‖ Tata McGraw Hill, 11th Edition, 2020.
2.	Stephen P. Robbins & Mary Coulter, ―Management‖, Prentice Hall (India) Pvt. Ltd., 15th Edition,2020.
3.	JAF Stoner, Freeman R.E and Daniel R Gilbert ―Management‖, Pearson Education, 6th Edition, 2018.

Reference Books:

1.	Tripathy PC & Reddy PN, ―Principles of Management‖, Tata McGraw Hill, 2021.
2.	Stephen A. Robbins & David A. Decenzo & Mary Coulter, ―Fundamentals of Management‖Pearson Education, 7th Edition, 2011.

3.	Robert Kreitner & Mamata Mohapatra, ― Management‖, Biztantra, 2008.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the evolution of management, its Principles, types, current trends and issues in management.	Understand
CO2	Have a conceptual knowledge about the planning and decision making	Understand
CO3	Apply the concept of organising for the effective functioning of management.	Apply
CO4	Evaluate leadership style to anticipate the consequences of each leadership style	Evaluate
CO5	Analyze the techniques for controlling and coordination	Analyze

COURSE ARTICULATIONMATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1					1			2	1	1	2			2
CO 2					1			2	1	1	2			2
CO 3					1			2	1	1	2			2
Avg					**1**			**2**	**1**	**1**	**2**			**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CS705	MACHINE LEARNING LABORATORY			SEMESTER VII			
PREREQUISITES			**CATEGORY**	**PC**	**Credit**		**2**
Machine learning, Python Programming			**Hours/Week**	**L**	**T**	**P**	**TH**
				0	**0**	**4**	**4**

Course Objectives:

1.	To understand how to build/use machine learning models.
2.	To understating the methods for reporting machine learning model performance.

EXPERIMENTS

1. Implement Bayesian classifier to build model for classification task and compute the accuracy of the classifier.
2. Implement naïve Bayesian classifier to build model for classification task and compute the accuracy of the classifier.
3. Implement classification task with perceptron learning algorithm.
4. Implement classification task using multilayer perceptron with back propagation algorithm.
5. Implement multilayer perceptron for prediction task.
6. Implement radial basis function network.
7. Implement principal component analysis to reduce the dimension of the feature space.
8. Implement independent component analysis for source separation.
9. Implement k-Nearest Neighbor algorithm to perform classification task.
10. Implement support vector machine.
11. Implement the decision tree algorithm for classification task.
12. Implement an ensemble classifier.

Total(60)=60 Periods

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Use or build machine learning models	Apply
CO2	Choose appropriate criteria to report machine learning model performance	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	3	2	2							1	3	3
CO2	1	3	3	2	2							1	1	2
Avg	**1**	**3**	**3**	**2**	**2**							**1**	**2**	**2.5**

3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)

22CS801	PROJECT WORK					SEMESTER VIII	
PREREQUISITES		**CATEGORY**	**EEC**	**Credit**		**7**	
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**	
			0	**0**	**14**	**14**	

The objective of project work is to enable the students, to work in convenient groups of not more than four members in a group, on a project involving some design and fabrication work or theoretical and experimental studies related to the respective engineering discipline.

Every project work shall have a Guide who is a member of the faculty of the University. Twelve periods per weeks shall be allotted in the Time Table for this important activity and this time shall be utilized by the student to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present periodical seminars of viva to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature-survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.

The continuous assessment and semester evaluation may be carried out as specified in the guidelines to be issued time to time.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Discover potential research areas in the field of Computer Science.	Analyze
CO2	Understand, Compare, and contrast the several existing solutions for the problems identified.	Understand
CO3	Formulate, and propose a plan for creating a solution for the research identified.	Create
CO4	Implementation of the solution as a team, take responsibility, and excel within a team both technically and ethically.	Apply
CO5	Interpret the results, and able to prepare report, present the findings of the work conducted.	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	2	1	3	3	3	3	3	3
CO2	3	3	3	2	3	2	2	1	3	3	3	3	3	3
CO3	3	3	3	2	3	2	2	1	3	3	3	3	3	3
CO4	3	3	3	2	3	2	2	1	3	3	3	3	3	3
CO5	3	3	3	2	3	2	2	1	3	3	3	3	3	3
Avg	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**3**	**3**	**3**	**3**	**3**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

PROFESSIONAL ELECTIVE COURSES

22CSPE101	SOFTWARE PROJECT MANAGEMENT					PE I
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Software Engineering		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the basic concepts of software project management and project planning
2.	To apply the project estimation, and evaluation techniques
3.	To implement the activity planning and project risk management
4.	To utilize the different techniques in monitoring and control of project
5.	To understand the behaviours and organization of people and team

UNIT I	**INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT**	**9**	**0**	**0**	**9**

Project Definition–Contract Management–Activities Covered By Software Project Management – Overview of Project Planning – Stepwise Project Planning.

UNIT II	**PROJECT EVALUATION**	**9**	**0**	**0**	**9**

Strategic Assessment – Technical Assessment – Cost Benefit Analysis – Cash Flow Forecasting–Cost Benefit Evaluation Techniques – Risk Evaluation.

UNIT III	**ACTIVITY PLANNING AND RISK MANAGEMENT**	**9**	**0**	**0**	**9**

Objectives – Project Schedule – Sequencing and Scheduling Activities –Network Planning Models – Forward Pass – Backward Pass – Activity Float – Shortening Project Duration – Activity on Arrow Networks – Risk Management – Nature of Risk – Types of Risk – Managing Risk – Hazard Identification – Hazard analysis –Risk Planning and Control.

UNIT IV	**MONITORING AND CONTROL**	**9**	**0**	**0**	**9**

Creating Framework – Collecting The Data – Visualizing Progress – Cost Monitoring – Earned Value –Prioritizing Monitoring – Getting Project Back ToTarget – Change Control –Managing Contracts–Introduction – Types Of Contract – Stages In Contract Placement – Typical Terms Of A Contract – Contract Management–Acceptance.

UNIT V	**MANAGING PEOPLE AND ORGANIZING TEAMS**	**9**	**0**	**0**	**9**

Introduction – Understanding Behavior – Organizational Behaviors A Background – Selecting The Right Person For The Job –Instruction In The Best Methods – Motivation –The Oldham–Hackman Job Characteristics Model–Working In Groups–Becoming A Team–Decision Making–Leadership–Organizational Structures –Stress –Health And Safety–Case Studies.

Total (45 L)=45 Periods

Text Books:

1.	Bob Hughes, Mikecotterell,"Software Project Management", Third Edition,TataMcGraw Hill, New Delhi, 2012.

Reference Books:

1.	Ramesh, Gopalaswamy,"Managing Global Projects",Tata Mc Graw Hill,2001.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Express the basic concepts of software project management and project planning	Understand
CO2	Apply the project estimation, and evaluation techniques	Apply
CO3	Apply the activity planning and project risk management	Apply
CO4	Apply the different techniques in monitoring and control of project	Apply
CO5	Understand the behaviours and organization of people and team	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			1	1				1	1	1	1
CO2	3	2	1			1	1				1	1	1	1
CO3	3	2	1			1	1				1	1	1	1
CO 4	3	2	1			1	1				1	1	1	1
CO 5	3	2	1			1	1				1	1	1	1
Avg	3	2	1			1	1				1	1	1	1
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE102	ARTIFICIAL INTELLIGENCE					PE I
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the fundamentals of Artificial Intelligence.
2.	To comprehend the problem-solving strategies in Artificial Intelligence
3.	To gain the knowledge about Agents

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Introduction to Artificial Intelligence – Definition – Foundations – History and the State-of-the-art – Intelligent Agents: Agents and Environment – Rationality – Nature of Environments – Structure of Agents.					
UNIT II	**PROBLEM SOLVING BY SEARCHING**	**9**	**0**	**0**	**9**
Problem solving agents – Problems with searching as solution – Searching for solutions – Uninformed search strategies – Informed search strategies – Heuristic functions.					
UNIT III	**PROBLEM SOLVING BY NON-CLASSICAL AND ADVANCED SEARCH**	**9**	**0**	**0**	**9**
Non-classical search: Local search Algorithms and Optimization Problems – Local search in continuous space – Searching with non-deterministic actions – Searching with partial observations – Online search agents and unknown environments – Advanced search: Games – Optimal decision in games – Alpha-beta pruning – Imperfect real time decisions – Stochastic games – Partially observable games – State-of-the-art game programs and alternative approaches.					
UNIT IV	**CONSTRAINT SATISFACTION PROBLEM**	**9**	**0**	**0**	**9**
Defining Constraint Satisfaction Problem (CSP) – Constraint propagation: Inference in CSP – Backtracking search for CSP – Local search for CSP – The structure of the problems.					
UNIT V	**LOGICAL AGENT**	**9**	**0**	**0**	**9**
Knowledge-based agents – The Wumpus world – Logic – Propositional Logic – Propositional theorem proving – Propositional model checking – Agents based on Propositional Logic.					
	Total (45 L)=45 Periods				

Text Books:	
1.	Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson, Fourth Edition, 2020
Reference Books:	
1.	David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010
2.	G. Luger, “Artificial Intelligence: Structures and Strategies for complex problemsolving”, Fourth Edition, Pearson Education, 2008.
3.	Nils J. Nilsson, ―The Quest for Artificial Intelligence, Cambridge University Press, 2009

COURSEOUTCOMES: Upon completion of the course,the students will be able to:		**Bloom’sTaxonomy Mapped**
CO1	Understand the fundamentals of Artificial Intelligence	Understand
CO2	Apply the problem-solving strategies in Artificial Intelligence	Apply
CO3	Design and demonstrate the behavior of a simple agent	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	2							1	2	2
CO2	3	3	3	2	2							1	2	2
CO3	3	3	3	2	2							1	2	2
Avg	**3**	**3**	**3**	**2**	**2**							**1**	**2**	**2**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE103	WEB TECHNOLOGY					PE I
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**C**
Java Programming		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand about client- server communication and protocols used during communication.
2.	To design interactive web pages using Scripting languages.
3.	To learn Server-side programming using Servlets and JSP.
4.	To develop web pages using XML / XSLT.

UNIT I	**WEB ESSENTIALS AND MARKUP LANGUAGES**	**9**	**0**	**0**	**9**

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients Web Servers-Case Study. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-XML Creating HTML Documents-Case Study.

UNIT II	**CSS AND CLIENT SIDE SCRIPTING**	**9**	**0**	**0**	**9**

Style Sheets: CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-Style Sheets and HTML Style Rule Cascading and Inheritance-Text Properties-Box Model-Normal Flow Box Layout- Beyond the Normal Flow-Other Properties-Case Study. Client-Side Programming: The JavaScript Language-History and Versions Introduction to JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators- Literals-Functions-Objects-Arrays-Built-in Objects - JavaScript Debuggers.

UNIT III	**HOST OBJECTS AND SERVER SIDE SCRIPTING**	**9**	**0**	**0**	**9**

Host Objects: Browsers and the DOM-Introduction to the Document Object Model DOM History and Levels- Intrinsic Event Handling-Modifying Element Style-The Document Tree-DOM Event Handling-Accommodating Noncompliant Browsers Properties of window-Case Study. Server-Side Programming: Java Servlets- Architecture -Overview-A Servlet-Generating Dynamic Content-Life Cycle- Parameter Data-Sessions- Cookies- URL Rewriting-Other Capabilities-Data Storage Servlets and Concurrency-Case Study- Related Technologies.

UNIT IV	**JSP and XML**	**9**	**0**	**0**	**9**

Separating Programming and Presentation: JSP Technology-Introduction-JSP and Servlets-Running JSP Applications Basic JSP-JavaBeans Classes and JSP-Tag Libraries and Files-Support for the Model-View-Controller Paradigm-Case Study-Related Technologies. Representing Web Data: XML-Documents and Vocabularies-Versions and Declaration- Namespaces JavaScript and XML: Ajax-DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML Documents in Browsers-Case Study-Related Technologies.

UNIT V	**AJAX AND WEB SERVICES**	**9**	**0**	**0**	**9**

AJAX: Ajax Client Server Architecture –XML Http Request Object –Call Back Methods. Web Services: JAX-RPC-Concepts-Writing a Java Web Service-Writing a Java Web Service Client-Describing Web Services: WSDL- Representing Data Types: XML Schema-communicating Object Data: SOAP Related Technologies-Software Installation-Storing Java Objects as Files.

Total (45 L) =45 Periods

Text Books:	
1.	Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2011.
Reference Books:	
1.	Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2012.
2.	Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Fifth Edition, Pearson Education, 2021.
3.	Marty Hall and Larry Brown, "Core Web Programming" Second Edition, Volume I and II, Pearson Education, Copyright 2010.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand about client- server communication and protocols used during communication.	Understand
CO2	Design of interactive Web pages using scripting languages.	Create
CO3	Implement the Servlet and Server side programs(JSP)	Apply
CO4	Develop web pages using XML / XSLT.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	1		1	1			2	2	3	2
CO 2	3	3	3	2	1		1	1			2	2	3	2
CO 3	3	3	3	2	1		1	1			2	2	3	2
Avg	**3**	**3**	**3**	**2**	**1**		**1**	1			**2**	**2**	**3**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSPE104	AGILE TECHNOLOGY					PE I		
PREREQUISITES		CATEGORY	PE	Credit		3		
NIL		Hours/Week	L	T	P	TH		
			3	0	0	3		

Course Objectives:

1.	To understand the internals of the Agile Project Development
2.	To know how Agile Project Development is actually implemented
3.	To understand the concepts of Scrum and Extreme Programming
4.	To understand the concepts of Unified Process and EVE

UNIT I	INTRODUCTION	9	0	0	9

Iterative and Evolutionary: Definition – Comparison - Major activities.
Agile: Basic concepts - Major activities - Available agile methods. **Story:** Overview-Estimated hours remaining**.**

UNIT II	MOTIVATION AND EVIDENCE	9	0	0	9

Motivation: Change on software projects – Key motivation-Requirement challenge –Problems of water fall.
Evidence: Research and early historical – Standard and though leader-Business case -Water fall validity.

UNIT III	SCRUM AND EXTREME PROGRAMMING	9	0	0	9

Scrum: Concepts, Method overview, Lifecycle, Work products, Roles and Practices, Values, Common mistakes and misunderstandings, Process Mixtures, Adaption Strategies, Fact versus Fantasy, Strength Versus Other, Sample Projects.
Extreme Programming: Concepts, Method overview, Lifecycle, Work products, Roles and Practices, Values, Common Mistakes and Misunderstandings, Sample Projects.

UNIT IV	UNIFIED PROCESS AND EVE	9	0	0	9

Unified Process: Concepts, Method overview, Lifecycle, Work products, Roles and Practices, Values, Common mistakes and misunderstandings, Process Mixtures, Adaption Strategies, Fact versus Fantasy, Strength Versus Other, and Sample Projects.
EVE: Concepts, Method overview, Lifecycle, Work products, Roles and Practices, Values, Common mistakes and misunderstandings, Process Mixtures, Adaption Strategies, Fact versus Fantasy, Strength Versus Other.

UNIT V	PROJECT MANAGEMENT	9	0	0	9

Practice Tips: Project – Management – Environment – Requirements – Tests - Frequently raised questions and answers.

Total (45 L)=45 Periods

Text Books:

1.	Craig Larman, “Agile and Iterative Development A Manger’s Guide” Pearson Education, First Edition, India, 2004.

Reference Books:

1.	Shore, “Art of Agile Development”, Shroff Publishers & Distributors, 2007
2.	Agile Software Development, Principles, Patterns and Practices, Robert C. Martin, Prentice Hall;1st edition,2002.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the internals of the Agile Project Development	Understand
CO2	Understand how to develop and manage Agile Project	Understand
CO3	Demonstrate the concepts of Scrum and Extreme Programming	Understand
CO4	Understand the concepts of Unified Process and EVE	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1			2	1	2			1			1			1
CO 2			2	1	2			1			1			1
CO 3			2	1	2			1			1			1
CO 4			1	1	1			1			1			1
Avg			**1.7**	**1**	**1.7**			**1**			**1**			**1**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSPE105	DATA MINING AND WAREHOUSING			PE I			
PREREQUISITES		**CATEGORY**		**PE**	**Credit**		**3**
Database Management Systems, Statistics, Programming Concepts & Data structures.		**Hours\Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To know the fundamentals of data mining and data warehouse concepts, architecture, business analysis.
2.	Be familiar with the algorithms for finding hidden and interesting patterns in data, and understand and apply various classification and clustering techniques using tools.
3.	Be aware about the recent trends of data mining.

UNIT I	DATA MINING	9	0	0	9
Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns –Classification of Data Mining Systems – Data Mining Task Primitives – Integration of a Data Mining System with a Data Warehouse – Issues – Data Preprocessing- Over view, Data cleaning, Data Integration and Transfermation data reduction, Data discretization and concept hierarchy generation.					
UNIT II	**DATA WAREHOUSING**	**9**	**0**	**0**	**9**
Basic concepts – Data Cube – Multidimensional Data Model – Data Warehouse Architecture -Data warehouse implementation – From Data Warehousing to Data Mining.					
UNIT III	**ASSOCIATION RULE MINING AND CLASSIFICATION**	**9**	**0**	**0**	**9**
Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining. Classification and Prediction,Issues, Decision Tree Induction, Bayesian Classification, Rule Based Classification, Classification by Backpropagation – Support Vector Machines - Other Classification Methods.					
UNIT IV	**CLUSTERING AND OUTLIER ANALYSIS**	**9**	**0**	**0**	**9**
Cluster Analysis - Types of Data – Categorization of Major Clustering Methods – K-means– PartitioningMethods – Hierarchical Methods - Density-Based Methods – Grid Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.					
UNIT V	**DATA MINING TRENDS**	**9**	**0**	**0**	**9**
Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Databases, Multimedia Databases, Time Series and Sequence Data, Text Databases, World Wide Web, Applications and Trends in Data Mining. Case studies involving classification and clustering.					
					Total (45 L)= 45 Periods

Text Books:

1.	Jiawei Han, Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann, Second Edition, 2011.

Reference Books:

1.	G. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, Third Edition, 2014.
2	David Hand, Heikki Manila, Padhraic Symth, “Principles of Data Mining”, PHI 2012.
3.	W.H.Inmon, “Building the Data Warehouse”, Third Edition, Wiley, 2011.

COURSE OUTCOMES Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the fundamentals of data mining and ware housing.	Understand
CO2	Develop association rule mining clustering and classification algorithms.	Apply
CO3	Apply new data mining techniques and concepts	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	2	3	2				2	3	2	3
CO 2	3	3	3	2	2	3	2				2	3	2	3
CO 3	3	3	3	2	2	3	2				2	3	2	3
Avg	**3**	**3**	**3**	**2**	**2**	**3**	**2**				**2**	**3**	**2**	**3**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSPE201	SOFTWARE QUALITY AND TESTING				PE II		
PREREQUISITES			**CATEGORY**	**PE**	**Credit**		**3**
Software Engineering			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To apply quality assurance steps at each phase of SDLC and conduct reviews and inspections
2.	To understand the concepts of metrics, and models in software quality assurance
3.	To develop the procedures and workbenches for various testing process.
4.	To apply various testing process to the software systems.

UNIT I	SOFTWARE QUALITY ASSURANCE AND REVIEW TECHNIQUES	9	0	0	9

Defining Quality – Importance of Quality –Quality Control Vs Quality assurance –Quality assurance at each phase of SDLC - Need for SQA group in an Organization. Structured walkthroughs –Inspections –Various roles and responsibilities involved in Inspections – Making review successful.

UNIT II	SOFTWARE MEASUREMENT AND METRICS	9	0	0	9

Product quality – Models for software product Quality – Process Quality Aspects. Measurement and Metrics: Introduction – Measurement during software life cycle context –Defect metrics – Metrics for software maintenance– Requirements related metrics – Measurements and process improvement – Measurement principles.

UNIT III	BASICS OF TESTING	9	0	0	9

Introduction – Definition– Testing Approaches – Essentials – features and principles of software Testing. Testing Environment: Assessing Capabilities – Staff Competency and User Satisfaction – Creating an environment supportive of software testing – Building the software testing process: Testing Guidelines.

UNIT IV	SOFTWARE TESTING PROCESS	9	0	0	9

Overview of Software Testing Process – Organizing for testing: Workbench – Input – Procedure. Developing the test plan:Workbench – Input – Procedure. Verification testing: Workbench – Input – Procedure. Validation testing :Workbench – Input – Procedure.

UNIT V	SOFTWARE TESTING PROCESS	9	0	0	9

Analyzing and reporting test results: Workbench – Input – Procedure. Testing software system security – Testing client/server systems – Testing web-based systems – Using Agile Methods to Improve Software Testing.

Total(45 L)=45 Periods

Text Books:

1.	Nina S. Godbole, "Software Quality Assurance Principles and Practice", 2 Edition, Narosa Publishing House, 2017 for Units I, II.
2.	Perry William, "Effective Methods for Software Testing", 3 Edition, Wiley, India, 2013 for Units III,IV,V.

Reference Books:

1.	Limaye M.G, "Software Testing - Principles, Techniques and Tools", 1 Edition, Tata McGraw-Hill, 2009.
2.	Mordechai Ben-Menachem, Garry S. Marliss, "Software Quality", 2 Edition, Vikas Publishing House Pvt. Ltd.,, New Delhi, 2014.

COURSE OUTCOMES: Upon completion of the course ,the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply quality assurance steps at each phase of SDLC and conduct reviews and inspections	Apply
CO2	Understand the concepts of metrics, and models in software quality assurance	Understand
CO3	Develop the procedures and workbenches for various testing process.	Apply
CO4	Apply various testing process to the software systems.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO4**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2										2	1
CO2	2	2	2										2	1
CO3	2	2	2										2	1
Avg	2	2	2										2	1

3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)

22CSPE202	BLOCKCHAIN TECHNOLOGIES				PE II		
PREREQUISITES		**CATEGORY**		**PE**	**Credit**		**3**
NIL		**Horus/Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	Acquiring the basic level of knowledge about the block chain technology and its business applications
2.	To familiarize with the decentralization and practical aspects of cryptography
3.	To provide conceptual understanding of bit coin technology, alternative coins and smart contracts
4.	Develop a distributed application using Ethereum.
5.	Develop an application using Hyper ledger.

UNIT I	**BLOCKCHAIN 101**	**9**	**0**	**0**	**9**
Distributed systems – The history of blockchain – Introduction to blockchain – definitions – elements – Features – Applications of blockchain technology – Tiers – Types of blockchain – Consensus in blockchain – CAP theorem – Benefits and limitations of blockchain.					
UNIT II	**DECENTRALIZATION, CRYPTOGRAPHY AND TECHNICAL FOUNDATIONS**	**9**	**0**	**0**	**9**
Introduction – Cryptography – Confidentiality – Integrity – Authentication – Cryptographic primitives – Asymmetric cryptography – Public and private keys – RSA – Discrete logarithm problem – Hash functions – Elliptic Curve Digital signature algorithm.					
UNIT III	**BITCOIN & ALTERNATIVE COINS**	**9**	**0**	**0**	**9**
Bitcoin – Transactions – Blockchain – Bitcoin payments – Alternative Coins – Theoretical foundations – Bitcoin limitations – Namecoin - Litecoin – Primecoin – Zcash – Smart Contracts.					
UNIT IV	**ETHEREUM 101**	**9**	**0**	**0**	**9**
Introduction – Ethereum blockchain – Elements of the Ethereum blockchain – Precompiled contracts – Accounts – Block – Ether – Messages – Mining - Clients and wallets – The Ethereum network –Ethereum Development.					
UNIT V	**HYPERLEDGER**	**9**	**0**	**0**	**9**
Projects- Protocol – Hyperledger fabric – Sawtooth lake – Corda – Blockchain – outside of currencies – Internet of Things – Government – Health –Finance.					
					Total(45 L)=45 Periods

Text Books:

1.	Imran Bashir, "Mastering Blockchain Distributed ledgers, decentralization and smart contracts Explained", Packt Publishing, 2017.

Reference Books:

1.	Brenn Hill, Samanyu Chopra & Paul Valencourt, "Blockchain Quick Reference: A guide to exploring decentralized blockchain application development", Packt, 2018
2.	Andreas Antonopoulos, "Mastering Bitcoin: Programming the open blockchain", 2nd Edition, O"Reilly Media, 2017.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Outline the history and different applications of blockchain	Understand
CO2	Illustrate decentralization and practical aspects of cryptography	Understand
CO3	Present bitcoin technology, alternative coins and smart contracts	Understand
CO4	Develop a distributed application using Ethereum	Apply
CO5	Develop an application using Hyperledger	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1		1								2	1
CO2	2	1	1		1								2	1
CO3	2	1	1		1								2	1
CO4	3	2	1		1								3	1
CO5	3	2	1		1								3	1
Avg	**2.4**	**1.4**	**1**		**1**								**2.4**	**1**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE203	PARALLEL COMPUTING ARCHITECTURE AND PROGRAMMING					PE II
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Computer Architecture, Programming Concepts		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To make use of the fundamental concept of the modern parallel architecture to build a simple parallel
2.	To design parallel algorithms and message passing interface methods
3.	To develop parallel algorithms for sieve and Floy's algorithm in various problems
4.	To study the performance of parallel algorithms using sorting algorithm

UNIT I	**PARALLEL ARCHITECTURES**	**9**	**0**	**0**	**9**

Motivation – Modern scientific method – Evolution of supercomputing – Modern parallel computers – Seeking concurrency – Data clustering – Programming Parallel computers. Parallel Architectures: Introduction – Interconnection networks – Processor Arrays – Multiprocessors – Multicomputer – Flynn‟s Taxonomy.

UNIT II	**PARALLEL ALGORITHM DESIGN**	**9**	**0**	**0**	**9**

Introduction – Task/Channel model – Foster‟s Design methodology – Boundary value problem – finding the maximum – The n-Body problem – Adding data input. Message-Passing Programming: Message-passing model – Message-passing interface – Circuit satisfiability – Introducing collective communication – Benchmarking parallel performance.

UNIT III	**THE SIEVE OF ERATOSTHENES**	**9**	**0**	**0**	**9**

Sequential algorithm – Sources of parallelism – Data Decomposition options – Developing the parallel algorithm – Analysis of parallel Sieve algorithm – documenting the parallel program. Floyd‟s Algorithm: The All-Pairs shortest path problem – Creating arrays at run time – Designing the parallel algorithm – Point-to-point communication – Documenting the Parallel program.

UNIT IV	**PERFORMANCE ANALYSIS**	**9**	**0**	**0**	**9**

Speedup and efficiency – Amdhal‟s Law – Gustafsan-Barsis‟s Law – The Karp-Flatt Metric – The Isoefficiency Metric. Sorting: Quick sort – A parallel quick sort – Hyper quick sort – parallel sorting by regular sampling.

UNIT V	**SHARED-MEMORY PROGRAMMING**	**9**	**0**	**0**	**9**

The Shared-memory model – Parallel for loops – Declaring private variables – Critical sections – Reductions – Performance Improvement – More general data parallelism – Functional parallelism. Combining MPI and OPenMP: Conjugate – Jacobi method.

Total (45 L)=45 Periods

Text Book:

1.	Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw Hill Education, India, 2013.

Reference Books:

1.	David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware/ Software Approach", Morgan Kaufmann, Elsevier, 2013.
2.	Munshi Aaftab,Gaster R. Benedict, "OpenCL Programming Guide", Addision-Wesley, 2011.

COURSE OUTCOMES: Upon completion of the course,the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the concept of parallel architecture models and parallel algorithms	Understand
CO2	Develop the parallel models and parallel algorithms for various problems	Apply
CO3	Analyses the performance of parallel algorithms	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO4	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1									2	1
CO2	3	2	1	1									2	1
CO3	3	2	1	1									2	1
Avg	**3**	**2**	**1**	**1**									**2**	**1**

3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)

22CSPE204	COMPUTER GRAPHICS AND MULTIMEDIA			PE II			
PREREQUISTIES			**CATEGORY**	**PE**	**Credit**		**3**
NIL			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To understand and design two-dimensional graphics and apply two dimensional transformations.
2.	To design three-dimensional graphics and apply three dimensional transformations.
3.	To be familiar with various software programs used in the creation and implementation of multi-media (interactive, motion/animation, presentation, etc.).
4.	To be familiar with hypermedia messaging and distributed multimedia systems.

UNIT I	INTRODUCTION	9	0	0	9

Survey of computer graphics - Video display devices, Raster scan systems - Random scan systems, Graphics monitors and Workstations - Graphics Software.

Output Primitives: Points and Lines - Line Drawing Algorithms (DDA Algorithm, Bresenham's Line Algorithm), Circle generating algorithms.

UNIT II	TWO-DIMENSIONAL GRAPHICS	9	0	0	9

Basic Transformations - Matrix representations and homogeneous coordinates - Composite Transformations- Other Transformations- The viewing pipeline - Viewing coordinate reference frame - Window-to-viewport coordinate transformation.

Clipping: Clipping operations - Point clipping - Line clipping (Cohen Sutherland algorithm, Liang Barsky algorithm) - Polygon Clipping (Sutherland-Hodgeman Algorithm) - Curve Clipping - Text Clipping.

UNIT III	THREE-DIMENSIONAL GRAPHICS	9	0	0	9

Three-Dimensional Object Representations: Polygon surfaces - Quadric surface - Spline representation - Bezier Curves and surfaces - B-spline curve and surfaces.

Three dimensional Geometric and Modeling Transformations: Translation – Rotation – Scaling - Composite Transformation. Three-Dimensional viewing: Viewing Pipeline - Viewing Coordinates -Projections (Parallel and Perspective).

UNIT IV	MULTIMEDIA SYSTEM DESIGN AND MULTIMEDIA FILE HANDLING	9	0	0	9

Multimedia basics − Multimedia applications − Multimedia system architecture − Evolving technologies for multimedia − Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases. Compression and decompression − Data and file format standards − Multimedia I/O technologies
− Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies.

UNIT V	HYPERMEDIA	9	0	0	9

Multimedia authoring and user interface – Hypermedia messaging -Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated multimedia message standards − Integrated document management − Distributed multimedia systems.

Total(45 L)=45 Periods

Text Books:

1.	Donald Hearn and Pauline Baker M, “Computer Graphics", Prentice Hall, New Delhi, 2007.(Unit I - III).
2.	Andleigh, P. K and Kiran Thakrar, “Multimedia Systems and Design”, PHI, 2003.(Unit IV & V)

Reference Books:

1.	John F. Hughes, Andries Van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner and Kurt Akeley, ”Computer Graphics: Principles and Practice”, , 3rd Edition, Addison Wesley Professional,2013.
2.	Donald Hearn and M. Pauline Baker, Warren Carithers, “Computer Graphics With Open GL”, 4th Edition, Pearson Education, 2010.
3.	Judith Jeffcoate, “Multimedia in practice: Technology and Applications”, PHI, 1998.

COURSE OUTCOMES: Upon completion of the course,the students will be able to:		**Bloom'sTaxonomy Mapped**
CO1	Design two-dimensional and three dimensional graphics	Create
CO2	Apply transformation in two- dimentional and three – dimension objects	Apply
CO3	Design applications using multimedia and hypermedia	Create

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	3	-	-	-	-	2	-	2	3	1
CO2	3	3	3	-	3	-	-	-	-	2	-	2	3	1
CO3	2	3	2	2	3	2	-	-	-	2	2	2	1	2
Avg	**2.7**	**3**	**2.7**	**2**	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**2.3**	**1.3**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSPE205	OBJECT ORIENTED ANALYSIS AND DESIGN					PE II
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the fundamentals of object modelling.
2.	To understand and differentiate Unified Process from other approaches.
3.	To design with static UML diagrams.
4.	To design with the UML dynamic and implementation diagrams
5.	To map the design properly to code

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

The system life cycle - Traditional life cycle models - The object-oriented approach - The Rational Unified Process (RUP) - The Unified Modeling Language (UML) - UML models - Introduction to the case study - Requirements for the Wheels case study system - Requirements engineering - Requirements elicitation – List of requirements for the Wheels system - Use cases - Use case diagram - Use case descriptions- Actors and actor descriptions - Use case relationships: communication association, include and extend - Boundary -Using the use case model in system development.

UNIT II	**OBJECTS AND CLASSES**	**9**	**0**	**0**	**9**

Basics – Object – classes - Relationships between classes - The class diagram - Stages in building a class diagram - Packages - Using the class diagram in system development.

UNIT III	**IDENTIFYING FUNCTIONALITIES**	**9**	**0**	**0**	**9**

Introduction - CRC cards and interaction diagrams - Identifying operations using the CRC card technique - Interaction diagrams - Specifying operations - Using the CRC cards and interaction diagrams in system development - State Diagrams - States and events - Constructing a state diagram - Using state diagrams in system development.

UNIT IV	**ACTIVITY DIAGRAMS**	**9**	**0**	**0**	**9**

Introduction - Modeling a sequence of activities - Modeling alternative courses of action - Modeling iteration of activities - Modeling activities that are carried out in parallel – Swimlanes - Design - Architecture - Implementation diagrams The user interface Dealing with persistent data.

UNIT V	**DESIGNING OBJECTS AND CLASSES**	**9**	**0**	**0**	**9**

Introduction - class diagram - Interaction diagrams. Implementation of class diagram - The code – Sequence diagram.

Total (45 L)= 45 Periods

Text Book:

1.	Carol Britton and Jill Doake, “A Student Guide to Object - Oriented Development”, Elsevier, Butterworth – Heinemann, Eighth edition, 2007.

Reference Books:

1.	Brett McLaughlin, Gary Pollice and David West, “Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D”, O’Reilly, Shroff Publishers & Distributors Pvt. Ltd., 2008.
2.	Mahesh P. Matha, “Object Oriented Analysis and Design using UML”, Prentice-Hall of India, 2008.

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify various scenarios based on software requirements	Apply
CO2	Express software design with UML diagrams	Understand
CO3	Understand the various testing methodologies for OO software	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2						2	2	2	2
CO2	3	2	3	2	2						2	2	2	2
CO3	3	2	3	2	2						2	2	2	2
Avg	**3**	**2**	**3**	**2**	**2**						**2**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSPE301	SERVICE ORIENTED ARCHITECTURE				PE III			
PREREQUISTIES			**CATEGORY**		**PE**	**Credit**		**3**
NIL			**Hours/Week**		**L**	**T**	**P**	**TH**
					3	**0**	**0**	**3**

Course Objectives:

1.	Learn fundamentals of XML
2.	Provide an overview of Service Oriented Architecture and Web services and their importance
3.	Learn web services standards and technologies
4.	Learn service oriented analysis and design for developing SOA based applications

UNIT I	XML	9	0	0	9
XML document structure – Well-formed and valid documents – DTD – XML Schema – Parsing XML using DOM, SAX – XPath - XML Transformation and XSL – Xquery					
UNIT II	**SERVICE ORIENTED ARCHITECTURE (SOA) BASICS**	**9**	**0**	**0**	**9**
Characteristics of SOA, Benefits of SOA , Comparing SOA with Client-Server and Distributed architectures –-- Principles of Service Orientation – Service layers					
UNIT III	**WEB SERVICES (WS) AND STANDARDS**	**9**	**0**	**0**	**9**
Web Services Platform – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Service-Level Interaction Patterns – Orchestration and Choreography					
UNIT IV	**WEB SERVICES EXTENSIONS**	**9**	**0**	**0**	**9**
WS-Addressing - WS-Reliable Messaging - WS-Policy – WS-Coordination – WS -Transactions - WS-Security – Examples					
UNIT V	**SERVICE ORIENTED ANALYSIS AND DESIGN**	**9**	**0**	**0**	**9**
SOA delivery strategies – Service oriented analysis – Service Modelling – Service oriented design – Standards and composition guidelines -- Service design – Business process design					
					Total (45 L)= 45 Periods

Text Books:

1.	Thomas Erl, ― Service Oriented Architecture: Concepts, Technology, and Design‖, Pearson Education, 2005
2.	Sandeep Chatterjee and James Webber, ―Developing Enterprise Web Services: An Architect's Guide‖, Prentice Hall, 2004

Reference Books:

1.	James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, ―Java Web Services Architecture‖, Elsevier, 2003
2.	Ron Schmelzer et al. ― XML and Web Services‖, Pearson Education, 2002
3.	Frank P.Coyle, ―XML, Web Services and the Data Revolution‖, Pearson Education, 2002

E-Reference:

1	https://www.coursera.org/lecture/python-network-data/video-service-oriented-architectures-0CpCx

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand XML technologies	Understand
CO2	Understand service orientation, benefits of SOA	Understand
CO3	Understand web services and WS standards	Understand
CO4	Use web services extensions to develop solutions	Apply
CO5	Understand and apply service modeling, service oriented analysis and design for application development	Create

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	1	3	1					1			1		3	1
CO2	1	3	3					1			1		3	1
CO3	1	3	2					1			1		3	1
CO4	1	3	2					1			1		3	1
CO5	1	3	3					1			1		3	1
Avg	**1**	**3**	**2.2**					**1**			**1**		**3**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22CSPE302	OPEN-SOURCE TECHNOLOGIES					PE III
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the fundamentals of open-source technologies
2.	To comprehend the open-source software development process

UNIT I	**INTRODUCTION, PRINCIPLES AND METHODOLOGIES**	**9**	**0**	**0**	**9**

Open-source software (OSS) – Need and Requirements for OSS – OSS success – Free Software – Free Vs. Proprietary Software – Free Software Vs. Open-Source Software – Public Domain – Open-source Standards – Principles – Methodologies – Software freedom – Open-Source Software Development– Open-Source Initiatives– FOSS – GNU Project

UNIT II	**OPEN-SOURCE ETHICS AND LICENSING**	**9**	**0**	**0**	**9**

Ethics in Open-source – Social and Financial impacts of open-source technology – Shared software – Shared source – Open Source as a Business Strategy – Licensing – Creating own Licenses - Important FOSS Licenses (Apache, BSD, PL, LGPL) – copyrights – copy lefts – Patent – Zero Marginal Cost – Income Generation Opportunities

UNIT III	**OPEN-SOURCE PROJECTS AND COLLABORATION**	**9**	**0**	**0**	**9**

Open-Source projects: Developing Open-Source Project – Open-Source Hardware – Open-Source Design – Open-source Teaching – Open-source media - Collaboration: Community and Communication – Contributing to Open-Source Projects – Introduction to GitHub – Interacting with the community on GitHub – Communication and etiquette – testing open-source code – reporting issues – contributing code – Introduction to Wikipedia – contributing to Wikipedia or contributing to any prominent open-source project

UNIT IV	**OPEN-SOURCE ECOSYSTEM**	**9**	**0**	**0**	**9**

Open-Source Operating Systems: GNU/Linux – Android – Free BSD – Open Solaris – Open-Source Hardware – Virtualization Technologies – Containerization Technologies: Docker – Development tools – IDEs – Debuggers – Programming languages - LAMP – Open-Source Database technologies

UNIT V	**CASE STUDIES**	**9**	**0**	**0**	**9**

Understanding the developmental models, licensing, mode of funding and commercial/non-commercial use information in Apache web server, GNU/Linux, Android, Mozilla (Firefox), Wikipedia, Drupal, wordpress, GCC, GDB, github,Open Office

Total(45 L)=45 Periods

Text Book:

1.	Kailash Vadera, Bhavyesh Gandhi, “Open Source Technology”, First Edition, Laxmi Publications Pvt Ltd., 2012

References:

1.	Fadi P. Deek and James A. M. McHugh, “Open Source: Technology and Policy”, Cambridge Universities Press 2007.
2.	Coursera online course – Open Source Software Development Methods - https://www.coursera.org/learn/open-source-software-development-methods

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Recall the fundamentals of open-source technologies	Remember
CO2	Apply the procedure to develop open-source software	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		1	2		1								1	
CO2		1	2		1								1	
Avg		**1**	**2**		**1**								**1**	
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE303	BIG DATA ANALYTICS		PE III			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Java Programming		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the big data and their processing
2.	To comprehend the big data platform – the Hadoop ecosystem

UNIT I	INTRODUCTION TO BIG DATA ANALYTICS	9	0	0	9

Introduction to Big data: Characteristics of data – Types of digital data – Evolution of Big Data – Definition of Big Data – Challenges with Big Data – Introduction to Big data analytics: Types of analytics – Importance and challenges in big data analytics – Terminologies used in big data environments – Big Data Technology Landscape.

UNIT II	INTRODUCTION TO HADOOP	9	0	0	9

Introduction to Hadoop – RDBMS versus Hadoop – Distributed Computing Challenges – History and overview of Hadoop – Use Case of Hadoop – Hadoop Distributors – Processing Data with Hadoop: Analysing Data with Hadoop – Hadoop Streaming – Hadoop Echo System – Interacting with Hadoop Ecosystem

UNIT III	HADOOP DISTRIBUTED FILESYSTEM (HDFS)	9	0	0	9

The Design of HDFS – HDFS Concepts – Command Line Interface – Hadoop file system interfaces – Data flow – Data Ingest with Flume and Sqoop and Hadoop archives – Hadoop I/O: Compression, Serialization, and File-Based Data structures.

UNIT IV	MAP – REDUCE FRAMEWORK	9	0	0	9

Map Reduce Framework: Exploring the features of Map Reduce – Working of Map Reduce – Exploring Map and Reduce Functions – Failures – Job Scheduling – Shuffle and Sort – Task Execution – Techniques to optimize Map Reduce jobs – Uses of Map Reduce - Controlling MapReduce Execution with input formats – Reading data with custom RecordReader – Reader, Writer, Combiner, Partitioners – Map Reduce Phases – Developing simple MapReduce Application.

UNIT V	HADOOP ECO SYSTEM	9	0	0	9

Pig: Introduction to PIG – Execution Modes of Pig – Comparison of Pig with Databases – Grunt – Pig Latin – User defined functions – Data processing operators.
Hive: Hive Shell – Hive Services – Hive Metastore – Comparison with Traditional Databases – HiveQL – Tables – Querying data – user defined functions.
Hbase: HBasics – Concepts – Clients – Example – Hbase Versus RDBMS.
Big SQL: Introduction

Total(45 L)=45 Periods

Text Book:

1.	Samiya Khan, "Big Data and Analytics", First Edition, Notion Press, 2022

Reference Books:

1.	Tom White, "Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale", O'Reilly, Fourth Edition, 2015.
2.	Donald Miner and Adam Shook, "MapReduce Design Patterns", O'Reilly, First Edition, 2012.
3.	Alex Holmes, "Hadoop in Practice", Manning Publications, Second Edition, 2015.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Recall the fundamentals of Big data analytics	Remember
CO2	Use Hadoop ecosystem to process big data.	Apply

COURSE ARTICULATIONMATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3		2	2							1	1	1
CO2	3	3		2	2							1	1	1
Avg	**3**	**3**		**2**	**2**							**1**	**1**	**1**
3 / 2 /1 - indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE304	USER INTERFACE DESIGN					PE III	
PREREQUISITES		**CATEGORY**	PE	Credit		3	
NIL		**Hours/Week**	L	T	P	TH	
			3	0	0	3	

Course Objectives:	
1.	Learn the characteristics of User Interface and design issues.
2.	Study the characteristics and components of windows, the various controls for the windows and various problems in windows design with color, text, and graphics and To study the testing methods.
3.	Gain knowledge of various testing tools of interface designs.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
UID Importance-Human-Computer interface-characteristics of graphics interface-Direct manipulation graphical system - web user interface-popularity-characteristic & principles.					
UNIT II	**DESIGN ISSUES**	**9**	**0**	**0**	**9**
User interface design process- obstacles-usability-human characteristics in design - Human interaction speed- business functions-requirement analysis-Direct-Indirect methods-basic business functions-Design standards- system timings - Human consideration in screen design - structures of menus - functions of menus-contents of menu-formatting -phrasing the menu - selecting menu choice-navigating menus-graphical menus.					
UNIT III	**WINDOWS CONTROLS (GUI)**	**9**	**0**	**0**	**9**
Windows: Characteristics-components-presentation styles-types-managements-organizations-operations-web systems-device-based controls: characteristics-Screen -based controls: operate control - text boxes-selection control-combination control-custom control-presentation control.					
UNIT IV	**MULTIMEDIA**	**9**	**0**	**0**	**9**
Text for web pages - effective feedback-guidance & assistance-Internationalization-accessibility-Icons-Image- multimedia - coloring.					
UNIT V	**LAYOUT AND TOOLS**	**9**	**0**	**0**	**9**
Windows layout-test: prototypes - kinds of tests - retest - Information search - visualization - Hypermedia - www - Software tools.					
Total (45L)= 45 Periods					

Text Books:	
1.	Wilbent. O. Galitz ,"The Essential Guide to User Interface Design: An Introduction to GUI Design Principles", John Wiley& Sons, 2007.
Reference Books:	
1.	Ben Sheiderman, "Design the User Interface", Pearson Education, 2nd Edition, 2008.
2.	Alan Cooper, "The Essential of User Interface Design", Wiley – Dream Tech Ltd., 2008.

COURSE OUTCOMES Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Outline the characteristics of User Interface and design issues	Understand
CO2	Design graphical interface using window controls layout and tools	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	3	3	2				3	3	3	3	2
CO 2	3	3	3	3	3	2				3	3	3	3	2
CO 3	3	3	3	3	3	2				3	3	3	3	2
Avg	**3**	**3**	**3**	**3**	**3**	**2**				**3**	**3**	**3**	**3**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSPE305	E-COMMERCE				PE III			
PREREQUISTIES			**CATEGORY**	**PE**	**Credit**		**C**	
NIL			**Hours/Week**	**L**	**T**	**P**	**TH**	
				3	**0**	**0**	**3**	

Course Objectives:

1.	Learn the Various e-commerce business models
2.	Understand how companies, use e-commerce to gain competitive advantages
3.	Develop an understanding of electronic market and market place
4.	Familiarize with the planning and execution of e-commerce projects
5.	Develop an understanding of business standards

UNIT I	**ELECTRONIC COMMERCE**	**9**	**0**	**0**	**9**
Frame work, anatomy of E-Commerce applications - E- Commerce Consumer applications - E-Commerce organization applications					
UNIT II	**CONSUMER ORIENTED ELECTRONIC COMMERCE**	**9**	**0**	**0**	**9**
Mercantile Process models-Electronic payment systems: Digital Token-Based - Smart Cards - Credit Cards -Risks in electronic Payment systems					
UNIT III	**MOBILE ELECTRONIC COMMERCE**	**9**	**0**	**0**	**9**
Wireless Industry Standards - Wireless Communication Platforms for LANs - Wireless WANs - Facilitators of a Wireless Environment - Concerns for the Mobile Enterprise					
UNIT IV	**E-COMMERCE APPLICATIONS DEVELOPMENT**	**9**	**0**	**0**	**9**
The Changing Face of Application Development - Enterprise Development Needs - Enhanced Web Server Based E-Commerce Site Business Objectives - Categories of Business Value - Assessing a Site's Current Business Value - Improving Business Value - Managed Solutions					
UNIT V	**E-COMMERCE SECURITY**	**9**	**0**	**0**	**9**
Types of Security Technologies: The Internet - The Internet Is Big Business - The New Economy - Where Old Meets New - Flawed Infrastructure - Emergence of Cyber Crime - Outside Attacks - Inside Attacks - Threats Due to Lack of Security - Cyber Security Need - Internet Security Education - E-Commerce Application Security Technology Essentials					
					Total (45L)= 45 Periods

Text Books:	
1.	Ravi Kalakota and Andrew B Whinston, “Frontiers of Electronic Commerce”,Addison Wesley,2008.(UNIT I - II)
2.	Pete Loshin, John Vacca, “Electronic Commerce”, IV Edition, Firewall Media, 2005.(UNIT III-V)
Reference Books:	
1.	Efraim Turban , Electronic Commerce, fourth edition, Pearson, 2006
2.	Jeffrey F Rayport, Bernard J Jaworski , Introduction to E-Commerce, second edition, Tata McGraw Hill,2003
3.	Gary P Schneider ,E-commerce: Strategy, Technology and Implementation, eleventh edition, Cengage Learning,2011
4.	Kamlesh K Bajaj, DebjaniNag ,E-Commerce: The Cutting Edge of Business, second edition,Tata McGraw Hill, 2005
E-Reference:	
1	https://youtu.be/xKJjyn8DaAw

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Develop an understanding of the foundations and importance of E-commerce	Apply
CO2	Analyze the impact of E-commerce on business models and strategies	Analyze
CO3	Examine legal issues and privacy in E-Commerce	Analyze
CO4	Describe Internet trading relationships including Business to Consumer, Business-to-Business, Intra-organizational	Understand
CO5	Understand the business standards	Understand

COURSE ARTICULATION MATRIX														
COs / POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO1**	**PSO2**
CO1	1		1	1	1						1		1	1
CO2	1		3	3	2						1		1	1
CO3	1		2	3	2						1		1	1
CO4	1		2	3	2						1		1	1
CO5	1		3	3	2						1		1	1
Avg	**1**		**2.2**	**2.6**	**1.8**						**1**		**1**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22CSPE401	WIRELESS SENSOR NETWORKS			PE IV		
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Computer Networks		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	The course helps the learners to know the architecture of WSN and communication standards.
2.	To learn various protocols for information gathering and energy management in wireless sensor network.
3.	This course also gives insight into challenges, various attacks and counter measures for attacks in wireless sensor networks.
4.	To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.

UNIT I	**WIRELESS SENSOR NETWORKS ARCHITECTURE**	**9**	**0**	**0**	**9**

Sensors – Sensor Node Architecture – Sensor Network Architecture – Mote Technology – Comparison of MANET and WSN – Requirements of a WSN – Challenges for a WSN – WSN Applications – Wireless Sensor Networks Architecture: Introduction – Network Protocol Stack – Communication Standards – IEEE 802.11 – IEEE 802.15.4 – ZigBee – 6LoWPAN.

UNIT II	**INFORMATION GATHERING**	**9**	**0**	**0**	**9**

Introduction – Routing – Flat-based Routing Algorithms – Sensor Protocols for Information Negotiation (SPIN) – Hierarchical Routing Algorithms – LEACH Routing Protocol – Information Gathering Based on Geographic Locations – Geographical Routing – Greedy Perimeter Stateless Routing – Landmark-based Routing – Data Aggregation – Content-based Naming.

UNIT III	**ENERGY MANAGEMENT IN WSN**	**9**	**0**	**0**	**9**

Introduction – Duty Cycling – Independent Strategies – Dependent Strategies – Independent Sleep/Wakeup Schemes – Asynchronous Schemes – TDMA-based MAC Protocols – Contention-based MAC Protocols – Hybrid MAC Protocols – Data-driven Approaches – Energy-aware Routing Protocols – Hierarchical Energy-aware Routing – Location-based Routing – Data Aggregation-based Routing.

UNIT IV	**SECURITY IN WSN**	**9**	**0**	**0**	**9**

Introduction – Challenges in WSN – Attacks in WSN – Protection against Attacks – Key Management – Secure Routing in WSNs – Attacks on Routing Protocols – Countermeasures for Attacks – Intrusion Detection in WSN.

UNIT V	**OPERATING SYSTEMS FOR WSNS**	**9**	**0**	**0**	**9**

Introduction – Architecture – Execution Model – Scheduling – Power Management – Communication – Case Study on Popular Operating Systems. Programming WSNs – Introduction – TinyOS – Contiki- Castalia – NS-3.

Total (45 L)=45 Periods

Text Books:

1.	Nandini Mukherjee, SarmisthaNeogy & Sarbani Roy, "Building Wireless Sensor Networks Theoretical & Practical Perspectives", 3rd Edition, CRC Press, Taylor & Francis Group, 2016.
2.	Waltenegus Dargie , Christian Poellabauer, “Fundamentals of Wireless Sensor Networks - Theory and Practice”, John Wiley & Sons Publications, 2011

Reference Books:

1.	HolgerKarl & Andreas Willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley & Sons, 2006.
2.	KazemSohraby, Daniel Minoli & TaiebZnati, "Wireless Sensor Networks Technology, Protocols and Applications", John Wiley & Sons, 2007.
3.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks Technology, Protocols, and Applications”, John Wiley, 2007.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the fundamentals of wireless sensor networks.	Understand
CO2	Demonstrate various routing protocols for gathering information in Wireless Sensor networks.	Understand
CO3	Illustrate different schemes for energy management in wireless sensor networks.	Understand
CO4	Summarize various challenges, attacks and countermeasures for attacks in wireless Sensor networks.	Understand
CO5	Describe and install various operating systems used in wireless sensor networks.	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	1	1	2					1	1	2	2	1
CO 2	1	2	1	1	2					1	1	2	2	1
CO 3	1	2	1	1	2					1	1	2	2	1
CO 4	1	2	1	1	2					1	1	2	2	1
CO 5	1	2	1	1	2					1	1	2	2	1
Avg	**1**	**2**	**1**	**1**	**2**					**1**	**1**	**2**	**2**	**1**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSPE402	DATA VISUALIZATION TECHNIQUES			PE IV			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**	
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives:

1.	Develop skills to carry out preprocessing in real time data.
2.	Demonstrate visualization techniques for various data analysis tasks – numerical data.
3.	Demonstrate visualization techniques for the applications using unstructured data
4.	Apply different visualization techniques for the given problems.
5.	Develop information dashboard for Sales and marketing analysis.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Visualization – visualization process – role of cognition – Pseudo code conventions – Scatter plot - Data foundation: Types of data - Structure within and between records - Data preprocessing – Human perceptions and information processing – Visualization foundations.

UNIT II	**SPATIAL AND GEOSPATIAL, TIME ORIENTED DATA AND MULTIVARIATE DATA**	**9**	**0**	**0**	**9**

One, two, three dimensional data – Dynamic data – Combining techniques – Visualization of spatial data – Visualization of point data – Visualization of line data – Visualization of area data – Issues in Geospatial data Visualization – Characterizing and visualizing Time oriented data – Point, Line ad region based techniques for multivariate data.

UNIT III	**TREE, GRAPH, NETWORKS, TEXT AND DOCUMENT**	**9**	**0**	**0**	**9**

Displaying hierarchical structure – Displaying Arbitrary Graphs/Networks – Other issues. Visualization techniques for Tree – Graph and Networks – Levels of text representation – Vector space model – Single Document Visualization – Document collection visualization Extended text visualization.

UNIT IV	**DESIGNING EFFECTIVE VISUALIZATION**	**9**	**0**	**0**	**9**

Steps in Designing Visualization – problems in Designing Effective Visualization – Comparing and evaluating visualization techniques – Visualization Systems.

UNIT V	**INFORMATION DASHBOARD DESIGN**	**9**	**0**	**0**	**9**

Characteristics of dashboards – Key goals in visual design process – Dashboard display media – Designing dashboards for usability – Meaningful organization – Maintaining consistency – Aesthetics of dashboards – Testing for usability – Case Studies: Sales dashboard – Marketing analysis dashboard.

Total(45 L)=45 Periods

Text Books:

1.	Matthew O. Ward. , Georges Grinstein and Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2ndEdition, CRC Press, 2015 (Unit I-IV).
2.	Stephen Few, "Information Dashboard Design: The Effective Visual Communication of Data", O'Reilly, 2006 (Unit V).

Reference Books:

1.	Stephen Few, "Now you see it: Simple Visualization Techniques for Quantitative Analysis", Analytics Press, 2009.
2.	Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe principles of visual perception and carry out preprocessing in real time data	Understand
CO2	Apply visualization techniques for various data analysis tasks – numerical data	Apply
CO3	Apply visualization techniques for the applications using unstructured data	Apply
CO4	Make use of different visualization techniques for the given problems	Apply

CO5	Design information dashboard for Sales and marketing analysis	Create

COURSE ARTICULATIONMATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1									3	1
CO2	3	2	1	1									3	1
CO3	3	2	1	1									3	1
CO4	3	2	1	1									3	1
CO5	3	2	1	1									3	1
Avg	**3**	**2**	**1**	**1**									**3**	**1**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE403	PREDICTIVE DATA ANALYTICS				PE IV		
PREREQUISTIES			**CATEGORY**	**PE**	**Credit**		**3**
NIL			**Hours\Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	Develop and use various quantitative and classification predictive models based on various regression and decision tree methods
2.	Understanding of how to formulate predictive analytics questions
3.	Learn how to search, identify, gather and pre-process data for the analysis

UNIT I	OVERVIEW OF PREDICTIVE ANALYTICS	9	0	0	9

Predictive Analytics – Predictive Analytics vs. Business Intelligence – Predictive Analytics vs. Statistics – Predictive Analytics vs. Data Mining – Challenges in Using Predictive Analytics. Setting up the Predictive Modeling project: Predictive Analytics Processing Steps: CRISP-DM – Defining Data for Predictive Modeling – Defining the Target Variable – Defining Measures of Success for Predictive Models.

UNIT II	DATA UNDERSTANDING	9	0	0	9

Single Variable Summaries – Data Visualization in One Dimension – Histograms – Multiple Variable Summaries – Data Visualization, Two or Higher Dimensions. Data Preparation: Variable Cleaning – Feature Creation.

UNIT III	DESCRIPTIVE MODELING	9	0	0	9

Data Preparation Issues with Descriptive Modeling – Principal Component Analysis – Clustering Algorithms. Interpreting Descriptive Models: Standard Cluster Model Interpretation.

UNIT IV	PREDICTIVE MODELING	9	0	0	9

Decision Trees – Logistic Regression – Neural Networks – K-Nearest Neighbor –Naive Bayes – Linear Regression – Other Regression Algorithms. Assessing Predictive Models: Batch Approach to Model Assessment.

UNIT V	MODEL ENSEMBLES	9	0	0	9

Motivation for Ensembles – Bagging – Boosting – Improvements to Bagging and Boosting – Interpreting Model Ensembles. Model Deployment: General Deployment Considerations – Case Study.

Total (45 L)= 45 Periods

Text Book:

1.	Dean Abbott, "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, JohnWiley & Sons, Inc., 2014

Reference Books:

1.	John D.Kelleher, Brain Mac Namee, Aoife D‟Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics", MIT Press,2015
2.	Gopal M, "Applied Machine Learning", McGraw Hill Education, 2018

E-Reference:

1	https://archive.nptel.ac.in/courses/111/106/111106164/

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Examine the processing steps of predictive analysis for solving real time problems	Analyze
CO2	Make use of data for modeling project	Apply
CO3	Utilize various descriptive modeling algorithms	Apply
CO4	Implement different types of predictive modeling algorithms	Apply
CO5	Apply predictive analytics concepts to real world applications	Apply

COURSE ARTICULATION MATRIX

CO\ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	1	1	1	1							2		3	1
CO2	1	1	1	1							2		3	1
CO3	1	1	1	1							2		3	1
CO4	1	1	1	1							2		3	1
CO5	1	1	1	1							2		3	1
Avg	1	1	1	1							2		3	1
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

2CSPE404	GAME THEORY AND ITS APPLICATIONS					PE IV		
PREREQUISITES			**CATEGORY**	**PE**	**Credit**		**3**	
NIL			**Hours/Week**	**L**	**T**	**P**	**TH**	
				3	**0**	**0**	**3**	

Course Objectives:

1.	To understand the principles and strategies of games theory
2.	To solve the real time games and present its optimized solution
3.	To apply the concept of games theory to identify the certainty of games.

UNIT I	**GAMES**	**9**	**0**	**0**	**9**
Games: Reasoning about Behavior in Game – Best responses and Dominant Strategies – Nash Equilibrium – Mixed Strategies – Pareto Optimality – Dominated strategies and dynamic strategies.					
UNIT II	**NON-COOPERATIVE GAMES**	**9**	**0**	**0**	**9**
Discrete static games – Continuous static games – Relation to other Mathematical Problems: Nonlinear optimization – Fixed point problems.					
UNIT III	**EQULIBRIA AND DYNAMIC GAMES**	**9**	**0**	**0**	**9**
Existence of Equilibria – Computation of Equilibria – Special matrix games – Uniqueness of Equilibria – Repeated and Dynamic games – Games under uncertainty.					
UNIT IV	**COOPERATIVE GAMES**	**9**	**0**	**0**	**9**
Solutions based on characteristic function – Conflict Resolution – Multi objective optimization – Social choice.					
UNIT V	**CASE STUDIES AND APPLICATIONS**	**9**	**0**	**0**	**9**
A salesman's Dilemma – Oligopoly in water management – A forestry management problem – International fishing – Water distribution problem.					
					Total(45 L)=45 Periods

Text Books:

1.	David Easley and Jon Kleinberg, " Networks, Crowds and Markets: Reasoning about a highly Connected World", Cambridge University, 2010 (Unit I).
2.	Matsumoto A., Szidarovszky F, "Game Theory and Applications", Springer, 2016 (Units II –V).

Reference Books:

1.	E.M.Barron, "Game Theory: An Introduction", Wiley, 2009.
2.	Leon Petrosjan, Valdimir V.Mazalov, "Game Theory &Applications", Nova Science Publishers, Inc, 2015.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the principles and strategies of games theory	Understand
CO2	Solve the real time games and present its optimized solution	Create
CO3	Apply the concept of games theory to identify the certainty of games.	Apply

COURSE ARTICULATION MATRIX														
COs/ POs	**PO1**	**PO2**	**PO4**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1										2	1
CO2	3	2	1										2	1
CO3	3	2	1										2	1
Avg	**3**	**2**	**1**										**2**	**1**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE405	BUSINESS INTELLIGENCE AND ITS APPLICATIONS					PE IV
PREREQUISITES		CATEGORY	PE	Credit		C
Data Mining and Warehousing		Horus/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To understand the complete context of a Business
2.	To be familiar with OLAP tools and BI architecture
3.	To learn the concept of ETL in Data warehousing
4.	To learn the basics of data 176odeling, measurement technologies and process.

UNIT I	INTRODUCTION TO BUSINESS INTELLIGENCE	9	0	0	9

Business Enterprise Organizations, Functions & core business processes, Baldrige Business Framework, Keypurpose of using IT in Business, Connected World Characteristics of Internet Ready IT Application, Information users & its requirements.[Case Study Inclusions].

UNIT II	BI ARCHITECTURE ROLES AND RESPONSIBILITIES	9	0	0	9

Introduction to digital data and its types – structured, semi-structured and unstructured, Introduction to OLTP and OLAP (MOLAP, ROLAP, HOLAP), BI Definitions & Concepts, BI Framework, Data Warehousing concepts and its role in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities, Business Applications of BI, BI best practices.

UNIT III	BASICS OF DATA INTEGRATION	9	0	0	9

Concepts of data integration, needs and advantages of using data integration, introduction to common data integration approaches, Meta data – types and sources, Introduction to data quality, data profiling concepts and applications, introduction to ETL using Pentaho data Integration (formerly Kettle).

UNIT IV	INTRODUCTION TO MULTI-DIMENSIONAL DATA MODELING	9	0	0	9

Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema,introduction to business metrics and KPIs, creating cubes using Microsoft Excel.

UNIT V	BASICS OF ENTERPRISE REPORTING	9	0	0	9

A typical enterprise, Malcolm Baldrige – quality performance framework, balanced scorecard, enterprise dashboard, balanced scorecard vs. enterprise dashboard, enterprise reporting using MS Access / MS Excel, best practices in the design of enterprise dashboards.

Total (45 L) =45 Periods

Text Book:

1.	R.N.Prasad, Seema Acharya,"Fundamentals of Business Analytics", second edition, Wiley Publications,2016.

Reference Books:

1.	David Loshin, Business Intelligence, The Savy Manager's Guide, Second Edition, 2012.
2.	Mike Biere, Business intelligence for the Enterprise, Prentice Hall Professional, 2003.

3.	Larissa Terpeluk Moss, Shaku Atre .Business intelligence roadmap, Prentice Hall Professional,2003
4.	William H. inmon, An introduction to Building the Data Warehouse – IBM, 1993.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the complete context of a Business, BI architecture and various quality performance framework	Understand
CO2	Illustrate various operations of OLAP on Multidimensional data.	Understand
CO3	Familiarize with ETL in the context of data warehousing.	Understand
CO4	Develop a data model at conceptual and logical levels.	Apply

COURSE ARTICULATION MATRIX

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	2	2	1		1	2			2	2	3	2
CO 2	3	2	2	2	1		1	2			2	2	3	2
CO 3	3	2	2	2	1		1	2			2	2	3	2
CO4	3	2	2	2	1		1	2			2	2	2	2
Avg	**3**	**2**	**2**	**2**	**1**		**1**	2			**2**	**2**	**3**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSPE501	INFORMATION SECURITY				PE V		
PREREQUISITES			**CATEGORY**	**PE**	**Credit**		**3**
NIL			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To understand the basics of Information Security
2.	To understand the common threats faced today
3.	To know the aspects of risk management
4.	To understand the Security technology and Intrusion Detection System

UNIT I	**INTRODUCTION TO INFORMATION SECURITY**	**9**	**0**	**0**	**9**

History of Information Security, What is Security?- Key Information Security Concepts, Critical Characteristics of Information, CNSS Security Model; Components of an Information System, Security and the Organization- Balancing Information Security and Access, Approaches to Information Security Implementation, Security Professionals, Data Responsibilities, Communities of Interest; Information Security: Is it an Art or A Science?

UNIT II	**THE NEED FOR INFORMATION SECURITY**	**9**	**0**	**0**	**9**

Business Needs First, Threats, Attacks; Legal, Ethical and Professional Issues in Information Security- Law and Ethics in Information Security, Relevant U.S. Laws, International Laws and Legal Bodies, Ethics and Information Security, Code of Ethics and Professional Organizations.

UNIT III	**INFORMATION SECURITY MANAGEMENT**	**9**	**0**	**0**	**9**

Information Security Policy, Standards and Practices, Security Education, Training and Awareness Program; The Information Security Blueprint, Models and Frameworks-NIST Models, Design of Security Architecture

UNIT IV	**RISK MANAGEMENT**	**9**	**0**	**0**	**9**

Introduction to Risk Management, The Risk Management Framework, The Risk Management Process-Risk Identification, Risk Assessment, Risk Evaluation; Risk Treatment/Risk Response.

UNIT V	**SECURITY TECHNOLOGY**	**9**	**0**	**0**	**9**

Intrusion Detection and Prevention Systems, Scanning and Analysis Tools, Biometric Access Control; Physical Security-Physical Access Control, Security and Personnel- Positioning and Staffing the Security Function.

Total(45 L)=45 Periods

Text Books:

1.	Michael E Whitman and Herbert J Mattord, —Principles of Information Security, Cengage Publication, Seventh Edition, 2021.

Reference Books:

1.	Micki Krause, Harold F. Tipton, — Handbook of Information Security Management, Vol 1-3 CRC Press LLC, 2004.
2.	Stuart Mc Clure, Joel Scrambray, George Kurtz, —Hacking Exposed, Tata McGraw-Hill, 2003
3.	Matt Bishop, — Computer Security Art and Science, Pearson/PHI, 2002.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the vulnerabilities in any computing system and hence be able to design a security solution.	Understand
CO2	Identify the common threats and security challenges.	Apply
CO3	Analyze the possible security attacks in complex real time systems and their effective countermeasures.	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	3	2	1					3	2	1	2
CO2	2	2	1	3	2	1					3	2	1	2
CO3	2	2	1	3	2	1					3	2	1	2
Avg	**2**	**2**	**1**	**3**	**2**	**1**					**3**	**2**	**1**	**2**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE502	DATA SCIENCE					PE V		
PREREQUISITES			**CATEGORY**		**PE**	**Credit**		**3**
NIL			**Hours/Week**		**L**	**T**	**P**	**TH**
					3	**0**	**0**	**3**

Course Objectives:

1.	Develop the ability to build applications using of the concepts of data science.
2.	To apply machine learning techniques for solving problems with large data.
3.	To develop experiment using Hadoop and Spark framework for data science applications.
4.	To apply the data science process to solve real world problem by using NoSQL database and Graph database.
5.	To use of text analytics techniques for building solutions for text mining problem.

UNIT I	**DATA SCIENCE IN A BIG DATA WORLD**	**9**	**0**	**0**	**9**
Benefits of Data Science – Facets of Data – Data Science Process –Big Data Ecosystem and Data Science–Example using Hadoop.The Data Science Process: Overview – Defining Research Goals – Retrieving Data – Data Preparation – Exploratory Data Analysis – Building Models – Building Applications.					
UNIT II	**MACHINE LEARNING**	**9**	**0**	**0**	**9**
Applications for Machine Learning in Data Science – Machine Learning in Data Science Process – The Modeling Process. Handling Large Data: Problems in Handling Large Data – General Techniques – Programming Tips – Case Studies.					
UNIT III	**BIG DATA**	**9**	**0**	**0**	**9**
Distributing Data Storage and Processing with Frameworks: Hadoop – Spark – Case Study: Assessing Risk with Loaning Money.					
UNIT IV	**NoSQL**	**9**	**0**	**0**	**9**
Introduction: ACID– CAP Theorem – The BASE Principles of NoSQL Databases – NoSQL Database Types – Case Study: What disease is that?– Graph Database: Introducing Connected Data and Graph Databases – Connected Data Example.					
UNIT V	**TEST MINING AND TEXT ANALYTICS**	**9**	**0**	**0**	**9**
Test Mining in Real World – Text Mining Techniques: Bag of Words – Stemming and Lemmatization – Decision Tree Classifier – Case Study: Classifying Reddit Posts.					
Total(45 L)=45 Periods					

Text Book:	
1.	Davy Cielen, Arno D. B. Meysman, Mohamed Ali , "Introducing Data Science – Big Data, Machine Learning and more, Using Python Tools", Manning Publications, 2016
Reference Books:	
1.	John Wiley and Sons , "Data Science and Big data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services, 2015.
2.	Joel Grus, "Data Science from the Scratch", O‟Reilly, 2015

COURSE OUTCOMES: Upon completion of the course,the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Make use of the concepts of data science for building applications	Apply
CO2	Utilize machine learning techniques for solving problems with large data	Apply
CO3	Experiment with Hadoop and Spark framework for data science applications	Apply

CO4	Apply the data science process to solve real world problem by using NoSQL database and Graph database	Apply
CO5	Make use of text analytics techniques for building solutions for text mining problem	Apply

COURSE ARTICULATIONMATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1										3	1
CO2	3	2	1	1									3	1
CO3	3	2	1										3	1
CO4	3	2	1										3	1
CO5	3	2	1										3	1
Avg	**3**	**2**	**1**	**1**									**3**	**1**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE503	SOCIAL NETWORK ANALYSIS			PE V			
PREREQUISITES		CATEGORY		PE	Credit		3
		Hours/Week		L	T	P	TH
				3	0	0	3

Course Objectives:

1	To understand the concept of semantic web and related applications.
2	To learn knowledge representation using ontology.
3	To understand human behaviour in social web and related communities.
4	To learn visualization of social networks.

UNIT I	INTRODUCTION	9	0	0	9

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

UNIT II	MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION	9	0	0	9

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

UNIT III	EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS	9	0	0	9

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

UNIT IV	PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES	9	0	0	9

Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

UNIT V	VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS	9	0	0	9

Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

Total (45 L)= 45 Periods

Text Books:

1.	Peter Mika, ―Social Networks and the Semantic Web, First Edition, Springer, 2010.
2.	Borko Furht, ―Handbook of Social Network Technologies and Applications, First Edition, Springer, 2010.

Reference Books:

1.	Guandong Xu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
2.	Dion Goh and Schubert Foo, ―Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

COURSE OUTCOMES: Upon completion of this course,the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Develop semantic web related applications.	Apply
CO2	Represent knowledge using ontology.	Understand
CO3	Explore mining communities in web social networks.	Understand
CO4	Identify human behaviour in social web and related communities.	Apply
CO5	Develop and Visualize Social Network applications	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2				2	2	2	2	3	2
CO2	3	3	3	3	2				2	2	2	2	3	2
CO3	3	3	3	3	2				2	2	2	2	3	2
CO4	3	3	3	3	2				2	2	2	2	3	2
CO5	3	3	3	3	2				2	2	2	2	3	2
Avg	**3**	**3**	**3**	**3**	**2**				**2**	**2**	**2**	**2**	**3**	**2**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22CSPE504	NATURAL LANGUAGE PROCESSING				PE V
PREREQUISTIES		CATEGORY	PE	Credit	3
NIL		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	This course introduces the fundamental concepts and techniques of natural language processing (NLP)
2.	Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information
3.	The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches

UNIT I	INTRODUCTION	9	0	0	9

Semantics and Knowledge Representation - Natural Language Processing - Information Extraction - Main Challenges in Information Extraction - Approaches to Information Extraction - Performance Measures - General Architecture for Information Extraction

UNIT II	DATA GATHERING, PREPARATION AND ENRICHMENT	9	0	0	9

Process Overview -Tokenization and Sentence Boundary Detection -Representative Tools: Punkt and iSentenizer - Morphological Analysis and Part-of-Speech Tagging -Representative Tools: Stanford POS Tagger, -SVM Tool, and TreeTagger -Syntactic Parsing -Representative Tools: Epic, StanfordParser, - MaltParser, TurboParser -Representative Software Suites - Stanford NLP - Natural Language Toolkit (NLTK)-GATE

UNIT III	IDENTIFYING THINGS, RELATIONS AND SEMANTIZING DATA	9	0	0	9

Identifying the Who, the Where, and the When -Relating Who, What, When, and Where -Getting Everything Together - Ontology -Ontology-Based Information Extraction (OBIE)

UNIT IV	EXTRACTING RELEVANT INFORMATION USING A GIVEN SEMANTIC	9	0	0	9

Introduction -Defining How and What Information Will Be Extracted -Architecture -Implementation of a Prototype Using State-of-the-Art Tools -Natural Language Processing -Domain Representation -Semantic Extraction and Integration

UNIT V	APPLICATIONS	9	0	0	9

Selecting and Obtaining Software Tools -Tools Setup -Processing the Target Document -Using for Other Languages and for Syntactic Parsing -Application Example 2: IE Applied to Electronic Government -Goals - Documents -Obtaining the Documents -Application Setup -Making Available Extracted Information Using a Map -Conducting Semantic Information Queries

Total (45 L)= 45 Periods

Text Book:

1.	"Advanced Applications of Natural Language Processing for Performing Information Extraction",-Mário Rodrigues, AntónioTeixeira

Reference Books:

1.	"Analyzing Discourse and Text Complexity for Learning and Collaborating_ A Cognitive Approach Based on Natural Language Processing",-MihaiDascălu
2.	"Natural Language Processing for Social Media",-Farzindar, Atefeh_ Inkpen, Diana
3.	"Natural Language Processing and Cognitive Science",-Bernadette Sharp, Rodolfo Delmonte

E-Reference

1	https://nptel.ac.in/courses/106105158

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand approaches to syntax and semantics in NLP	Understand
CO2	Have a basic understanding of a variety of NLP tools	Understand
CO3	Understand approaches to discourse, generation, dialogue and summarization within NLP	Understand
CO4	Understand current methods for statistical approaches to ma chine translation	Understand
CO5	Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP	Understand

COURSE ARTICULATION MATRIX

COs / POs	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO1	1	2	1										1	1
CO2	1	2	1										1	1
CO3	1	2	1										1	1
CO4	1	2	1										1	1
CO5	1	2	1										1	1
Avg	**1**	**2**	**1**										**1**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22CSPE505	ETHICAL HACKING					PE V
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**C**
Computer Networks		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To learn about the importance of information security
2.	To learn different scanning and enumeration methodologies and tools
3.	To understand various hacking techniques and attacks
4.	To be exposed to programming languages for security professionals
5.	To get familiarized with the different phases in penetration testing

UNIT I	BASICS OF HACKING	9	0	0	9

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Footprinting – Information Gathering Methodology – Footprinting Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines.

UNIT II	SCANNING AND ENUMERATION	9	0	0	9

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools.

UNIT III	SYSTEM HACKING	9	0	0	9

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Counter measures – Escalating Privileges – Executing Applications – Keyloggers and Spyware.

UNIT IV	PROGRAMMING FOR SECURITY PROFESSIONALS	9	0	0	9

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.

UNIT V	PENETRATION TESTING	9	0	0	9

Introduction – Security Assessments – Types of Penetration testing – Phases of Penetration Testing – Tools – Choosing Different Types of Pen –Test Tools – Penetration Testing Tools.

Total (45 L) =45 Periods

Text Books:

1.	Patrick Engebretson, The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy, Syngress Media, Second Revised Edition, 2013.
2.	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.

Reference Books:

1.	Michael T. Simpson, Kent Backman and James E. Corley, Hands-On Ethical Hacking and Network Defense, Cengage Learning, 2012
2.	Ec-Council, Ethical Hacking and Countermeasures: Attack Phases, Delmar Cengage Learning, 2009
3.	Jon Erickson, Hacking: The Art of Exploitation, No Starch Press, Second Edition, 2008.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Defend hacking attacks and protect data assets.	Understand
CO2	Defend a computer against a variety of security attacks using various tools.	Understand
CO3	Practice and use safe techniques on the World Wide Web.	Apply
CO4	Write the programming for security professionals.	Apply
CO5	Use the different testing tools in real world applications.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1		1	2		2	1					1		2	
CO 2		1	2		2	1					1		3	
CO 3		1	2		2	1					1		3	
CO 4		1	2		2	1					1		2	
CO 5		1	2		1	1					1		2	
Avg		**1**	**2**		**1.8**	**1**					**1**		**2.4**	
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSPE601	COMPUTER HARDWARE AND TROUBLESHOOTING			PE VI		
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the fundamentals of computer and different types of memory
2.	To learn different kind of peripheral devices
3.	Be familiar with hardware and technology of computer
4.	To understand the installation and maintenance of computer
5.	Be expose to the issues in troubleshooting

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Introduction - Computer Organization – Number Systems and Codes – Memory – ALU– CU – Instruction prefetch – Interrupts – I/O Techniques – Device Controllers – Error Detection Techniques – Microprocessor – Personal Computer Concepts – Advanced System Concepts – Microcomputer Concepts – OS – Multitasking and Multiprogramming – Virtual Memory – Cache Memory – Modern PC and User.

UNIT II	**PERIPHERAL DEVICES**	**9**	**0**	**0**	**9**

Introduction – Keyboard – CRT Display Monitor – Printer – Magnetic Storage Devices – FDD – HDD – Special Types of Disk Drives – Mouse and Trackball – Modem – Fax Modem – CD ROM Drive – Scanner – Digital Camera – DVD – Special peripherals.

UNIT III	**PC HARDWARE OVERVIEW**	**9**	**0**	**0**	**9**

Introduction – Hardware BIOS DOS Interaction – The PC family – PC hardware – Inside the System Box – Motherboard Logic – Memory Space – Peripheral Interfaces and Controllers – Keyboard Interface – CRT Display interface – FDC – HDC.

UNIT IV	**INSTALLATION AND PREVENTIVE MAINTENANCE**	**9**	**0**	**0**	**9**

Introduction – system configuration – pre installation planning – Installation practice – routine checks – PC Assembling and integration – BIOS setup – Engineering versions and compatibility – preventive maintenance – DOS – Virus – Data Recovery.

UNIT V	**TROUBLESHOOTING**	**9**	**0**	**0**	**9**

Introduction – computer faults – Nature of faults – Types of faults – Diagnostic programs and tools – Microprocessor and Firmware – Programmable LSI's – Bus Faults – Faults Elimination process – Systematic Troubleshooting – Symptoms observation and analysis – fault diagnosis – fault rectification – Troubleshooting levels – FDD, HDD, CD ROM Problems.

Total (45 L) =45 Periods

Text Books:

1.	Hardware bible By : Winn L Rosch, 6th Edition, B.P.B, Publication Ltd.,2004
2.	Trouble shooting, maintaining and repairing PCs, Stephon J Bigelow Tata McGraw Hill Publication
3.	B. Govindarajalu, "IBM PC Clones Hardware, Troubleshooting and Maintenance", 2/E, TMH, 2002.

Reference Books:

1.	Peter Abel, Niyaz Nizamuddin, "IMB PC Assembly Language and Programming", Pearson Education, 2007
2.	Scott Mueller Upgrading and Repairing PCs 22nd Edition, 2015

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the fundamentals of computer and different types of memory and different kind of peripheral devices	Understand
CO2	Familiar with hardware and technology of computer	Understand
CO3	Apply the knowledge for installation and maintenance of computer	Apply
CO4	Understand the issues in troubleshooting	Understand

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1			1	1	1	2					1		1	
CO 2			1	1	1	2					1		1	
CO 3			1	1	1	2					2		1	
CO 4			1	2	1	2					2		1	
Avg			**1**	**1.5**	**1**	**2**					**1.5**		**1**	
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSPE602	CYBER FORENSICS			PE VI		
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
Computer Networks		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To acquire the knowledge computer forensics
2.	To familiarize the forensics tools
3.	To analyze and validate forensics data
4.	To gain the knowledge of ethical hacking techniques

UNIT I	INTRODUCTION TO COMPUTER FORENSICS	9	0	0	9

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II	EVIDENCE COLLECTION AND FORENSICS TOOLS	9	0	0	9

Processing Crime and Incident Scenes – Working with Windows and DOS Systems, Current Computer Forensics Tools - Software/ Hardware Tools.

UNIT III	ANALYSIS AND VALIDATION	9	0	0	9

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics.

UNIT IV	ETHICAL HACKING	9	0	0	9

Introduction to Ethical Hacking - Foot-printing and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats – Sniffing.

UNIT V	ETHICAL HACKING IN WEB	9	0	0	9

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

Total(45 L)=45 Periods

Text Books:

1.	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, “Computer Forensics and Investigations”, Cengage Learning, India Edition, 2016.
2.	CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.

Reference Books:

1.	John R.Vacca,”Computer Forensics”, Cengage Learning, 2005
2.	MarjieT.Britz, “Computer Forensics and Cyber Crime”: An Introduction”,3 rd Edition,Prentice Hall,2013.
3.	AnkitFadia “Ethical Hacking” Second Edition, Macmillan India Ltd, 2006.
4.	Kenneth C.Brancik “Insider Computer Fraud “Auerbach Publications Taylor & amp; Francis Group-2008.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Acquire the basics of computer forensics	Understand
CO2	Apply different computer forensic tools to a given scenario	Apply
CO3	Analyze and validate forensics data	Analyze
CO4	Implement real-world hacking techniques to test system security	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	3	2	2	-	-	2	-	2	3	2
CO2	3	3	3	3	3	2	2	-	-	2	-	2	3	3
CO3	2	3	2	2	3	2	2	-	-	2	2	2	3	3
CO4	3	3	2	2	3	2	2	-	-	2	2	2	3	3
Avg	**2.5**	**3**	**2.5**	**2.5**	**3**	**2**	**2**	**-**	**-**	**2**	**2**	**2**	**3**	**2.7**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSPE603	CLOUD COMPUTING					PE VI
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Computer Networks		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To introduce the broad perceptive of Parallel Computing, Distributed Computing and Cloud Computing.
2.	To understand the concept of Virtualization, Cloud Architecture and Storage.
3.	To understand the Cloud Platforms in Industry and Software Environments.
4.	To understand the concept of Cloud Security and Applications.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

The vision of Cloud Computing – Defining a Cloud – The Cloud Computing reference model –Characteristics and Benefits; Historical developments: Distributed systems – Virtualization - Web 2.0 - Service-oriented computing - Utility-oriented computing.

Principles of Parallel and Distributed Computing: Parallel vs. distributed computing - Elements of parallel and distributed computing - Technologies for distributed computing.

UNIT II	**VIRTUALIZATION**	**9**	**0**	**0**	**9**

Introduction - Characteristics of Virtualized environments - Virtualization techniques: Machine Reference Model – Hardware Level Virtualization - Programming Language Level Virtualization –Application-Level Virtualization - Other types of Virtualizations - Pros and cons of Virtualization; Technology examples-Xen: Para virtualization; VMware: Full Virtualization.

UNIT III	**CLOUD ARCHITECTURE AND STORAGE**	**9**	**0**	**0**	**9**

The cloud reference model: IaaS, PaaS, SaaS; Types of clouds: Public clouds – Private clouds – Hybrid clouds – Community clouds; Architectural design challenges.

Cloud Storage: Storage as a Service – Advantages of cloud storage – Cloud Storage Provider: Amazon Simple Storage Service (S3) – Nirvanix - MobileMe.

UNIT IV	**CLOUD INDUSTRIAL PLATFORMS AND SOFTWARE ENVIRONMENTS**	**9**	**0**	**0**	**9**

Cloud Platforms in Industry: Amazon Web Service - Google App Engine - Microsoft Azure;

Cloud Software Environments -Hadoop –Map Reduce -Eucalyptus –Open Nebula;

UNIT V	**CLOUD SECURITY AND APPLICATIONS**	**9**	**0**	**0**	**9**

Security in the cloud: Cloud Security challenges – Software as a Service Security: Security Management – Security governance – Security Architecture Design -Virtual Machine Security – Identity Access Management.

Cloud Scientific Applications: Healthcare: ECG analysis in the cloud - Biology: gene expression data analysis for cancer diagnosis - Geoscience: Satellite Image Processing.

Total (45 L)=45 Periods

Text Books:

1.	Rajkumar Buyya, Christian Vecchiola, S.TamaraiSelvi, ‘Mastering Cloud Computing-Foundations and Applications Programming”, TMGH,2013.
2.	Rittinghouse, JohnW., and James F. Ransome – Cloud Computing: Implementation, Management and Security. CRC Press, 2017.

Reference Books:

1.	Kai Hwang.GeoffreyC.Fox.JackJ.Dongarra, “ Distributed and Cloud Computing ,From Parallel Processing to The Internet of Things”, 2012 Elsevier
2.	Barrie Sosinsky, “Cloud Computing Bible”, Wiley Publisher, 2011

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		Bloom'sTaxonomy Mapped
CO1	Understand the main concepts and architecture of Parallel computing, Distributed Computing and Cloud Computing.	Understand
CO2	Analyze the concept of Virtualization, Cloud Architecture and Storage.	Analyze
CO3	Analyze the Cloud Platforms in Industry and Software Environments.	Analyze
CO4	Identify the security issues in scientific and real time applications.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	1	-	1	-	-	-	-	-	2	-	3	3
CO3	3	3	2	-	1	-	-	-	-	-	2	-	3	3
CO4	3	3	2	-	1	-	-	-	-	-	2	-	3	3
Avg	**2.8**	**2.8**	**1.3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**3**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSPE604	MOBILE APPLICATION DEVELOPMENT				PE VI		
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**	
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives:

1.	Understand the android SDK
2.	Understanding of Android application development
3.	Inculcate working knowledge of Android Studio development tool

UNIT I	INTRODUCTION	9	0	0	9

The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest fil

UNIT II	ANDROID APPLICATION DESIGN ESSENTIALS	9	0	0	9

Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions

UNIT III	ANDROID USER INTERFACE DESIGN ESSENTIALS	9	0	0	9

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation

UNIT IV	ANDROID SOFTWARE DEVELOPMENT PROCESS	9	0	0	9

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources

UNIT V	USING COMMON ANDROID APIs	9	0	0	9

Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World

Total (45 L)= 45 Periods

Text Book:

1.	Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)

Reference Books:

1.	Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd
2.	Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd
3.	Android Application Development All in one for Dummies by Barry Burd, Edition: I

E-Reference:

1	https://youtu.be/9z7AEAyhAG8

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify various concepts of mobile programming that make it unique from programming for other platforms	Apply
CO2	Critique mobile applications on their design pros and cons	Analyze
CO3	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces	Apply
CO4	Program mobile applications for the Android operating system that use basic and advanced phone features	Apply
CO5	Deploy applications to the Android marketplace for distribution	Create

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO2
CO1	1	1	1			1					1		1	1
CO2	1	3	3			1					1		1	1
CO3	1	2	2			1					1		1	1
CO4	1	3	2			1					1		1	1
CO5	1	2	3			1					1		1	1
Avg	**1**	**2.2**	**2.2**			**1**					**1**		**1**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22CSPE605	DEEP LEARNING					PE VI
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Programming Language, Mathematics, Statistics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	Explain the fundamental methods involved in deep learning, including the underlying optimization concepts (gradient descent and backpropagation), typical modules they consist of, and how they can be combined to solve real-world problems.
2	Differentiate between the major types of neural network architectures (convolutional neural networks, recurrent neural networks, Generative Deep learning models) and what types of problems each is appropriate for.
3	Describe some of the latest research being conducted in the field and open problems that are yet to be solved.

UNIT I	INTRODUCTION	9	0	0	9

Basics: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.

UNIT II	DEEP NEURAL NETWORKS	9	0	0	9

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training.

Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT III	RECURRENT NEURAL NETWORKS	9	0	0	9

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated RecurrentUnits, Bidirectional LSTMs, Bidirectional RNNs

Convolutional Neural Networks: LeNet, AlexNet.

UNIT IV	GENERATIVE MODELS	9	0	0	9

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling,gradient computations in RBMs, Deep Boltzmann Machines.

UNIT V	RECENT TRENDS	9	0	0	9

Recent trends: Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning

Total (45 L)= 45 Periods

Reference Books:

1.	Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2.	Pattern Recognition and Machine Learning, Christopher Bishop, 2007

Text Books:

1.	Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

COURSE OUTCOMES Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the fundamentals of deep learning and deep neural network aspects	Understand
CO2	Explain the concept behind Recurrent Neural Networks and Identify the Generative Deep learning models	Apply
CO3	Recognize the tangible applications of Deep learning.	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	2	3	2				2	3	2	3
CO 2	3	3	3	2	2	3	2				2	3	2	3
CO 3	3	3	3	2	2	3	2				2	3	2	3
Avg	**3**	**3**	**3**	**2**	**2**	**3**	**2**				**2**	**3**	**2**	**3**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

OPEN ELECTIVE COURSES

22MAOE01	SAMPLING THEORY AND NUMERICAL METHODS				
PREREQUISTIES	**CATEGORY**	**L**	**T**	**P**	**C**
Basic 12^{th} level knowledge of Probability, Statistics, Matrices, ODE and PDE.	**BS**	**3**	**0**	**0**	**3**

Course Objectives:

1.	To gain the knowledge of tests of significance for large and small samples.
2.	To find the numerical solution of linear, non-linear equations and to obtain the knowledge about fitting of curves by the method of least squares.
3.	To obtain the knowledge about numerical interpolation, differentiation and integration.
4.	To acquire the knowledge about numerical solutions to first order ordinary differential equations using single step and multi-step methods.
5.	To gain the knowledge about numerical solutions to second order partial differential equations by using explicit and implicit methods.

UNIT I	**SAMPLING THEORY**	**9**	**0**	**0**	**9**

Test of significance: Large Sample tests for Single proportion, difference of proportions, single mean and difference of means- Small Sample test for single mean, difference of means, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

UNIT II	**SOLUTION OF EQUATIONS**	**9**	**0**	**0**	**9**

Solutions of nonlinear equations by Newton Raphson Method-Solutions of linear system of equations by Gauss Elimination, Gauss Jacobi and Gauss Seidel methods, Curve fitting by the Method of Least Squares – Fitting of straight lines, second degree parabolas.

UNIT III	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9**	**0**	**0**	**9**

Interpolation using Newton's Forward and Backward formula- Interpolation with unequal intervals: Newton's divided difference and Lagrange's formula -Numerical Differentiation and Integration: Trapezoidal rule, Simpson's 1/3 rule and Simpson's 3/8 rule.

UNIT IV	**NUMERICAL SOLUTION FOR ORDINARY DIFFERENTIAL EQUATIONS**	**9**	**0**	**0**	**9**

Ordinary differential equations: Taylor series method- Euler and modified Euler's method- Runge-Kutta method of fourth order for solving first order differential- Milne's and Adam's predictor - corrector methods.

UNIT V	**NUMERICAL SOLUTION FOR PARTIAL DIFFERENTIAL EQUATIONS**	**9**	**0**	**0**	**9**

Partial differential equations: Finite difference solution of two-dimensional Laplace and Poisson equations- Implicit and Explicit methods for one dimensional heat equation (Bender Schmidt and Crank-Nicholson methods) - Finite difference explicit method for wave equation.

Total (45 L + 0T) = 45 Periods

Text Books:

1.	Veerarajan T, "Probability and Random Process (With Queuing theory)", 4^{th} Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2016.
2.	Kandasamy.P, Thilagavathy.K, Gunavathi.K, "Numerical Methods", S. Chand & Co., New Delhi, 2005.
3.	Gupta, S.C. and Kapoor, V.K., "Fundamentals of Mathematical Statistics", S. Chand and Sons, New Delhi, 11^{th} Edition, 2014.

Reference Books:

1.	Freund John, E. and Miller Irwin, “Probability and Statistics for Engineers”, 8th Edition, Prentice Hall India (P) Ltd, 2010.
2.	Gerald, C. F. and Wheatley, P.O., “Applied Numerical Analysis”, Sixth Edition, Pearson Education Asia, New Delhi, 2002.
3.	M.K. Venkataraman, “Numerical Methods in Science and Engineering”, 5th Edition, National Publishing Company, 2000.
4.	Jain M.K, Iyengar K & Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, New Age International (P) Ltd, Publishers, 2003.
5.	Manish Goyal, “Numerical Methods and Statistical techniques Using ‘C”, 1st Edition, Laxmi Publications (P) Ltd, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Learn about the concept of sampling theory and testing of hypotheses.	L2: Understanding
CO2	:	Find the numerical solution of equations and fitting the curves by Least Square Method.	L2: Understanding
CO3	:	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.	L3: Applying
CO4	:	Solve the initial value problems for ordinary differential equations.	L3: Applying
CO5	:	Find the numerical solution of the partial differential equation by using the Finite difference method.	L2: Understanding

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2									2		
CO2	3	2		2									2		
CO3	3	2		2									2		
CO4	3	2		2									2		
CO5	3	2		2									2		
Avg	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

22MAOE02	NUMERICAL METHODS					
PREREQUISTIES		**CATEGORY**	**L**	**T**	**P**	**C**
Basic 12th level knowledge of solution of equations, differentiation, integration, ODE and PDE.		**BS**	**3**	**0**	**0**	**3**

Course Objectives:

1.	To familiarize the numerical solution of the linear system of equations.
2.	To understand the concept of interpolation and approximation.
3.	To obtain the knowledge about numerical differentiation, integration.
4.	To familiarize the students on solving first order ordinary differential equations using single step and multi-step methods
5.	To enable them to solve boundary value problems associated with engineering applications using numerical methods.

UNIT I	**SOLUTION OF EQUATIONS**	**9**	**0**	**0**	**9**

Solutions of nonlinear equations by Newton Raphson Method-Solutions of linear system of equations by Gauss Elimination, Gauss Jordan, Gauss Jacobi and Gauss Seidel Methods.

UNIT II	**INTERPOLATION AND APPROXIMATION**	**9**	**0**	**0**	**9**

Interpolation with Equal Intervals-Newton's Forward and Backward interpolations- Unequal intervals-Newton's divided difference formula and Lagrangian Polynomials.

UNIT III	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9**	**0**	**0**	**9**

Newton's Forward and Backward Differences to compute derivatives-Trapezoidal rule-Simpson's 1/3 rule, Simpson's 3/8 rule –Two- and three-point Gaussian quadrature formulas.

UNIT IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS**	**9**	**0**	**0**	**9**

Solving first order ODE – Single step method: Taylor series method-Euler and modified Euler Method-Fourth order Runge-Kutta method- Multistep method: Milne's and Adam's predictor and corrector methods.

UNIT V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**	**9**	**0**	**0**	**9**

Finite difference solution of second order ordinary differential equations-Finite difference solutions of one-dimensional heat equation by explicit and implicit methods-One dimensional wave equation and two-dimensional Laplace and Poisson equations.

Total (45 L + 0 T) = 45 Periods

Text Books:

1.	Veerarajan. T and Ramachandran, "Numerical methods with Programs in C and C++", Tata McGraw Hill, New Delhi, 2006.
2.	Kandasamy.P, Thilagavathy.K, Gunavathi.K, "Numerical Methods", S. Chand & Co., New Delhi, 2005.

Reference Books:

1.	Gerald, C. F. and Wheatley, P.O.," Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
2.	M.K. Venkataraman, "Numerical Methods in Science and Engineering", 5th Edition, National Publishing Company, 2000.
3.	Jain M.K. Iyengar, K & Jain R.K., "Numerical Methods for Scientific and Engineering Computation", New Age International (P) Ltd, Publishers, 2003.
4.	Manish Goyal, "Numerical Methods and Statistical Techniques Using 'C", 1st Edition, Laxmi Publications (P) Ltd, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Obtain the numerical solutions of linear and nonlinear equations.	L2: Understanding
CO2	:	Acquired the techniques of interpolation and approximations.	L2: Understanding
CO3	:	Familiarize with numerical differentiation and integration.	L2: Understanding
CO4	:	Solve the initial value problems for ordinary differential equations.	L3: Applying
CO5	:	Acquire the techniques of solving Boundary value problems.	L2: Understanding

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		2									2		
CO2	3	2		2									2		
CO3	3	2		2									2		
CO4	3	2		2									2		
CO5	3	2		2									2		
Avg	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22MAOE03	PROBABILITY AND QUEUING THEORY				
PREREQUISTIES	**CATEGORY**	**L**	**T**	**P**	**C**
Basic 12th level knowledge of Probability and Statistics.	**BS**	**3**	**0**	**0**	**3**

Course Objectives:

1.	To understand the basic concepts of one-dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
2.	To understand the concept of two-dimensional random variables, Correlation and linear regression.
3.	To provide necessary basic concepts in random processes for applications such as random signals, linear systems in communication engineering.
4.	To understand the concept of queueing models and apply in engineering.
5.	To understand the significance of advanced queueing models and develop probabilistic models which can be used in several areas of science and engineering

UNIT I	**RANDOM VARIABLES**	**9**	**0**	**0**	**9**

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Uniform, Exponential and Normal distributions.

UNIT II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**9**	**0**	**0**	**9**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables .

UNIT III	**RANDOM PROCESSES**	**9**	**0**	**0**	**9**

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations .

UNIT IV	**QUEUEING MODELS**	**9**	**0**	**0**	**9**

Markovian queues – Birth and death processes – Single and multiple server queueing models – Little’s formula - Queues with finite waiting rooms.

UNIT V	**ADVANCED QUEUEING MODELS**	**9**	**0**	**0**	**9**

Finite source models - M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/E_K /1 as special case – Series queues – Open Jackson networks.

Total (45 L + 0 T) = 45 Periods

Text Books:

1.	Gross, D., Shortle, J.F, Thompson, J.M and Harris, C.M., “Fundamentals of Queueing Theory”, Wiley, Student 4th Edition, 2014.
2.	Ibe, O.C., “Fundamentals of Applied Probability and Random Processes”, Elsevier, 1st Indian Reprint, 2007.

Reference Books:

1.	Hwei Hsu, “Schaum‘s Outline of Theory and Problems of Probability, Random Variables and Random Processes”, Tata McGraw Hill Edition, New Delhi, 2004.
2.	Taha, H.A., “Operations Research”, 9th Edition, Pearson India Education Services, Delhi, 2016.
3.	Trivedi, K.S., “Probability and Statistics with Reliability, Queueing and Computer Science Applications”, 2nd Edition, John Wiley and Sons, 2002.
4.	Yates, R.D. and Goodman. D. J., “Probability and Stochastic Processes”, 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand the fundamental knowledge of the standard distributions which can describe real life phenomenon.	L2: Understanding
CO2	:	Understand the concepts of two-dimensional random variables, Correlation and linear regression.	L2: Understanding
CO3	:	Apply the concept of random processes in engineering disciplines.	L3: Applying
CO4	:	Acquire skills in analysing queueing models.	L2: Understanding
CO5	:	Understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.	L2: Understanding

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		2									2		
CO2	3	2		2									2		
CO3	3	2		2									2		
CO4	3	2		2									2		
CO5	3	2		2									2		
Avg	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

22CEOE01	ENVIRONMENTAL MANAGEMENT			Semester		VI
PREREQUISITES		Category	OE	Credit		3
NIL		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To study the variable natures of our environmental resources and to understand their importance associated with our societic life.
2	To study the variable categories of pollutants and their controlling measures
3	To impart an understanding of systems approach to Environmental Management as per ISO 14000 and to evaluate the management plan using gis tools
4	To impart skills for environmental performance in terms of legal compliance, pollution prevention and continual improvement.
5	To impart skills for managing the usage of our natural resources without disrupting balance and stability of the natural system.

Unit I	ENVIRONMENTAL RESOURCES	9	0	0	9

Non-renewable resources-Mineral use and exploitation; fossil fuels. Renewable resources: Water resources-supply, demand, dams-benefits and problems; Soil and Land resources- Structure, formation, erosion, conservation of soil, agricultural practices, land use,degradation and desertification; Fisheries- Inland and marine fisheries, aquaculture, overharvesting; Forest resources- Timber, Medicinal plants, fuel-wood, deforestation, forest management- Management of renewable and non-renewable resources; Sustainable use

Unit II	ENVIRONMENTAL POLLUTION	9	0	0	9

Definition of pollution and pollutants; types of pollution-Air, Water ,Soil, Noise, thermal, nuclear; causes of pollution, effects of pollution and control measures; Liquid and Solid waste management, nuclear holocausts. Case studies: leather industry, fly ash, thermal stations, nuclear power plants

Unit III	ENVIRONMENTAL MANAGEMENT SYSTEM	9	0	0	9

Environmental Management Systems; ISO14000 series; Environmental auditing: Environmental Impact Assessment; Life cycle assessment; Human health risk assessment. Management plans using GIS and RS tools

Unit IV	ENVIRONMENTAL LAW AND POLICY	9	0	0	9

Environmental Law and Policy – Objectives; Polluter pays principle, Precautionary principle; The Water and Air Acts with amendments; The Environment (Protection) Act (EPA) 1986; National Green Tribunal Act, 2010; National Environment Policy; Principles of International Law and International treaties.

Unit V	ENERGY-ENVIRONMENT AND SUSTAINABLE DEVELOPMENT	9	0	0	9

Energy and Environment: Energy sources – overview of resources and reserves; Renewable and non-renewable energy sources; Energy-Environment nexus Sustainable Development: Definition and concepts of sustainable development; Sustainable development goals; Hurdles to sustainability; Environment and economics.

Total= 45 Periods

Text Books:

1	"Natural Resources Conservation & Management" , K.K.SINGH -MD PUBLICATIONS PVT LTD
2	"Environmental Pollution " by N.MANIVASAKAM,2021
3	ISO 14001/14004: Environmental management systems –Requirements and Guidelines – International Organisation for Standardisation, 2004.
4	Fundamental Concepts in Environmental Studies by Dr.D.D Mishra

Reference Books:

1	ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002.
2	Paul LBishop „Pollution Prevention: Fundamentals and Practice‟, McGraw -Hill International, Boston,2000.

3	Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001
4	Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems –a step by step guide" Earthscan Publications Ltd, London, 1999.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the importance of variable natural resources	Understand
CO2	Understand the necessity of environmental management that will be caused by projects or industries.	Understand
CO3	Develop, Implement, maintain and Audit Environmental Management systems for Organizations.	Understand /Evaluate
CO4	Gain the Knowledge about the legal requirements of Environmental management and auditing	Remembering
CO5	Understand eco-friendly business in order to achieve sustainable development	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	2	-	-	3	1	1	1	-	1	3	3	-	2
CO2	-	1	3	-	-	3	1	1	1	-	1	3	3	-	2
CO3	1	1	1	2	2	3	1	-	2	2	3	2	3	-	3
CO4	-	1	1	-	-	3	1	1	2	2	1	2	1	-	2
CO5	1	1	3	2	1	3	3	-	2	-	3	3	3	-	2
Avg	1	1	2	2	0.6	3	1.4	0.6	1.6	2	1.8	2.6	2.6	-	2.2
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

<table>
<tr><td>22CEOE02</td><td colspan="2">DISASTER MITIGATION AND MANAGEMENT</td><td colspan="3">Semester</td><td>VI</td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>OE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">NIL</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To provide students an exposure to disasters, their significance and types</td></tr>
<tr><td>2</td><td colspan="6">To ensure that students begin to understand the relationship between vulnerability disasters, disaster prevention and risk reduction</td></tr>
<tr><td>3</td><td colspan="6">To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)</td></tr>
<tr><td>4</td><td colspan="6">To enhance the institutional processes in the country</td></tr>
<tr><td>5</td><td colspan="6">To evaluate the various case studies in disaster management</td></tr>
<tr><td>Unit I</td><td colspan="2">INTRODUCTION TO DISASTERS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters –Earthquake, Landslide, Flood, Drought, Fire etc – Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability- Global trends I n disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don"ts during various types of Disasters.</td></tr>
<tr><td>Unit II</td><td colspan="2">APPROACHES TO DISASTER RISK REDUCTION (DRR)</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural-nonstructural measures, Roles and responsibilities of- community, Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA)– Early Warning System – Advisories from Appropriate Agencies.</td></tr>
<tr><td>Unit III</td><td colspan="2">INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources.</td></tr>
<tr><td>Unit IV</td><td colspan="2">DISASTER RISK MANAGEMENT IN INDIA</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.</td></tr>
<tr><td>Unit V</td><td colspan="2">DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and fieldworks related to disaster management</td></tr>
<tr><td colspan="7" align="right">Total= 45 Periods</td></tr>
</table>

Text Books:	
1	Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13:978-9380386423
2	Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt.Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
Reference Books:	
1	Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2	Government of India, National Disaster Management Policy, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Differentiate the types of disasters, causes and their impact on environment and society	Analyze
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation	Understand
CO3	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.	Create
CO4	Use the GIS softwares for disaster risk management in india	Evaluate
CO5	Gain knowledge on various case studies of disaster management	Evaluate

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	1		1	1	1	1	1		1
CO2	1	1	1	2	1	1	1		1	1	2	1	1		1
CO3	2	1	2	2	1	-	1		2	1	2	1	1		1
CO4	1	1	2	1	3	3	2	1	3	2	3	2	2	2	3
CO5	1	2	2	2	2	2	2	1	2	2	2	2	2		2
Avg	1.4	1.2	1.6	1.6	1.6	1.6	1.4	1	1.8	1.4	2	1.4	1.4	2	1.6
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22CEOE03	REPAIR AND REHABILITATION OF BUILDING ELEMENTS			Semester			VI
PREREQUISITES			Category	OE	Credit		3
Construction materials and Technology & Concrete Technology			Hours/Week	L	T	P	TH
				3	0	0	3
Course Learning Objectives							
1	To get the knowledge on causes of deterioration of structure						
2	To know about the assessment of distressed structures						
3	To get the knowledge on maintenance of building systems						
4	To know about the repairing of structures						
5	To gain knowledge about the techniques involved in the demolition procedure						
Unit I	**MAINTENANCE AND REPAIR STRATEGIES**			**9**	**0**	**0**	**9**
Maintenance, repair and rehabilitation, Facts of Maintenance, importance of Maintenance various aspects of inspection, assessment procedure for evaluating a damaged structure, causes of deterioration.							
Unit II	**MAINTENANCE OF ELECTRICITY AND DOMESTIC WATER PUMP SYSTEMS**			**9**	**0**	**0**	**9**
Load rating of lighting devices and usual household appliances, electric supply from street line to building, devices for alternate supply during power failure, importance of earth leakage circuit breaker (ELCB), Maintenance of electric system in buildings. General specifications of water pumps, centrifugal pumps, jet pumps and submersible pumps, general rules in operation of water pumps. Maintenance of the sump.							
Unit III	**MATERIALS AND TECHNIQUES FOR REPAIR**			**9**	**0**	**0**	**9**
Materials for Repair: Special concretes and mortar concrete chemicals construction chemicals Expansive cement polymer concrete sulphur infiltrated concrete Ferro cement Fibre reinforced concrete Rust eliminators and polymers coating for rebar foamed concrete dry pack vacuum concrete asphalt sheeting Techniques for Repairs Gunniting, grouting and Shotcrete Epoxy injection							
Unit IV	**REPAIRS,REHABILITATION AND RETROFITTING OF BUILDING SYSTEMS**			**9**	**0**	**0**	**9**
Repairs of RC beams and columns damaged by steel corrosion, repair of rising dampness in walls, repair of efflorescence effect, repair of cracks in concrete structures, repair of rain water, groundwater leakage in buildings.							
Unit V	**DEMOLITION TECHNIQUES**			**9**	**0**	**0**	**9**
Engineered demolition techniques for dilapidated structures- case studies							
Total= 45 Periods							

Text Books:	
1	Varghese P.C., Maintenance Repair Rehabilitation and Minor Works of Buildings, PHI Learning pvt.ltd.,NewDelhi,2014
Reference Books:	
1	Santhakumar A.R, Training Course notes on Damage Assessment and Repair in Low cost housing, “RHDC.NBO” Anna University, July 1992.
2	Shetty, M.S., Concrete Technology-Theory and Practice, S. Chand and company, NewDelhi,1992
3	RaikarR.N., Learning from failures- deficiencies in design, construction and services– R &D centre (SDCPL), raikar bhavan, Bombay,1987
4	Palaniyappan, N., Estate management, Anna Institute of Management, Chennai, 1992.
5	Lakshmipathy, M. et al., Lecture notes of workshop on Repairs and Rehabilitation of structures, 29-30thoctober 1999.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Carry out the damage assessment and Rapid Visual inspection of a building showing signs of deterioration and thus should be able to detect the possible cause /source of deterioration	Analyse
CO2	Know how to Maintain and repair the building systems like electricity, plumbing etc.	Remember
CO3	Know how of the Concrete repair industry equipped with variety of repair materials and techniques	Remember
CO4	Know the various repair works in building systems.	Remember
CO5	Demonstrate the dismantling and demolishing structures	Apply

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	-	**1**
CO2	-	-	-	-	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	-	**1**
CO3	-	-	-	-	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	-	**1**
CO4	-	-	-	-	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	-	**1**
CO5	-	-	-	-	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**1**	-	**1**
Avg	-	-	-	-	**1.6**	**1.2**	**1**	**1.2**	**1.2**	**1.25**	**1.5**	**1**	**1.2**	-	**1**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22CEOE04	MECHANICS OF DEFORMABLE BODIES			Semester		VI
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
Mechanics of Solids and Strength of Materials		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To learn the fundamental concepts of stress, strain and their relations based on linear elasticity with applications to bars and beams.
2	Analyze the bending of various types of beams under static loading conditions and compute the shear-moment diagrams of a beam and find the Maximum moment/shear and their locations for different cross sections of beams.
3	Understand the basic concept of theory of flexure and torsion, springs and strain energy.
4	To learn the principles of mechanics applied to different materials under static conditions and to develop problem solving skills through application of these principles to basic engineering problems.
5	To learn the principles of mechanical behavior of engineering materials, various tests under dynamics conditions and parametric studies.

Unit I	**SIMPLE STRESSES, BEHAVIOUR OF COMPOSITE SECTIONS, THERMAL STRESSES**	**9**	**0**	**0**	**9**
Mechanical properties of solids –Hooke's law, principle of superposition, Bars of varying sections –Elastic constants – composite sections – determination of stress, strain , deformation –Temperature stress ,strain					
Unit II	**BENDING AND SHEAR**	**9**	**0**	**0**	**9**
Types of beams – shear force and bending moment. Theory of simple bending - Analysis of stress-load carrying capacity. Shear stress distribution of simple beams of different cross sections					
Unit III	**TORSION AND SPRINGS**	**9**	**0**	**0**	**9**
Torsion of circular shaft – Hollow and solid circular section, torsional rigidity-stepped shaft-Twist and torsional stiffness-compound shaft-shafts springs-Stiffness and deflection of helical springs, leaf spring					
Unit IV	**MECHANICAL BEHAVIOUR OF MATERIALS UNDER STATIC LOADS**	**9**	**0**	**0**	**9**
Tension tests – stress – strain diagram, Elastic and plastic regions – True stress – strain properties in tension – fracture under tensile loads – compression and Torsion tests – stress concentration –Residual stresses					
Unit V	**MECHANICAL BEHAVIOUR OF MATERIALS UNDER DYNAMIC LOADS**	**9**	**0**	**0**	**9**
Fatigue loading and Fatigue fracture – Fatigue tests – Empirical relations between variable stress and mean stress – Fatigue stress concentration Factors – Cumulative Damage – Endurance limit –Impact – notched – Bar Impact tests, Charpy Impact tests – Izod Impact tests – Elevated temperature – Creep tests – Isochronous curves – stress Relaxation – Parametric methods					
					Total= 45 Periods

Text Books:	
1	James M.Gere, Mechanics of Materials, Brooke/Cole Thomson Learning, 5 Ed., 2001.
2	Dr.R.Vaithiyanathan, Dr. P. Perumal &Lingeswari", Mechanics of Solids and StructuresVolume-I" Sci- tech publications, India(Pvt) Chennai-17.
3	Srinath L.S; - Strength of materials – Macmillan India Limited – New Delhi,2017

Reference Books:	
1	Popov.E.P., “Engineering Mechanics of solids”, Prentice- Hall of India, New Delhi
2	Beer F.P and Johnston R, “Mechanics of Materials”, McGraw- Hill book Co, Third Edition
3	Timoshenko S.P., “Elements of Strength of Materials”, Tata McGraw- Hill, New Delhi
4	Nash W.A., “Theory and Problems in Strength of Materials”, Schuam outline Series, McGraw- Hill Book Co., New York.
5	Rajput. R.K., “Strength of Materials”, S. Chand & Co, Delhi, Third Edition, 2003.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	To acquire basic knowledge of stress strain and deformation of structures of varying cross sections of bars.	Knowledge
CO2	To draw Shear Force and Bending Moment Diagram for transverse loading under various types of loadings and beams.	Analyse
CO3	To solve problems of Torsional shear stress for shaft and stiffness and deflection of springs	Apply
CO4	Describe the mechanical behaviour of engineering materials subjected to various types of stresses	Understand
CO5	Understand the concept of mechanical behaviour under dynamic loading of various tests to find the stresses induced in the materials.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	2	-	-	1	-	-	-	-	1	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	1	1	-	1	-	-	-	-	-	-	-	1	-	-	-
CO4	1	1	-	1	-	-	-	-	-	-	1	1	-	-	-
CO5	1	1	-	1	-	-	-	-	-	-	1	1	-	-	-
Avg	1	1	-	1.25	-	-	1	-	-	-	1	1	-	-	-

22CSOE01	OBJECT ORIENTED PROGRAMMING CONCEPTS					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Problem Solving and C Programming		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:	
1.	To understand object oriented programming concept
2.	To apply object oriented concept for problem solving
3.	To design solutions to the real world problems using object oriented concept.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Procedure oriented programming paradigm - Object oriented programming paradigm - Basic concepts of object oriented programming, benefits of OOP, application of OOP - C++ fundamentals –structure of C++ program, tokens, data types - Operators and expressions - Control structures - Functions.					
UNIT II	**CLASSES AND OBJECTS**	**9**	**0**	**0**	**9**
Classes and objects - friend functions- constructors and destructors- Operator overloading – binary and unary operator overloading using member function and friend function - Type conversions.					
UNIT III	**INHERITANCE AND VIRTUAL FUNCTIONS**	**9**	**0**	**0**	**9**
Inheritance – defining derived classes, types, virtual base classes, abstract classes, constructor in derived classes - Pointers- pointers to objects, this pointer, pointer to derived classes - Virtual functions.					
UNIT IV	**TEMPLATES AND EXCEPTION HANDLING**	**9**	**0**	**0**	**9**
Generic Classes – class template, class templates with multiple parameters - Generic Functions - function templates, function templates with multiple parameters, member function templates - Exception handling – basics, exception handling mechanism, rethrowing an exception .					
UNIT V	**CONSOLE I/O AND FILE HANDLING**	**9**	**0**	**0**	**9**
C++ Stream Classes – unformatted I/O operations, formatted console I/O operations, manipulators - Files-classes for file operation, opening and closing a file, detecting end of file, files modes, sequential file operations, random file operations.					
					Total (45 L) =45 Periods

Text Books:	
1.	E. Balagurusamy “Object Oriented Programming with C++”, Eighth Edition, Tata McGraw-Hill, 2020.
Reference Books:	
1.	Herbert Schildt, "The Complete Reference C++", Fifth Edition, Tata McGraw Hill, 2015.
2.	Bjarne Stroustrup, “The C++ programming language”, Fourth Edition Addison Wesley, 2013.
3.	K.R.Venugopal, Rajkumar Buyya, T.Ravishankar , Mastering in C++, Second Edition, Tata McGraw Hill,2013.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Familiarize the object oriented programming concepts, Generic Programming and handling exceptions.	Understand
CO2	Build Object Oriented Programming concepts for problem solving.	Apply
CO3	Develop solutions to real world problems using Object Oriented Concepts.	Apply

22CSOE02	OPERATING SYSTEMS PRINCIPLES					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the structure and functions of Operating systems
2.	To understand the process concepts and scheduling algorithms
3.	To understand the concept of process synchronization and deadlocks
4.	To learn various memory management schemes
5.	To illustrate various file systems and disk management strategies

UNIT I	**INTRODUCTION AND OPERATING SYSTEM STRUCTURES**	**9**	**0**	**0**	**9**

Main frame Systems, Desktop Systems, Multiprocessor Systems, Distributed Systems, Clustered Systems, Real Time systems, Hand held Systems; Operating Systems Structures - System Components, Operating System Services, System calls, System Programs, System Design and Implementation.

UNIT II	**PROCESS MANAGEMENT**	**9**	**0**	**0**	**9**

Processes-Process Concepts, Process Scheduling, Operation on Processes, Co-Operating Processes, InterProcess Communication; Threads- Multithreading Models, Threading Issues; CPU Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT III	**PROCESS SYNCHRONIZATION AND DEADLOCKS**	**9**	**0**	**0**	**9**

Process Synchronization- The Critical Section Problem, Semaphores, Classical Problem of Synchronization, Monitors; Deadlocks- Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance ,Deadlock Detection, Recovery from Deadlock.

UNIT IV	**MEMORY MANAGEMENT AND VIRTUAL MEMORY**	**9**	**0**	**0**	**9**

Memory Management- Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging; Virtual Memory - Demand paging, Page Replacement, Thrashing.

UNIT V	**FILE SYSTEM AND MASS-STORAGE STRUCTURE**	**9**	**0**	**0**	**9**

File System Interface - File Concepts, Access methods, Directory Structure, File Sharing, File Protection; File System Implementation - File System Structure and Implementation, Directory Implementation, Allocation Methods, Free Space Management; Mass-Storage Structure - Disk Structure, Disk scheduling, Disk Management, RAID Structure.

Total (45 L) =45 Periods

Text Books:

1.	Abraham Silberschatz, P.B.Galvin, G.Gagne ―Operating System Concepts 6th edition, John Wiley & Sons, 2003.

Reference Books:

1.	Andrew S. Tanenbaum, ―Modern Operating Systems, PHI , 2nd edition, 2001
2.	D.M.Dhamdhere, "Systems Programming and Operating Systems ", 2nd edition, Tata McGraw Hill Company, 1999.
3.	Maurice J. Bach, ―The Design of the Unix Operating System, 1st edition, PHI, 2004.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Interpret the components and functionalities of the operating system	Understand
CO2	Apply various services and concepts of operating system to real time applications	Apply
CO3	Analyze the issues related to operating system and provide suitable solutions.	Analyze

22CSOE03	COMPUTER COMMUNICATIONS AND NETWORKS					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To study the concepts of data communications and functions of different ISO/OSI reference architecture
2.	To understand the error detection and correction methods and also the types of LAN
3.	To study the concepts of subnetting and routing mechanisms
4.	To understand the different types of protocols and congestion control
5.	To study the application protocols and network security

UNIT I	**DATA COMMUNICATIONS AND PHYSICAL LAYER**	**9**	**0**	**0**	**9**
Data Communication; Networks- Physical Structures (Types of Connections, Physical Topology),Categories of Networks, Interconnection of Networks: Internetwork; Protocols and Standards; Network Models-The OSI Model, Layers in the OSI Model, Addressing; Transmission media-Guided Media, Unguided Media.					
UNIT II	**DATA LINK LAYER**	**9**	**0**	**0**	**9**
Introduction-Types of errors, Redundancy, Detection versus Correction; Block Coding-Error Detection and Correction (VRC, LRC, CRC, Checksum, Hamming Code);Data link Control- Flow Control (Stop- and-Wait, Sliding Window),Error Control (Automatic Repeat Request, Stop-and-wait ARQ, Sliding Window ARQ), HDLC; Local Area Networks- Ethernet, Token Bus, Token Ring.					
UNIT III	**NETWORK LAYER**	**9**	**0**	**0**	**9**
Network Layer services-Packet Switching-Network Layer Performance-IPv4 addresses-IPv6 addressing- Subnetting-Bridges-Gateways- Routers-Routing Algorithm-Distance Vector Routing, Link State Routing.					
UNIT IV	**TRANSPORT LAYER**	**9**	**0**	**0**	**9**
Duties of the Transport layer-User Datagram Protocol-Transmission Control Protocol- Congestion Control and Quality of Service-Congestion, Congestion Control, Quality of Service, Techniques to improve QoS.					
UNIT V	**APPLICATION LAYER**	**9**	**0**	**0**	**9**
Domain Name System - Domain Name Space, DNS in the Internet; Electronic Mail-FTP- HTTP- World Wide Web.					
					Total (45 L) =45 Periods

Text Book:

1.	Behrouz A. Ferouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, 2007.

Reference Books:

1.	Andrew S. Tanenbaum, "Computer networks "PHI, 4th edition 2008
2.	William Stallings," Data and computer communications", 10th edition,PHI, 2012
3.	Douglas E. comer," Internetworking with TCP/IP-Volume-I", 6th edition,PHI, 2008

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the fundamental concepts of networking and working principles of various communication protocols.	Understand
CO2	Apply the various functionalities of OSI layers in real time applications	Apply
CO3	Analyze the various network issues in different layers and provide suitable solutions.	Analyze

22CSOE04	PYTHON PROGRAMMING					
PREREQUISITES		Category	OE	Credit		3
NIL		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives	
1	To Learn the basic concepts of python programming.
2	To write simple programs using python programming concepts.
3	To build simple real world applications using python.

UNIT I	INTRODUCTION	9	0	0	9
Introduction - Features- The Basics - Numbers, Sequence: Strings, Lists, Tuples, Mapping and set types. Variables- Operators- Expressions- Precedence of operators – Comments - Input and output functions - Formatting numbers and strings- Implicit/explicit type conversion.					
UNIT II	**CONDITIONS,CONTROL STRUCTURES AND FILES**	**9**	**0**	**0**	**9**
Conditionals and loops-if statement-else statement – elif-Conditional Expressions-while statement-for statement – break-continue –pass; Files and Input/ Output.					
UNIT III	**PYTHON EXCEPTIONS, MODULES AND PACKAGES**	**9**	**0**	**0**	**9**
Errors and Exceptions – Introduction-Detecting and handling Exceptions- Raising Exceptions – Assertions-Standard Exceptions – Modules: user defined modules, random and o s modules - Packages.					
UNIT IV	**FUNCTIONS**	**9**	**0**	**0**	**9**
Functions-Calling functions-Creating functions-Passing Functions-Formal Arguments-Variable length arguments- Variable scope – Recursion- Map, Filter, Reduce and List Comprehensions-Iterators -Generator Expressions.					
UNIT V	**OBJECT ORIENTED PROGRAMMING AND REGULAR EXPRESSION**	**9**	**0**	**0**	**9**
Introduction – Classes- Class Attributes – Instances-Instances attributes-Building and Method Invocation-Static methods and Class Methods – Inheritance-Operator overloading-Regular Expression.					
					Total (45 L) =45 Periods

Text Books:	
1.	Wesley J.Chun-“Core Python Programming” –Prentice Hall, Third Edition, 2012.
Reference Books:	
1.	Swaroop C N, “ A Byte of Python “, ebshelf Inc., 1st Edition, 2013
2.	“A Practical Introduction to python programming”, Brian Heinold,MountSt.Mary’s University,2012
3.	Learning to Program with Python,” Richard L. Halterman”., Southern Adventist University

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	To understand the basic concepts of python programming.	Understand
CO2	To design simple programs using python programming concepts.	Apply
CO3	To apply python programming concepts in the real world application.	Analyze

22CSOE05	INTRODUTION TO PROGRAMMING IN JAVA					
PREREQUISITES		CATEGORY	OE	Credit		3
C Programming		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To familiarize and apply the Object Oriented concepts and java features
2.	To write the standalone applications and applet applications
3.	To build simple chart application and Database Connectivity

UNIT I	INTRODUCTION TO JAVA	9	0	0	9

Fundamentals of object oriented programming- java features, comparing JAVA with C and C++, JAVA environment; Overview of java language - java program structure, java tokens, java statements, implementing java program, java virtual machine, command line arguments; constants, variables and data types - Operators and expressions - Decision making – branching and looping.

UNIT II	JAVA FEATURES	9	0	0	9

Classes, objects methods – arrays, Strings and Vectors– Interfaces – Packages - Multithreaded programming- Exception handling.

UNIT III	APPLET	9	0	0	9

Applet programming- build applet code, applet life cycle, creating executable applet, designing a web page, applet tag, running the applet ,passing parameters to Applet; Graphics programming – graphics class, lines, rectangles, circles, ellipses, arcs and polygons

UNIT IV	AWT CONTROLS	9	0	0	9

Event handling – event handling Mechanisms, delegation event model, event classes, sources of events, event listener interfaces; AWT - AWT controls, Layout Managers, Menu Bars and Menus, Dialog Boxes, FileDialogs;

UNIT V	I/O FILES AND JDBC	9	0	0	9

I/O Files- concepts of stream, stream classes, byte stream classes, character stream classes, file classes, creation of files, reading and writing characters and bytes; Design of JDBC - JDBC drivers; JDBC programming concepts - Database concepts, making connection, executing SQL commands, managing connections, statements, and result sets; Query execution - Prepared Statements.

Total(45L)=45Periods

Text Books:

1.	E. Balaguruswamy, “Programming with java”, Sixth, TMH 2019 (Unit- I-III)
2.	Patrick Naughton , Herbert Schildt, “The Complete Reference Java 2” , Twelfth edition Tata McGraw Hills , 2021 (Unit IV - V)

Reference Books:

1.	Cay S. Horstmann, Gary Cornell “ Core Java 2” Eighth Edition, Pearson Education, 2008
2.	Graham Hamilton , Rick Cattell, Maydene Fisher ,”JDBC Database access with java”.1997
3.	PaulDeitel and Harvey Deitel, “Java How to Program”, Eleventh Edition, Pearson Prentice Hall 2017.

COURSEOUTCOMES: Upon completion of the course ,the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Familiarize the Object Oriented concepts and java features	Understand
CO2	Build the simple standalone applications and web applications	Create
CO3	Develop simple application using files and Database	Create

22CSOE06	COMPUTER ORGANIZATION				SEMESTER VI	
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Digital Principles and System Design		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:	
1.	To understand the basic structure and operations of digital computer and to learn the working of different arithmetic operations.
2.	To expose different types of processor control and the concept of pipelining and to familiarize hierarchical memory system including cache memory and virtual memory
3.	To expose the different ways of communicating with I/O devices and standard I/O interfaces

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Functional units ,Basic Operational Concepts, Bus Structure ,Memory Locations and Addresses, MemoryOperations, Instruction and Instruction Sequencing, Addressing modes.					
UNIT II	**ARITHMETIC UNIT**	**9**	**0**	**0**	**9**
Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, BoothAlgorithm, Fast Multiplication, Integer Division, Floating point number operations.					
UNIT III	**PROCESSOR UNIT AND PIPELINING**	**9**	**0**	**0**	**9**
Fundamental Concepts, Execution of Instruction, Multi Bus Organization, Hardwired control, Micro programmed control, Basic Concepts of pipelining, Data Hazards, Instruction Hazards, Data path & Control Considerations.					
UNIT IV	**MEMORY SYSTEMS**	**9**	**0**	**0**	**9**
Basic Concepts, Semiconductor RAM, ROM, Cache memory, Improving Cache Performance, Virtual memory, Memory Management requirements, Secondary Storage Device.					
UNIT V	**INPUT AND OUTPUT ORGANIZATION**	**9**	**0**	**0**	**9**
Accessing I/O devices, Programmed I/O, Interrupts, Direct Memory Access, Interface circuits, Standard I/OInterfaces (PCI, SCSI, USB).					
					Total (45 L)= 45 Periods

Text Books:	
1.	Carl Hamacher V.,Zvonko G.Vranesic, Safwat G. Zaky, " Computer organization ", Tata McGraw Hill,5th Edition, 2008.
Reference Books:	
1.	Patterson and Hennessey, “Computer Organization and Design ". The Hardware/Software interface,Harcourt Asia Morgan Kaufmann, 3rd Edition, 2007
2.	Hayes, “Computer Architecture and Organization ", 3rd edition,Tata McGraw Hill, 2006
3.	Heuring V.P., Jordan H.F., " Computer System Design and Architecture ", 6th edition ,Addison Wesley,2008

COURSE OUTCOMES Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Understand the working principles of computer components	Understand
CO2	Design the arithmetic and processing units	Create
CO3	Analyze the various computer components	Analyze

22CSOE07	DATA STRUCTURES USING C++					SEMESTER VI	
PREREQUISITES		**Category**	**OE**	**Credit**			**3**
C Programming		**Hours/Week**	**L**	**T**		**P**	**TH**
			3	**0**		**0**	**3**

Course Learning Objectives

1	To comprehend the fundamentals of object oriend programming, particularly in C++
2	To design linear and non linear data structure using object programming concepts
3	To apply various sorting and searching alogorithims.

UNIT I	**DATA ABSTRACTION & OVERLOADING**	**9**	**0**	**0**	**9**

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Overloading: Function overloading and Operator Overloading.

UNIT II	**INHERITANCE AND POLYMORPHISM**	**9**	**0**	**0**	**9**

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Class Object to Base – Class Object Conversion – Virtual functions – this Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding.

UNIT III	**LINEAR DATA STRUCTURES**	**9**	**0**	**0**	**9**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –Singly Linked lists –Polynomial Manipulation – Stack ADT – Queue ADT – Evaluating arithmetic expressions.

UNIT IV	**NON-LINEAR DATA STRUCTURES**	**9**	**0**	**0**	**9**

Trees – Binary Trees – Binary tree representation and traversals – Application of trees – Binary Search Tree - Heaps - Operations of Heaps - Binary Heap - Max Heap - Min Heap - Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search.

UNIT V	**SORTING AND SEARCHING**	**9**	**0**	**0**	**9**

Sorting algorithms: Insertion sort – Quick sort – Merge sort – Searching: Linear search –Binary Search

Total (45 L) =45 Periods

Text Books:

1	Deitel and Deitel, “C++, How To Program”, Tenth Edition, Pearson Education, 2017.
2	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Fourth Edition, Addison Wesley, Copyright 2014.

Reference Books:

1	Bhushan Trivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press,2010.
2	Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7thEdition, Wiley. 2004.
3	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Second Edition, Mc Graw Hill, 2002.
4	Bjarne Stroustrup, “The C++ programming language”, Fourth Edition Addison Wesley, 2013.
5	Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, 2007.

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Understand the concepts of Object oriented programming	Understand
CO2	Design linear and non-linear data structure using object oriented programming concepts	Apply
CO3	Apply various sorting and searching Alogarithms.	Analyze

22CSOE08	CLOUD COMPUTING FUNDAMENTALS				
PREREQUISITES:	**CATEGORY**	**OE**	**Credit**		**3**
Computer Networks	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To introduce the broad perceptive of Parallel Computing, Distributed Computing and Cloud Computing.
2.	To understand the concept of Virtualization, Cloud Architecture and Storage.
3.	To understand the Cloud Platforms in Industry and Software Environments.
4.	To understand the concept of Cloud Security and Applications.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

The vision of Cloud Computing – Defining a Cloud – The Cloud Computing reference model –Characteristics and Benefits; Historical developments: Distributed systems – Virtualization - Web 2.0 - Service-oriented computing - Utility-oriented computing.
Principles of Parallel and Distributed Computing: Parallel vs. distributed computing - Elements of parallel and distributed computing - Technologies for distributed computing.

UNIT II	**VIRTUALIZATION**	**9**	**0**	**0**	**9**

Introduction - Characteristics of Virtualized environments - Virtualization techniques: Machine Reference Model – Hardware Level Virtualization - Programming Language Level Virtualization –Application Level Virtualization - Other types of Virtualization - Pros and cons of Virtualization.

UNIT III	**CLOUD ARCHITECTURE AND STORAGE**	**9**	**0**	**0**	**9**

The cloud reference model: IaaS, PaaS, SaaS; Types of clouds: Public clouds – Private clouds – Hybrid clouds – Community clouds ;Architectural design challenges.
Cloud Storage: Storage as a Service – Advantages of cloud storage – Cloud Storage Provider: Amazon Simple Storage Service (S3).

UNIT IV	**CLOUD INDUSTRIAL PLATFORMS AND SOFTWARE ENVIRONMENTS**	**9**	**0**	**0**	**9**

Cloud Platforms in Industry: Amazon Web Service - Google App Engine - Microsoft Azure; Cloud Software Environments -Hadoop –Map Reduce -Eucalyptus – Open Nebula;

UNIT V	**CLOUD SECURITY AND APPLICATIONS**	**9**	**0**	**0**	**9**

Security in the cloud: Cloud Security challenges – Software as a Service Security: Security Management – Security governance – Security Architecture Design -Virtual Machine Security – Identity Access Management.
Cloud Scientific Applications: Healthcare: ECG analysis in the cloud- Geo science: Satellite Image Processing.

Total (45 L)=45 Periods

Text Books:

1.	Rajkumar Buyya, Christian Vecchiola, S.TamaraiSelvi, ‘Mastering Cloud Computing-Foundations and Applications Programming”, TMGH,2013.
2.	Rittinghouse, John W., and James F. Ransome – Cloud Computing: Implementation, Management and Security. CRC Press, 2017.

Reference Books:

1.	Kai Hwang.GeoffreyC.Fox.JackJ.Dongarra, “ Distributed and Cloud Computing ,From Parallel Processing to The Internet of Things”, 2012 Elsevier
2.	Barrie Sosinsky, “Cloud Computing Bible”, Wiley Publisher, 2011

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explain the main concepts and architecture of Parallel computing, Distributed Computing and Cloud Computing.	Understand
CO2	Analyze the concept of Virtualization, Cloud Architecture and Storage.	Analyze
CO3	Analyze the Cloud Platforms in Industry and Software Environments.	Analyze
CO4	Identify the security issues in scientific and real time applications.	Apply

22CSOE09	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING				
PREREQUISITES:	**CATEGORY**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To learn the various characteristics of Intelligent agents, different search strategies and represent knowledge in solving AI problems
2.	To understand the need for machine learning for various problem solving
3.	To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning

UNIT I	INTRODUCTION	9	0	0	9

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II	PROBLEM SOLVING METHODS	9	0	0	9

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning.

UNIT III	KNOWLEDGE REPRESENTATION	9	0	0	9

First Order Predicate Logic – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information.

UNIT IV	LEARNING PROBLEMS	9	0	0	9

Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT V	NEURAL NETWORKS AND GENETIC ALGORITHMS	9	0	0	9

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

Total (45 L)=45 Periods

Text Books:

1.	S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009
2.	I. Bratko, ―Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011
3.	Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Reference Books:

1.	M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008
2.	Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009
3.	William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003

E-References:	
1.	https://builtin.com/artificial-intelligence
2.	https://science.howstuffworks.com/robot6.htm
3.	https://onlinecourses.nptel.ac.in/noc18_cs40/preview, (Prof. Sudeshna Sarkar,IIT KHARAGPUR)
4.	Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning From Theory to Algorithms, Cambridge University Press, 2014
5.	Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Use appropriate search algorithms for any AI problem	Apply
CO2	Represent a problem using first order and predicate logic	Understand
CO3	Differentiate between supervised, unsupervised, semi-supervised machine learning approaches	Analyze
CO4	Discuss the decision tree algorithm and identity and overcome the problem of over fitting	Apply

22ECOE01	FUNDAMENTALS OF ELECTRON DEVICES					OPEN ELECTIVE
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the fundamentals of electron devices and apply the knowledge of these devices in electronic circuits.
2.	To design and analyse single stage and multistage amplifier circuits.
3.	To understand and classify different kinds of power and feedback amplifiers.

Unit I	**SEMICONDUCTOR DIODE**	**9**	**0**	**0**	**9**

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diode.

Unit II	**BIPOLAR JUNCTION TRANSISTORS**	**9**	**0**	**0**	**9**

NPN -PNP -Operations-Early effect-Current equations — Input and Output characteristics of CE, CB, CC – Hybrid -p model – h-parameter model, Multi Emitter Transistor.

Unit III	**FIELD EFFECT TRANSISTORS**	**9**	**0**	**0**	**9**

JFETs — Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage, D-MOSFET, E-MOSFET- Characteristics — Comparison of MOSFET with JFET.

Unit IV	**SPECIAL SEMICONDUCTOR DEVICES**	**9**	**0**	**0**	**9**

Metal-Semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode, LASER diode.

Unit V	**POWER DEVICES AND DISPLAY DEVICES**	**9**	**0**	**0**	**9**

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS, LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.

Total (45L) = 45 periods

Text Books:

1.	Millman and Halkias, “Electronic Devices and Circuits”, 4th Edition, McGraw Hill, 2015.
2.	Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, “Electronic Devices and circuits”, Fourth Edition, Tata McGraw- Hill, 2016.

Reference Books:

1.	Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory” Pearson Prentice Hall, 11th Edition, 2014.
2.	Bhattacharya and Sharma, “Solid State Electronic Devices”, 2nd Edition, Oxford University Press, 2014.
3.	R.S.Sedha, “A Textbook of Electronic Devices and Circuits”, 2nd Edition, S.Chand Publications, 2008.
4.	David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.

E-References:

1.	https://archive.nptel.ac.in/courses/108/108/108108122/
2.	https://www.youtube.com/watch?v=qqQ8wO-lNmI
3.	https://slideplayer.com/slide/12438044/

Course Outcomes: Upon completion of this course, the students will be able to		Bloom's Taxonomy Mapped
CO1	Analyze the characteristics of semiconductor diodes.	Understanding
CO2	Describe the problems of Transistor circuits using model	Analysing
CO3	Analyze the knowledge of various types of FET.	Analysing
CO4	Gain a knowledge on special semiconductor devices	Understanding
CO5	Understand the knowledge on Power and Display devices.	Understanding

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	3	1	2	-	-	-	-	-	-	-	-	2	-	-
CO3	2	3	1	3	-	-	-	-	-	-	-	-	3	-	-
CO4	1	2	1	-	-	-	1	-	-	-	1	3	3	-	1
CO5	1	3	1	1	1	-	1	-	-	-	2	3	3	1	2
Avg	1.6	2.8	1	2	2	-	2	-	-	-	1.5	3	2.4	1	1.5
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECOE02	PRINCIPLES OF MODERN COMMUNICATION SYSTEMS					OPEN ELECTIVE
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**
Course Objectives:						
1.	To have the knowledge of the basic concepts of AM, FM and PM.					
2.	To gain knowledge about different pulse modulation and digital modulation techniques.					
3.	To gain knowledge about technical information on satellite communication and wireless communication					
Unit I	**FUNDAMENTALS OF ANALOG COMMUNICATION**		**9**	**0**	**0**	**9**
Modulation: Introduction - Amplitude modulation: Modulator and demodulator with waveforms - Angle Modulation: Frequency modulation: Modulator and demodulator with waveforms - Phase modulation - Equivalence between PM and FM - FM transmitters and receivers (Block diagram approach only) - Comparison of various Analog Communication System (AM – FM – PM).						
Unit II	**BASICS OF DIGITAL COMMUNICATION AND PULSE MODULATION**		**9**	**0**	**0**	**9**
Pulse Amplitude Modulation (PAM) – Pulse Width Modulation (PWM) – Pulse code Modulation (PCM)–Differential Pulse Code Modulation - Pulse Position modulation: Generation and detection - Comparison of various Pulse Communication System (PAM – PWM – PCM - PPM).						
Unit III	**DIGITAL MODULATION TECHNIQUES**		**9**	**0**	**0**	**9**
Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) - Minimum Shift Keying (MSK) –Binary Phase Shift Keying (BPSK) – QPSK –M- ary PSK- Comparison of various Digital Communication System (ASK – FSK – PSK).						
Unit IV	**SATELLITE COMMUNICATION**		**9**	**0**	**0**	**9**
History of Satellites- Kepler's laws - Satellite Orbits-Geo synchrous Satellites - Satellite Classification - Footprints - Satellite system link models: Uplink model and down link model - Multiple Access Techniques: TDMA - FDMA-CDMA-SDMA - Comparison of Multiple Access Schemes - various satellite services.						
Unit V	**CELLULAR MOBILE COMMUNICATION**		**9**	**0**	**0**	**9**
Cellular concept - Frequency reuse-Channel Assignment Strategy - Hand off mechanism - Basic propagation models: Reflection - diffraction and scattering - Bluetooth-WLAN-Global System for Mobile Communications (GSM) –GPRS.						
						Total (45L)= 45 Periods

Text Books:	
1.	Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
2.	Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2010
Reference Books:	
1.	Dennis Roddy, John Coolen, "Electronic Communications", Prentice Hall of India, 4th Edition.,2016
2.	H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007.
3.	B. P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.
4.	AnokhSingh , "Principles of Communication Engineering" ,S.CHAND Publication, 2002

E-References:	
1.	http://www.nptelvideos.in/2012/11/communication-engineering.html
2.	https://www.tutorialspoint.com/analog_communication/analog_communication_introduction.htm
3.	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-973-communication-system-design-spring-2006/lecture-notes/

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the need for modulation and how analog modulation takes place	Understanding
CO2	Understand the features of digital communication and pulse modulation.	Understanding
CO3	Analyse various digital modulation schemes.	Analysing
CO4	Have the knowledge about satellite communication.	Remembering
CO5	Have the basics of wireless and mobile communication.	Remembering

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	1	-	-	-	-	-	-	-	3	2	2
CO2	2	2	1	1	1	-	-	-	-	-	-	-	2	1	2
CO3	1	3	2	2	1	-	-	-	-	-	-	-	3	1	2
CO4	2	2	1	1	1	-	-	-	-	-	-	-	3	2	2
CO5	1	2	2	1	1	-	-	-	-	-	-	-	3	2	2
Avg	1.6	2.2	1.4	1.4	1	-	-	-	-	-	-	-	2.8	1.6	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECOE03	MICROCONTROLLERS AND ITS APPLICATIONS				OPEN ELECTIVE		
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**	
		Hours/Week	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives:

1.	To learn microcontroller basics and get exposure to 8051 architectures
2.	To embed and program with 8051 microcontrollers
3.	To introduce the advanced features in microcontrollers and its applications

Unit I	**INTRODUCTION TO 8051 MICROCONTROLLER**	**9**	**0**	**0**	**9**
Introduction to the concepts of microprocessors, microcontrollers, RISC, CISC, Harvard and Von Neumann architectures. Selection of microcontrollers, variants of MCS-51 family and their features. Applications of microcontrollers. 8051 architecture - Registers in 8051 - Pin description - 8051 parallel I/O ports - memory organization.					
Unit II	**ASSEMBLY LANGUAGE PROGRAMMING**	**9**	**0**	**0**	**9**
Features of machine language, assembly language, middle-level and high-level languages. 8051 Addressing modes. Instruction set: Classification, syntax and function of instructions, example programs.					
Unit III	**I/O PORT AND INTERRUPTS PROGRAMMING**	**9**	**0**	**0**	**9**
Features of I/O ports. Byte size I/O, bit addressability and configuring I/O ports, interface I/O devices such as LED, buzzer, push-button switch, relay, example programs with assembly. Polling & interrupt methods, executing an interrupt, different types, IE and IP registers, enabling, disabling and priority setting, example programs in assembly.					
Unit IV	**PIC MICROCONTROLLERS**	**9**	**0**	**0**	**9**
Main characteristics of PIC microcontrollers – PIC microcontroller families-12-bit instruction word-14-bit instruction word-16-bit instruction word-Inside a PIC microcontroller.					
Unit V	**APPLICATIONS**	**9**	**0**	**0**	**9**
Multiplexed seven-segment display, LCD module, ADC 0804, wave form generation using DAC 0808, DC motor-PWM for speed control, Stepper motor, appropriate program.					
Total (45L)= 45 Periods					

Text Books:

1.	A.Mazidi , J.C. Mazidi&R.D.McKinlay,” The 8051 Microcontroller & Embedded systems using assembly and C” (2ndEdition)
2.	Lucio Di Jasio et.al., “PIC Microcontrollers: Know It All”, Elsevier Science,2007

Reference Books:

1.	Microcontrollers & applications, Ramani Kalpathi, & Ganesh Raja
2.	Embedded C - Michael .J.Pont - Pearson Education -2002
3.	I. Scott MacKenzie, Raphael C.-W. Phan “The 8051 Microcontroller” , Pearson/Prentice Hall Publishers, 2008.
4.	M. Mahalakshmi, “8051 Microcontroller Architecture, Programming and Application”, Laxmi Publications , 2008.

E-References:

1.	https://nptel.ac.in/courses/108105102
2.	https://www.youtube.com/playlist?list=PLm_MSClsnwm9hEIDpFfDnOEu-6kVnF4ug
3.	http://www.satishkashyap.com/2012/02/video-lectures-on-microprocessors-and.html

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the basics of microcontroller and 8051 architectures.	Understanding
CO2	Develop programs for control applications using assembly language	Applying
CO3	Illustrate the use of interrupts service routines	Applying
CO4	Understand the PIC microcontroller architecture.	Understanding
CO5	Design microcontroller based simple real-world applications	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	-	2	-	2	-	-	-	-	-	-	3	-	2
CO2	1	2	-	-	-	2	-	-	-	-	-	-	-	-	1
CO3	2	2	-	3	-	1	-	-	-	-	-	-	2	-	3
CO4	1	3	-	2	-	2	-	-	-	-	-	-	2	-	1
CO5	2	3	-	1	-	2	-	-	-	-	-	-	2	-	2
Avg	1.4	2.4	-	2	-	1.8	-	-	-	-	-	-	2.25	-	1.8
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECOE04	COMPUTER NETWORKS					OPEN ELECTIVE
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:	
1.	To introduce the basic concept in modern data communication and computer networking.
2.	To introduce the students the functions of different layers and in - depth knowledge of data link layer.
3.	To make students to get familiarized with different protocols and network layer components.
4.	To introduce the basic functions of transport layer and congestion in networks.
5.	To understand the concepts of various network Applications and Data security.

Unit	Title	L	T	P	TH
Unit I	**NETWORK FUNDAMENTALS AND PHYSICAL LAYER**	**9**	**0**	**0**	**9**
Components – networks – Topologies – The OSI reference model - layers and duties. TCP/IP reference model – layers and duties, Physical Layer: Transmission Media – Guided media & unguided media - EIA 232, SONET					
Unit II	**DATA LINK LAYER**	**9**	**0**	**0**	**9**
Logical link control Functions: - Framing, Flow control, Error control: CRC, LLC protocols -HDLC, P to P- Medium access layer: - Random access, Controlled access, Channelization - Wired LANs: Ethernet IEEE 802.3, IEEE 802.4, and IEEE 802.5. Internetworking, Interconnection issues, Interconnection devices: - Repeaters, Hubs, Routers/switches and Gateways.					
Unit III	**NETWORK LAYER**	**9**	**0**	**0**	**9**
Switching-Circuit switching, packet switching, message switching. Internet protocols; IPV4, IPV6, ARP, RARP, VPN. Network Routing Algorithms - Unicast routing protocol: Distance Vector Routing – Link State Routing.					
Unit IV	**TRANSPORT LAYER**	**9**	**0**	**0**	**9**
Transport Services, Elements of Transport protocols, Connection management, – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control and Quality of services (QoS) – Integrated Services					
Unit V	**APPLICATION LAYER**	**9**	**0**	**0**	**9**
Domain Name Space (DNS) – Electronic mail (SMTP, MIME, POP3, IMAP4) - Application protocols: WWW, HTTP, FTP and TELNET, Network management protocol: SNMP.					
	Total (45L)= 45 Periods				

Text Books:	
1.	Behrouz A. Foruzan, “Data communication and Networking”, TMH, 4th edition, 2014.
2.	James. F. Kurouse& W. Ross, “Computer Networking: A Top down Approach Featuring”, Pearson, 2020.
Reference Books:	
1.	LarryL.Peterson&PeterS.Davie,“ComputerNetworks”,HarcourtAsiaPvt.Ltd.,SecondEdition.
2.	AndrewS.Tanenbaum,“ComputerNetworks”,PHI,FourthEdition,2003.
3.	An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education
4.	AjitPal,“DataCommunicationandComputerNetworks”,PHI,2014.
E-References:	
1.	https://nptel.ac.in/courses/106105183
2.	https://www.mbit.edu.in/wp-content/uploads/2020/05/Computer-Networks-5th-Edition.pdf
3.	https://www.tutorialspoint.com/data_communication_computer_network/index.htm

Course Outcomes: Upon completion of this course, the students will be able to:			Bloom's Taxonomy Mapped
CO1	:	Explain the basic concept in modern data communication and different level of layers in the protocol	Understanding
CO2	:	Analyse the functions and services of data link layer	Analysing
CO3	:	Categorize the functions and services of network layer	Understanding
CO4	:	Examine the basic functions of transport layer and congestion in networks	Understanding
CO5	:	Analyse the concepts of various network applications and data security	Analysing

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	-	1	-	-	-	-	-	-	-	2	-	1
CO2	2	1	2	-	1	-	-	-	-	-	-	-	2	1	1
CO3	2	1	1	-	-	-	-	-	-	-	-	-	3	1	2
CO4	3	2	1	-	2	-	-	-	-	-	-	-	2	-	2
CO5	2	1	1	-	1	-	-	-	-	-	-	-	1	1	1
Avg	2.2	1.2	1.2	-	1.25	-	-	-	-	-	-	-	2	1	1.4
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECOE05	BASICS OF EMBEDDED SYSTEMS					OPEN ELECTIVE			
PREREQUISITES					**CATEGORY**	**OE**	**Credit**		**3**
					Hours/Week	**L**	**T**	**P**	**TH**
						3	**0**	**0**	**3**

Course Objectives:

1.	To impart knowledge on embedded system architecture and embedded development Strategies
2.	To understand the bus Communication in processors and peripheral interfacing
3.	To understand basics of Real Time Operating System

Unit I	**BASICS OF EMBEDDED SYSTEMS**	**9**	**0**	**0**	**9**
Introduction - Fundamental Components of Embedded Systems - Challenges for Embedded Systems - Examples - Programming Languages - Recent Trends in Embedded Systems - Architecture of Embedded Systems - Embedded Design Life Cycle - Selection Process - Hardware Software Partitioning - Development Environment.					
Unit II	**MEMORY MANAGEMENT AND INTERRUPTS**	**9**	**0**	**0**	**9**
Memory Access Procedure - Types of Memory - Memory Management Methods - DMA – Memory Interfacing - Polling Vs Interrupts - Types of Interrupts - Interrupt Latency - Interrupt Priority – Programmable Interrupt Controllers - Interrupt Service Routines.					
Unit III	**COMMUNICATION INTERFACES**	**9**	**0**	**0**	**9**
Interfacing Buses - Serial Interfaces - RS232/UART - RS422/RS485 - I2C Interface - SPI Interface - USB – CAN - IRDA - Ethernet - IEEE 802.11 – Bluetooth					
Unit IV	**REAL TIME OPERATING SYSTEMS**	**9**	**0**	**0**	**9**
Real-Time Concepts - Task Management - Task Scheduling - Classification of Scheduling Algorithms - Clock Driven Scheduling - Event Driven Scheduling - Resource Sharing - Priority Inheritance Protocol - Priority Ceiling Protocol - Inter Task Communication - Mutex - Semaphores - Message Queues - Timers - Commercial RTOS.					
Unit V	**VALIDATION AND DEBUGGING**	**9**	**0**	**0**	**9**
Host and Target Machines - Validation Types and Methods - Host Testing - Host-Based Testing Setup - Target Testing - Remote Debuggers and Debug Kernels - ROM Emulator - Logical Analyzer – Background Debug Mode - InCircuit Emulator CASE STUDY: RFID Systems - GPS Navigation System – Development of Protocol Converter.					
					Total (45L)= 45 Periods

Text Books:

1.	Sriram VIyer and Pankaj Gupta, ―Embedded Real-time Systems Programming‖, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
2.	Arnold S Berger, ―Embedded Systems Design - An Introduction to Processes, Tools and Techniques, Elsevier, New Delhi, 2011.

Reference Books:

1.	Prasad K V K K, ―Embedded/Real-Time Systems: Concepts, Design and Programming – The Ultimate Reference, Himal Impressions, New Delhi, 2003
2.	Heath, "Embedded Systems Design‖", Newnes an Imprint of Elsevier, Massachusetts, 2003.
3.	Tammy Noergaard, "Embedded Systems Architecture‖, Newnes an Imprint of Elsevier, Massachusetts, 2006.
4.	Raj Kamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013

E-References:

1.	https://lecturenotes.in/subject/225/embedded-system-es
2.	https://nptel.ac.in/courses/108102045/19
3.	https://www.coursera.org/learn/introduction-embedded-systems.

Course Outcomes: Upon completion of this course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Outline the concepts of embedded systems	Remembering
CO2	Understand the concept of memory management system and interrupts.	Understanding
CO3	Know the importance of interfaces.	Understanding
CO4	Understand real time operating system concepts.	Understanding
CO5	To realize the applications of validation and debugging.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	3	3	3	2	-	-	-	3	3	3	-	2
CO2	3	3	2	3	3	3	2	-	-	-	3	3	3	-	2
CO3	3	3	3	3	3	3	2	-	-	-	3	3	3	-	2
CO4	3	3	2	3	3	3	2	-	-	-	2	3	3	-	2
CO5	3	3	2	3	3	3	2	-	-	-	3	3	3	-	2
Avg	3	3	2	3	3	3	2	-	-	-	2.8	3	3	-	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECOE06	BASICS OF INTERNET OF THINGS					OPEN ELECTIVE	
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**	
		Hours/Week	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives:	
1.	To understand the vision of M2M to IOT.
2.	To gain an understanding of IOT market perspective.
3.	To acquire knowledge on Io T Technology Fundamentals and applications
4.	To build small system using Raspberry Pi.

Unit I	**M2M TO IOT – THE VISION**	**9**	**0**	**0**	**9**
Introduction - From M2M to Io T- M2M towards Io T: M2M Communication - The global context - A use case example – Differing Characteristics.					
Unit II	**M2M TO IOT – A MARKET PERSPECTIVE**	**9**	**0**	**0**	**9**
Introduction - Some Definitions - M2M Value Chains – Io T Value Chains - An emerging industrial structure for Io T- International driven global value chain and global information monopolies - M2M to Io T-An Architectural Overview – Building an architecture - Main design principles and needed capabilities - An Io T architecture outline - Standards considerations.					
Unit III	**IOT TECHNOLOGY FUNDAMENTALS**	**9**	**0**	**0**	**9**
Io T Enabling technologies – Io T levels and deployment templates - Devices and gateways - Data management - Business processes in Io T - Everything as a Service (XaaS) - M2M and Io T Analytics.					
Unit IV	**BUILDING IOT WITH HARDWARE PLATFORMS**	**9**	**0**	**0**	**9**
Io T Systems-Logical Design using Python –Io T Physical Devices and End Points- Io T Device - Raspberry Pi - Interfaces – Programming – Other Io T devices – Io T Reference Model - Real World Design Constraints.					
Unit V	**IOT USE CASES AND APPLICATIONS**	**9**	**0**	**0**	**9**
Home automation-Automatic lighting-Home intrusion detection- Cities-Smart parking – Environment - Weather monitoring system-Air pollution Monitoring-Forest Fire Detection- Agriculture- Smart irrigation. Commercial Building Automation – Introduction - Case study (Phase one) : Commercial building automation today - Case study (Phase two) - Commercial building automation in the future.					
					Total (45L)= 45 Periods

Text Books:	
1.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things-A hands-on approach”, Universities Press, 2015
Reference Books:	
1.	Olivier Hersent, davidBoswarthick, Omar Elloumi, ‘The Internet of Things Applications to the smart grid building automation’, John Wiley & Sons, 2012
2.	Francis daCosta, “Rethinking the Internet of Things : A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013
3.	HakimaChaouchi, ‘The Internet of Things Connecting Objects’, John Wiley & Sons, 2010.
4.	FabriceTheoleyr, Ai-Chun Pang, ‘Internet of Things and M2M Communications’, River Publishers, 2013.
E-References:	
1.	https://nptel.ac.in/courses/106105166
2.	https://onlineitguru.com/IoT-online-training.html
3.	https://onlinecourses.nptel.ac.in/noc22_cs53/preview

Course Outcomes: Upon completion of this course, the students will be able to:			Bloom's Taxonomy Mapped
CO1	:	Understand the vision of IoT from a global context.	Understanding
CO2	:	Determine the Market perspective of IoT.	Remembering
CO3	:	Understand the IoT technology fundamentals.	Understanding
CO4	:	Build small system using Raspberry Pi.	Applying
CO5	:	Analyse applications of IoT and case studies	Analysing

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	2	2	-	-	-	-	-	-	1	1	-	-
CO3	2	2	2	2	2	-	-	-	-	-	-	1	1	-	-
CO4	2	2	2	2	2	-	-	-	-	-	2	2	2	-	-
CO5	2	2	2	2	2	-	-	-	-	-	2	-	2	-	2
Avg	2	1.8	2	2	2	-	-	-	-	-	2	1.3	1.5	-	2

3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)

22ECOE07	BASICS OF ARTIFICIAL INTELLIGENCE				OPEN ELECTIVE			
PREREQUISITES			**CATEGORY**		**OE**	**Credit**		**3**
			Hours/Week		**L**	**T**	**P**	**TH**
					3	**0**	**0**	**3**

Course Objectives:

1.	Study about uninformed and Heuristic search techniques.
2.	To Learn techniques for reasoning under uncertainty
3.	Introduce Machine Learning and supervised learning algorithms
4.	Study about ensemble and unsupervised learning algorithms.
5.	Learn the basics of deep learning using neural networks.

Unit I	**PROBLEM SOLVING**	**9**	**0**	**0**	**9**

Introduction to AI - AI applications – problem solving agents – search algorithms – Uninformed search strategies – Heuristic search strategies – local search and optimization problems –adversarial search – constraing satisfaction problems(CSP) .

Unit II	**PROBABILISTIC REASONING**	**9**	**0**	**0**	**9**

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

Unit III	**SUPERVISED LEARNING**	**9**	**0**	**0**	**9**

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree.

Unit IV	**ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING**	**9**	**0**	**0**	**9**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN

Unit V	**NEURAL NETWORKS**	**9**	**0**	**0**	**9**

Perceptron - Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) –batch normalization, regularization, dropout.

Total (45L)= 45 Periods

Text Books:

1.	Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021
2.	Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006

Reference Books:

1.	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.
2.	Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3.	Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4.	Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition,1997.

E-References:

1.	https://machinelearningmastery.com/
2.	https://ai.google/education/
3.	https://in.coursera.org/learn/machine-learning

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom’s Taxonomy Mapped
CO1	Use appropriate search algorithms for problem solving	Understanding
CO2	Apply reasoning under uncertainty	Applying
CO3	Build supervised learning models	Applying
CO4	Build ensembling and unsupervised models	Applying
CO5	Build deep learning neural network models	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	1	-	-	-	-	-	1	1	2	2	2
CO2	2	1	2	1	1	-	-	-	-	-	1	1	2	2	2
CO3	2	2	3	2	1	-	-	-	-	-	3	2	2	2	2
CO4	2	2	2	1	1	-	-	-	-	-	3	2	2	2	2
CO5	2	2	3	2	1	-	-	-	-	-	3	2	2	2	2
Avg	2	1.6	2.4	1.4	1	-	-	-	-	-	2.2	1.6	2	2	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22EEOE01	RENEWABLE ENERGY SOURCES		SEMESTER			VI / VII
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Basic Electrical and Electronics Engineering		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1. To impart knowledge on the different renewable energy sources and technologies.

		L	T	P	TH
UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamil Nadu, India and around the World – Potentials – Achievements / Applications – Economics of Renewable Energy Systems.					
UNIT II	**SOLAR ENERGY**	**9**	**0**	**0**	**9**
Solar Radiation – Measurements of Solar Radiation – Flat Plate and Concentrating Collectors – Solar Direct Thermal Applications – Solar Thermal Power Generation – Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.					
UNIT III	**WIND ENERGY**	**9**	**0**	**0**	**9**
Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects.					
UNIT IV	**BIO – ENERGY**	**9**	**0**	**0**	**9**
Biomass Direct Combustion – Biomass Gasifiers – Biogas Plants – Digesters – Ethanol Production – Bio Diesel – Cogeneration – Biomass Applications.					
UNIT V	**OTHER RENEWABLE ENERGY SOURCES**	**9**	**0**	**0**	**9**
Tidal Energy – Wave Energy – Open and Closed Ocean Thermal Energy Conversion(OTEC) Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage – Fuel Cell Systems – Hybrid Systems.					
					Total (45L+0T) = 45 Periods

Text Books:

1.	Rai. G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2.	Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.
3.	Godfrey Boyle, "Renewable Energy, Power for A Sustainable Future", Oxford University Press, U.K., 1996.

Reference Books:

1.	Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2009.
2.	Tiwari. G.N., Solar Energy – "Fundamentals Design, Modelling & Applications", Narosa Publishing House, New Delhi, 2002.
3.	Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
4.	Johnson Gary, L. "Wind Energy Systems", Prentice Hall, New York, 1985
5.	David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA 2010

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Recall the available renewable Energy Sources	L1: Remembering
CO2	:	Illustrate the types of generators.	L4: Analysing
CO3	:	Apply different types of mechanism for energy conversion.	L3: Applying
CO4	:	Analyze the benefits and challenges in harnessing renewable Energy.	L4: Analysing
CO5	:	Recognize and apply appropriate renewable energy sources.	L2: Understanding

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1
CO2	3	1	1	3	1	1	1	1	1	1	1	1	2	1	1
CO3	1	2	2	1	1	1	1	1	1	1	1	1	2	1	1
CO4	3	1	1	3	2	1	1	1	1	1	1	1	2	1	1
CO5	2	1	1	2	1	1	2	1	1	1	1	1	2	1	1
Avg	**2.2**	**1.2**	**1.2**	**2**	**1.4**	**1**	**1.2**	**1**	**1**	**1**	**1**	**1**	**1.7**	**1.2**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

22EEOE02	INDUSTRIAL DRIVES				SEMESTER			VI / VII
PREREQUISITES				**CATEGORY**	**OE**	**Credit**		**3**
Power Electronics, and Electrical Machines				**Hours/Week**	**L**	**T**	**P**	**TH**
					3	**0**	**0**	**3**

Course Objectives:

1.	To understand the basic components of electric drive system,
2.	To analyze the operation and performance of the chopper fed DCdrive,
3.	To understand the operation and performance of AC motor drives
4.	To understand the advanced techniques in the control of industrial drives.

Unit I	**BASICS OF ELECTRIC DRIVE**	**9**	**0**	**0**	**9**
Electric drive - introduction and advantages, types and choice of electric drive, components of electric drive system, motor duty class classification continuous, short time and intermittent duty, speed-torque characteristics of DC and Induction motor drive.					
Unit II	**DC DRIVES**	**9**	**0**	**0**	**9**
Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting, Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking					
Unit III	**AC DRIVES**	**9**	**0**	**0**	**9**
Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque speed curve with applied voltage, applied frequency and applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.					
Unit IV	**CONTROL OF DC AND AC DRIVES**	**9**	**0**	**0**	**9**
Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design. Generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor. Operation of slip-ring induction motor with external rotor resistance, power electronic based rotor side control of slip ring motor, slip power recovery schemes.					
Unit V	**ADVANCED TECHNIQUES**	**9**	**0**	**0**	**9**
Microcontroller based control of DC drive, Phase locked loop control of DC motor, AC/DC drive using microprocessor. Synchronous motor drives, Stepper motor - ratings, specifications, stepper motor drive employing microcontroller.					
					Total (45L+0T) = 45 Periods

Text Books:

1.	G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
2.	Subrahmanyam, Vedam “Electrical Drives Concepts and Applications”, Mc-Graw Hill Publishing, New Delhi, 2016
3.	S.K.Pillai, “A first course on Electric Drives”, Wiley Eastern Ltd., New Delhi, 2016

Reference Books:

1.	G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2.	W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.
3.	Jai P.Agrawal, “Power Electronics Systems - Theory and Design”, Pearson Education, Inc., New Delhi, 2016

Course Outcomes:

Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Identify the electric drive for the required speed-torque characteristics	L1: Remembering
CO2	:	Understand the functioning of DC drive using converters	L2: Understanding
CO3	:	Understand the functioning of AC drive using converters	L2: Understanding
CO4	:	Analyse the various control schemes for AC and DC drive	L4: Analyzing
CO5	:	To use microcontroller based system for motor control	L6: Creating

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	2	1							1	1	2	
CO2	2	2	2	3	2		1					1	1	2	
CO3	2	2	2	3	2		1					1	2	3	
CO4	2	3	3	3	3	1	2	2				3	2	3	2
CO5	1	2	2	3	3		2					3	1	2	2
Avg	**1.6**	**2**	**2**	**2.8**	**2.2**	**1**	**1.5**	**2**	**-**	**-**	**-**	**1.8**	**1.4**	**2.4**	**2**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

22EEOE03	ENERGY CONSERVATION AND MANAGEMENT			SEMESTER		VI / VII
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Basic Electrical and Electronics Engineering or Principles of Electrical Engineering or Basic Electrical Engineering for Metallurgy		**Hours/Week**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand basics of energy.
2.	To familiarize the energy scenario in India.
3.	To understand the energy conservation approaches.
4.	To get knowledge on energy management approaches.
5.	To update the knowledge in energy efficient technologies.

UNIT I	**ENERGY SCENARIO**	**9**	**0**	**0**	**9**

Energy scenario of India – Present non-renewable energy scenario – Gross domestic product- Energy intensity – Current energy production and pricing – Energy security - Energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT II	**BASICS OF ENERGY**	**9**	**0**	**0**	**9**

Introduction – Work, power and energy – Electricity basics – Thermal energy basics – Energy units and conversions – Energy performance – Matching energy usage to requirement.

UNIT III	**ENERGY CONSERVATION APPROACHES**	**9**	**0**	**0**	**9**

Energy saving opportunities in electric motors, Benefits of Power factor improvement and its techniques-Shunt capacitor, Synchronous Condenser etc., Energy conservation by industrial drives, Methods and techniques of energy conservation in ventilation and air conditioners, compressors pumps, fans and blowers. Energy conservation in electric furnaces, ovens and boilers., lighting techniques – Natural , CFL, LED lighting sources and fittings.

UNIT IV	**ENERGY MANAGEMENT**	**9**	**0**	**0**	**9**

Demand side management (DSM)– DSM planning – DSM Techniques – Load management as a DSM strategy – energy conservation – tariff options for DSM - Energy audit – instruments for energy audit – Energy audit for generation, distribution and utilization systems – economic analysis.

UNIT V	**ENERGY EFFICIENT TECHNOLOGIES**	**9**	**0**	**0**	**9**

Maximum demand controllers - Automatic power factor controllers - Energy efficient motors -Softstarters with energy saver - Variable speed drives - Energy efficient transformers - Electronic ballast - Occupancy sensors - Energy efficient lighting controls - Energy saving potential of each technology.

Total (45 L+0 T)= 45 Periods

Text Books:

1.	Sonal Desai, "Handbook of Energy Audit", McGraw Hill, 2015.
2.	Tripathy, S. C, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.

Reference Books:

1.	Guide books for National Certification Examination for Energy Manager / Energy AuditorsBook-1, General Aspects (available online).
2.	Guide books for National Certification Examination for Energy Manager / Energy AuditorsBook-3, Electrical Utilities (available online)
3.	Murphy. W.R and McKay. G, "Energy Management", Butterworths Publications, London, 1982.
4.	Wayne C Tuner, "Energy Management Hand Book", John Wiley and Sons, 1982.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Identify the present energy scenario.	L2: Understanding
CO2	:	Recognize the various form of energy.	L2: Understanding
CO3	:	Interpret the process of energy conservation.	L3: Applying
CO4	:	Categorize the methods improving energy management.	L4: Analysing
CO5	:	Examine the role of energy efficient devices in energy conservation	L4: Analysing

COURSE ARTICULATION MATRIX															
CO/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	1	2	3	2	2		3				2	2	2	2	1
CO 2	1	2	2	2	2		3				3	3	2	2	1
CO 3	2	2	2	3	2		3				2	3	1	3	1
CO 4	2	3	2	2	3		3				3	3	3	3	1
CO 5	2	2	3	1	2		3				2	1	3	2	1
Avg	**1.6**	**2.2**	**2.4**	**2**	**2.2**	**-**	**3**	**-**	**-**	**-**	**2.4**	**2.4**	**2.2**	**2.4**	**1**
3/ 2/ 1 – indicates strength of correlation (3- High, 2-Medium, 1-Low)															

22EEOE04	ELECTRIC VEHICLES			SEMESTER		VI / VII
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Electrical Machines		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To learn the components of Electric Vehicle, configurations and its architectural design
2.	To study the energy storage options for Electric vehicle.

UNIT I	**ELECTRIC VEHICLES**	**9**	**0**	**0**	**9**
Configurations of Electric Vehicles (EV), Performance of Electric Vehicles: Traction Motor Characteristics, Tractive Effort and Transmission Requirement and Vehicle Performance, Tractive Effort in Normal Driving , Energy Consumption					
UNIT II	**HYBRID ELECTRIC VEHICLES**	**9**	**0**	**0**	**9**
Concept of Hybrid Electric Drive Trains, Classification of hybrid electric vehicles , Architectures of Hybrid Electric Drive Trains: Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains, Torque-Coupling Parallel Hybrid Electric Drive Trains, Speed-Coupling Parallel Hybrid Electric Drive Trains, Torque-Coupling and Speed-Coupling Parallel Hybrid Electric Drive Trains					
UNIT III	**PLUG-IN HYBRID ELECTRIC VEHICLES (PHEV)**	**9**	**0**	**0**	**9**
Functions And Benefits Of PHEV, Components of PHEV, Operating Principles of Plug-In Hybrid Vehicle, Plug-In Hybrid Vehicular Architecture, Compound PHEV Architecture, Control Strategy of PHEV, Charging of PHEV					
UNIT IV	**FUEL CELL ELECTRIC VEHICLE**	**9**	**0**	**0**	**9**
Operating Principles of Fuel Cells, Fuel Cell System Characteristics, Fuel Cell Technologies, Hydrogen Storage, Configuration of a Fuel cell hybrid Electric Vehicle, Control Strategy of Fuel cell Electric Vehicle					
UNIT V	**ENERGY STORAGE SYSTEM**	**9**	**0**	**0**	**9**
Status of Battery Systems for Automotive Applications, Battery Technologies: Nickel–Metal Hydride (Ni–MH) Battery, Lithium–Polymer (Li–P) Battery, Lithium-Ion (Li-Ion) Battery, Ultracapacitors: Features, operation and performance, Hybridization of Energy Storages					
Total (45L+0T)= 45 Periods					

Text Books:

1.	Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, Taylor & Francis Group, Second Edition ,2011.
2.	Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, AliEmadi,, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles” CRC Press, 2016

Reference Books:

1.	Ali Emadi, Mehrdad Ehsani, John M.Miller ,“Vehicular Electric Power Systems”, Ali Emadi, Mehrdad Ehsani, John M.Miller, Special Indian Edition, Marcel dekker, Inc 2010

E-Reference

1	https://archive.nptel.ac.in/courses/108/106/108106170/

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Level**
CO1	:	Recall the concept of Electric Vehicle technology	L1: Remembering
CO2	:	Draw the configuration of different types of Electric Vehicle	L4: Analyzing
CO3	:	Describe the selection and sizing of Fuel cell for hybrid electric vehicle.	L2: Understanding
CO4	:	Select control strategy and control for Plug In Hybrid Electric vehicle	L4: Analyzing
CO5	:	Use the battery management system for electric vehicle	L3: Applying

COURSE ARTICULATION MATRIX															
COs/ POs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1		1	3	1	2	1		1	2	1	1	1	2	1
CO2	1	2	3	1		1	2	1	1		1	2	1	2	
CO3	1	1			2		3	2	1	2	1		1	1	1
CO4	3	1	2	1	2	1	1				3	2	1	2	1
CO5	1	2	1	2	1	2		1	2	1		1	1	2	1
Avg	**1.4**	**1.5**	**1.75**	**1.75**	**1.50**	**1.5**	**1.75**	**1.33**	**1.25**	**1.67**	**1.5**	**1.5**	**1**	**1.8**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

22MEOE01	DESIGN OF MACHINE ELEMENTS AND MACHINING				SEMESTER VI/VIII	
		CATEGORY	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

COURSE OBJECTIVES

1	To familiarize the various steps involved in the design process.
2	To understand the basic concepts of machining techniques.
3	To know the factors influencing the processes and their applications.
4	Applying the principles of milling and gear cutting machines.
5	To gain the knowledge of cutting tool materials and surface finishing process.

UNIT I	**STRESSES IN MACHINE ELEMENTS**	**9**	**0**	**0**	**9**
Stress in simple machine members- axial, bending, torsional, bearing stress, Hertz contact stress; combined stresses, principle stresses, Theories of failure, factor of safety, stress concentration, preferred numbers.					
UNIT II	**DESIGN OF SHAFTS AND WELDED JOINTS**	**9**	**0**	**0**	**9**
Design of shaft members subjected to simple and combined stresses - Welded joints- Types of welding symbols, design of welded joints subjected to various load -Design of Riveted joints					
UNIT III	**DESIGN OF MACHINE ELEMENTS**	**9**	**0**	**0**	**9**
Springs: Design of helical springs- stresses and deflection - design procedure. Bearings: Need for bearing, Types, sliding and rolling contact bearings, hydro- dynamic and hydro static bearings- Life of bearings – Selection of bearings-Problems.					
UNIT IV	**METAL CUTTING**	**9**	**0**	**0**	**9**
Theory of metal cutting: Introduction, mechanics of metal cutting, orthogonal and oblique cutting, merchants' equation, chip formation, heat generation, cutting fluids, cutting tool life, recent developments and applications (Dry machining and high-speed machining)					
UNIT V	**MACHINE TOOLS AND SURFACE FINISHING PROCESSES**	**9**	**0**	**0**	**9**
Tools and machine tools: Cutting tool materials, cutting tool nomenclature, introduction to machine tools, lathe, shaper, planning, milling, drilling and boring machines, working principle, operations, work holding devices. Surface finishing processes: Introduction to Grinding honing, lapping processes and machines. Introduction to CAD/CAM/CIM.					
					Total(45L) = 45Periods

REFERENCE BOOKS:

1	Rao P N, "Manufacturing Technology" Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2006
2	HMT, "Production Technology" Tata McGraw-Hill Co., New Delhi, 1998
3	Milton C Shaw, "Metal Cutting Principles", Clarendon Press, Oxford, 1999.
4	James Brown, "Advanced Machining Technology Handbook", McGraw- Hill Book Company, New York, 1988.
5	Robert L Mott, "Machine Elements in Mechanical Design", Macmillan Publishing Co., London. UK, 1992.
6	Shighley and Mische, "Mechanical Engineering Design" McGraw Hill, 1992.
7	Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2003.

E-REFERENCES:

1.	https://nptel.ac.in/courses/112105124
2.	Design of Machine Elements - V. B. Bhandari - Google Books
3.	"A Textbook of Machine Design" by R.S.Khurmi and J.K.Gupta

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Analyze the stresses induced in a machine element.	Analyze
CO2	Familiarize the design concept of joints under various loading.	Remember
CO3	Familiarize the design of various types of bearings and Spring.	Remember
CO4	Identify the process parameters associated with various machining processes.	Apply
CO5	Familiarize the cutting tools materials and surface finishing processes.	Remember

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2		1	1				1		3	2
CO2	2	2	1	2		1	1				1		3	2
CO3	2	2	1	2		1	1				1		3	2
CO4	2	2	1	2		1	1				1		3	2
CO5	2	2	1	2		1	1				1		3	2
Avg	**2**	**2**	**1**	**2**		**1**	**1**				**1**		**3**	**2**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEOE02	INDUSTRIAL ENGINEERING			SEMESTER VI / VIII			
		CATEGORY	OE	Credit		3	
		Hours/Week	L	T	P	TH	
			3	0	0	3	

COURSE OBJECTIVES	
1	Assume technical and managerial roles in the industries.
2	Apply engineering principles to the working environment.
3	Use quality tools to foresee and solve issues in the industrial situations.
4	Work collaboratively.
5	To know the importance of EBQ.

UNIT I	FORECASTING	9	0	0	9

Characteristics and Principles - Qualitative Methods, Delphi Technique, Market Research -Time Series Methods- Moving Average, Exponential Smoothing- Box Jenkins Method – Auto Regressive Moving Average (ARMA) or Auto Regressive Integrated Moving Average (ARIMA) models – Fitting Regression Models - Measurement of Forecast Errors, Coefficient of Correlation - Problem solving.

UNIT II	FACILITIES PLANNING AND WORK STUDY	9	0	0	9

Factors affecting Site Location Decisions - Principles and Types of Layout - Layout Planning -Layout Tools and Computerised Layout Techniques - Design of Group Technology Layout – Line Balancing - Line Balancing Methods- Objectives of Work Study -Method Study Procedure, Recording Techniques - Motion Study - Principles of Motion Economy - Techniques of Work measurement - Time Study - Synthesis Method - Analytical Estimating - Predetermined Motion Time System (PMTS) - Work Sampling Techniques.

UNIT III	LEAN MANUFACTURING	9	0	0	9

Elements of Just In Time (JIT) - Pull and Push System, Kanban System- Optimized ProductionTechnology and Synchronous Manufacturing – Implementation of Six Sigma - Single Minute Exchange of Die (SMED) 5S concept - Concurrent Engineering- Cellular Manufacturing – Enablersof Agile Manufacturing – Rapid Manufacturing - Business Process Re-engineering (BPR) - Basics of Supply Chain Management, Supply chain and “Keiretsu” – Enterprises Resources Planning (ERP) - Role of KAIZEN, Quality Circles and POKA YOKE in Modern Manufacturing – Seven wastes in Lean Manufacturing.

UNIT IV	AGGREGATE PRODUCTION PLANNING	9	0	0	9

Objectives of Aggregate Planning - Capacity Requirement Planning (CRP) Process - Types of Capacity Planning - Strategies for Aggregate Capacity Planning - Master Production Scheduling - Procedure for Developing MPS – Materials Requirements Planning (MRP-I), Issues in MRP, Designing and Managing the MRP System, Evaluation of MRP - Manufacturing Resources Planning (MRP-II).

UNIT V	SCHEDULING OF OPERATIONS	9	0	0	9

Operations Planning and Scheduling - Scheduling Techniques - Stages in Scheduling – Loading, Dispatching, Expediting - Finite Loading and Infinite Loading - Load Charts and Machine Loading Charts - Priority Sequencing -Dynamic Sequencing Rules - Batch Scheduling – Economic Batch Quantity (EBQ) or Economic Run Length (ERL) – Scheduling in Repetitive, Batch and Job Shop Manufacturing – Allocation of units for a single resource, allocation of multiple resources – Resource balancing - Flexible Manufacturing System.

Total (45L) = 45 Periods

REFERENCE BOOKS:	
1	R.Panneerselvam, “Production & Operations Management”, 3rd Edition, PHI LearningPrivate Limited, New Delhi, 2012
2	Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production/Operation Management”, 8thEdition, John Wiley & Sons, 2000
3	Dilworth B.James, “Operations Management Design, Planning and Control forManufacturing and Services”, Mcgraw Hill Inc., New York, 1992
4	Vollman T.E, “Manufacturing Planning and Control Systems”, Galgotia Publications, 2002.

E-REFERENCES:	
1.	https://www.newtondesk.com/industrial-engineering-study-notes-hand-written
2.	https://en.wikipedia.org/wiki/Lean_manufacturing
3.	https://www.planettogether.com/blog/types-of-scheduling-in-production-planning-and-control

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Apply the knowledge of engineering and sciences to improve the productivity of industries.	Apply
CO2	Design a system to meet the desired needs within realistic constraints.	Create
CO3	Function in multidisciplinary teams.	Apply
CO4	Use the techniques, skills, and modern engineering tools in manufacturing practice.	Understand
CO5	Perform as an effective industrial engineer integrating high and low levels of management	Create

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3			2	2									3
CO2			3											2
CO3						3	2		3	2	3	2	3	
CO4	3	3		2	3	3						2		3
CO5						3	2	3					3	
Avg	**3**	**3**	**3**	**2**	**2.5**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2.6**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)														

22MEOE03	INDUSTRIAL ROBOTICS				SEMESTER VI/VII		
		CATEGORY	OE	Credit		3	
		Hours/Week	L	T	P	TH	
			3	0	0	3	

COURSE OBJECTIVES

1	To explore concepts of robot technologies that is playing vital role in manufacture.
2	Describe various robot technology applications.
3	Develop an understanding of robot Kinematics and dynamics.
4	Explain and summarize robot end effectors and Sensors.
5	Explore conceptual understanding of Robot programming.

UNITI	INTRODUCTION	9	0	0	9

Robot - definition - robot anatomy - co-ordinate systems - work envelope - types and classification - specifications – joint notations – types of joints - speed of motion - pay load - robot parts and their functions - need for robots in Indian scenario.

UNIT II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	9	0	0	9

Drives - hydraulic, pneumatic, mechanical and electrical - servo motors - stepper motors - salient features, application – end effectors – types: tools - grippers - mechanical grippers - pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, multiple grippers.

UNIT III	SENSORS AND MACHINE VISION	9	0	0	9

Requirements of sensors – principles, types and applications of following types of sensors proximity (inductive, Hall effect, capacitive, ultrasonic and optical) – range (Triangulation, structured light approach, laser range) – speed, position (resolvers, optical encoders, pneumatic) – force – torque – touch sensors (binary, analog sensor) - Introduction to machine vision -functions - image processing and analysis.

UNIT IV	ROBOT KINEMATICS AND ROBOT PROGRAMMING	9	0	0	9

Forward kinematics and reverse kinematics of manipulators - two, three degrees of freedom (in 2 dimensional) – homogeneous transformation matrix - simple problems - lead through programming, robot programming languages - VAL programming –motion commands - sensor commands - end effecter commands - simple programs for loading, unloading and palletizing operations.

UNIT V	APPLICATIONS, IMPLEMENTATION AND ROBOT ECONOMICS	9	0	0	9

Robot cell design – types - Application of robots in processing - assembly - inspection - material handling - loading - unloading - automobile - implementation of robots in industries - safety considerations for robot operations – economic analysis of robots - pay back method and rate of return method.

Total (45L) = 45Periods

REFERENCE BOOKS:

1	Mikell. P. Groover, ‘Industrial Robotics Technology’, Programming and Applications, McGraw Hill Co, 1995.
2	Fu.K.S. Gonzalz.R.C., and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
3	Richard D.Klafter, Thomas A.Chmielewski and MichealNegin, “Robotic engineering –An Integrated Approach”, Prentice Hall Inc, Englewoods Cliffs, NJ, USA, 2005.
4	Janakiraman.P.A. “Robotics and Image Processing”, Tata McGraw-Hill, 1995.
5	YoramKoren, “Robotics for Engineers”, McGraw-Hill Book Co., 1992.
6	A.K.Gupta and S.K.Arora, “Industrial Automation and Robotics”, Laxmi Publications Pvt ltd, 2007.
7	Fu. K. S., Gonzalez. R. C. & Lee C.S.G., ‘Robotics control, sensing, vision and intelligence’, McGraw Hill Book co, 1987.
8	Craig. J. J. ‘Introduction to Robotics mechanics and control’,Addison- Wesley, 1999
9	Ray Asfahl. C., ‘Robots and Manufacturing Automation’, John Wiley & Sons Inc., 1985.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Understand the basic concepts, parts of robots and types of robots.	Understand
CO2	Understand the potential applications of robots in industries as part of automation tool.	Understand
CO3	Familiar with the various drive systems for robot, sensors and their applications in robots, programming of robots.	Remember
CO4	Discuss about the various applications of robots, justification, implementation and safety of robot	Analyze
CO5	Select an appropriate robot for a particular application.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1			1							1	1
CO2			1		1	1							1	1
CO3		1	0										1	1
CO4			1			3								1
CO5		2											1	2
Avg	**3**	**1.7**	**1**		**1**	**1.7**							**1**	**1.2**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)														

22MEOE04	POWER PLANT ENGINEERING					SEMESTER VI/VII		
PREREQUISITES			**CATEGORY**	**OE**	**Credit**			**3**
1. Having sufficient knowledge on basics of power plant			**Hours/Week**	**L**	**T**		**P**	**TH**
2. Basic unit calculation for consumption of power				**3**	**0**		**0**	**3**

COURSE OBJECTIVES:

1.	Understanding of thermal power plant operations and its components.
2.	Location of hydro power plant and its components to generate power.
3.	Complete knowledge about diesel and gas power plant.
4.	Basic knowledge of nuclear reaction and types of nuclear power plant.
5.	Basic knowledge of power plant economics and various tariff methods.

UNIT I	**STEAM POWER PLANT**	**9**	**0**	**0**	**9**

Layout of steam power plant – boilers - Modern high pressure and supercritical boilers - Preparation and handling of coal - Pulverizer - Dust collector - Ash removal; Stokers - Different types - Pulverized fuel burning; Draught - Different types - Chimney design - Selection of blowers, Cooling towers - Different types - Waste heat recovery, Fluidised Bed and Circulated Fluidised Bed boilers

UNIT II	**HYDRO ELECTRIC POWER PLANT**	**9**	**0**	**0**	**9**

Layout of hydel power plant- classification –working – components – layout of pumped storage power plant - Plant equipment for Pumped Store Schemes.

UNIT III	**DIESEL AND GAS POWER PLANT**	**9**	**0**	**0**	**9**

Layout of Diesel power plant- Important components – performance analysis – Layout of gas power plant – classification of gas turbine cycles – components – relative thermal efficiencies of different cycles.

UNIT IV	**NUCLEAR, MHD POWER GENERATION**	**9**	**0**	**0**	**9**

Elementary treatment - nuclear fission, chain reaction - Pressurized water reactors, boiling water reactors, gas cooled reactors - Fast breeder reactors, Magneto Hydro Dynamic power- open cycle and closed cycle system.

UNIT V	**ECONOMICS AND SAFETY**	**9**	**0**	**0**	**9**

Economics and safety - Actual load curves - Fixed and operating costs - Tariff methods for electrical energy - Peak load and variable load operations - Selection of generation type and general equipment. Introduction to safety aspects in power plants - Environmental impacts - assessment for thermal power plant.

Total(45L) = 45 Periods

TEXT BOOKS:

1.	S. Domkundwar, A.V. Domkundwar, S.C. Arora.A Course in Power Plant Engineering, Dhanpat Rai Publications. 2013
2.	P.K. Nag, Power Plant Engineering, Tata McGraw Hill, Laxmi Publications Pvt.Ltd New Delhi, 5th Edition, 2014.

REFERENCES:

1	R.K. Rajput. A Text of Power Plant Engineering, Laxmi publications, New Delhi 5th Edition, 2016.
2	G.R. Nagpal, Power Plant Engineering, Khanna Publications 1998.
3	Bernhardt G. Askrotzki and William A. Vopat, “Power Station Engineering and Economy”, Tata McGraw Hill Publishing Co. Ltd., 1972.
4	Frederick T. Mores, “Power Plant Engineering”, Affiliated East-West Press Private Ltd., 1953.
5	Joel Weisman and Roy Eckart, “Modern Power Plant Engineering”, Prentice Hall International Inc., 1985.

E-REFERENCES:	
1.	https://en.wikipedia.org/wiki/Power_plant_engineering
2.	https://onlinecourses.nptel.ac.in/noc21_me86/preview

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Ample knowledge on thermal power plant operation and its merits and demerits.	Analyze
CO2	Potential Power of water to convert into useful energy by hydropower.	Remember
CO3	Augment with diesel and gas power plant operation and its components.	Understand
CO4	Able to cope with recent developments on nuclear power plant.	Understand
CO5	Understanding of various economics to construct power plant and to measure the consumption of power by different tariff.	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	2	1		1	1	2		2	2	2	1	2
CO2	1	2	3	2	1		1	1	2		2	2	2	1	2
CO3	1	2	3	2	1		1	1	2		2	2	2	1	2
CO4	1	2	3	2	1		1	1	2		2	2	2	1	2
CO5	2		1	2				2	2	1	1	1	2		
Avg	**1.2**	**2**	**2.6**	**2.0**	**1**		**1**	**1.2**	**2.0**	**1**	**1.8**	**1.8**	**2.0**	**1**	**2**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)															

22MEOE05	PRINCIPLES OF MANAGEMENT						SEMESTER VI/VIII	
		CATEGORY	OE		Credit		3	
		Hours/Week	L		T	P	TH	
			3		0	0	3	

COURSE OBJECTIVES	
1.	To understand the management basic features of management.
2.	Principles usages in all walks of life and industrial growth.
3.	Able to have a clear understanding of the managerial functions like planning, organizing, staffing, leading and controlling.
4.	To gain some basic knowledge in international aspect of management.

UNITI	**MANAGEMENT - AN INTRODUCTION AND OVERVIEW**	**9**	**0**	**0**	**9**
Definitions of management – features of management – Management thoughts – different schools of management – Scientific management – Arts or Science, Management Vs administration – Principles of Management.					
UNIT II	**FUNCTIONS OF MANAGEMENT**	**9**	**0**	**0**	**9**
Role of managers. Functions approach to management, Management functions, Management levels – reconciling functions and role, responsibility of managers – towards subordinates, peers, supervisors, customers, government, company, creditors, shareholders, competitors etc.					
UNIT III	**MANAGERIAL PLANNING AND DECISION MAKING**	**9**	**0**	**0**	**9**
Planning fundamentals, objectives. Management by objectives – Changes in objectives – goal distortions – major types of planning, policies and objectives, procedures – methods, rules, programmes and schedule, projects, budgets – importance of decision making, types of decisions, decision making process – decision theory – quantitative techniques – decision making conditions – Operation Research (OR), Definition, successful areas of operation research - Decision tree.					
UNIT IV	**ORGANIZATION**	**9**	**0**	**0**	**9**
Organization: Basic concepts – organization as a structure – as a process – as a group property of modern organization – typology, importance of organization – business /industrial organization – sole trading, partnership company, co-operative, public enterprise line (military), line and staff, functional, matrix committee-based organization - departmentalization – need, bases of departmentation – career planning and management.					
UNIT V	**STAFFING, CONTROLLING AND COMMUNICATION**	**9**	**0**	**0**	**9**
Nature and purpose of staffing – man power planning, aims and objectives of HR recruitment, selection and training sources of recruitment, process of recruitment, training methods – performance appraisal methods – communication – importance process – barriers to communications. How to remove obstacles of effective communication – controlling – definition – Characteristics of control – types of control – requirements of effective control – direct and preventive control repairing, control techniques.					
					Total (45L) = 45Periods

REFERENCE BOOKS:	
1	Herald knootz and Heinz weihrich, Essentials of Management ‖, McGraw-Hill Publishing Company, Singapore International Edition, 2007
2	Joseph L, Massie, Essentials of Management. Prentice Hall of IndiaPvt., Ltd (Pearson) Fourth Edition, 2003.
3	Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 7th Edition, Pearson Education, 2011.
4	Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
5	Harold Koontz & Heinz Weihrich “Essentials of management” Tata McGraw Hill, 1998.
6	Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

7	R.S.N. Pillai & S. Kala "Principles and Practice of Management", S Chand & company, 2014.
E-REFERENCES:	
1.	https://nptel.ac.in/courses/110105146
2.	https://nptel.ac.in/courses/122106031

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Understand the basic concept of management.	Understand
CO2	Familiarize the contribution sand functions, types of business organization.	Understand
CO3	List the various types of leadership and evaluate the motivation the oriesand techniques.	Evaluate
CO4	Select forecasting models for future demands and to make decision in the management processes.	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1							1	3	1		2	2	1	1
CO2							1	1	2		3	2	1	1
CO3								1	2		1	1	1	1
CO4							2	1	2		2	1	1	1
Avg							**1.3**	**1.5**	**1.75**		**2**	**1.5**	**1**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEOE06	PROFESSIONAL ETHICS IN ENGINEERING					SEMESTER VI/VIII
		CATEGORY	OE	Credit		3
		Horus/Week	L	T	P	TH
			3	0	0	3

COURSE OBJECTIVES

1	To create awareness on Engineering Ethics and providing basic knowledge about engineering Ethics, Variety of moral issues and Professional Ideals.
2	To provide basic familiarity about Engineers as responsible Experimenters, Codes of Ethics, Industrial Standards.
3	To inculcate knowledge and exposure on safety and risk, risk benefit analysis.

UNIT I	HUMAN VALUES	9	0	0	9

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

UNIT II	ENGINEERING ETHICS	9	0	0	9

Senses of ‘Engineering Ethics’ - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg’s theory - Gilligan’s theory - consensus and controversy – Models of Professional Roles - theories about right action – Self-interest- customs and religion - uses of ethical theories.

UNIT III	ENGINEERING AS SOCIAL EXPERIMENTATION	9	0	0	9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law – the challenger case study.

UNIT IV	SAFETY, RESPONSIBILITIES AND RIGHTS	9	0	0	9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three-mile island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest – occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V	GLOBAL ISSUES	9	0	0	9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers (IETE),India.

Total(45L) = 45Periods

REFERENCE BOOKS:

1	Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 2005.
2	Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
3	Tripathi A N, “Human values”, New Age international Pvt. Ltd., New Delhi, 2002.
4	Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004.
5	Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Learning, United States, 2000.
6	John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
7	R S Naagarazan, “A Textbook on Professional Ethics and Human Values” New age international (p) limited, publishers, New Delhi – 110002, 2006.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		Bloom Taxonomy Mapped
CO1	Understand the importance of ethics and values in life and society.	Understand
CO2	Understood the core values that shape the ethical behavior of an engineer.	Understand
CO3	Exposed awareness on professional ethics and human values.	Remember

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2	1	3	2		1				1
CO2						1	1	3	1		1				1
CO3						2	1	3	1		1				1
Avg						**1.66**	**1**	**3**	**1.33**		**1**				**1**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)															

22MEOE07	RENEWABLE SOURCES OF ENERGY				SEMESTER VI/VIII
PRE-REQUISITE: 1. Basic idea about solar radiation and other renewable energy that exists. 2. Understanding about various chemical reactions occur in the energy conversion process	**CATEGORY**	**OE**	**Credit**		**3**
	Horus/Week	**L**	**T**	**P**	**TH**
		3	**0**	**1**	**4**

COURSE OBJECTIVES

1.	To recognize the consciousness of energy conservation in scholars
2.	To identify the employ of renewable energy sources for electrical power generation
3.	To collect different energy storage methods
4.	To detect about environmental effects of energy conversion

UNIT I	**SOLAR RADIATION AND ITS MEASUREMENTS**	**9**	**0**	**0**	**9**
Alternative energy sources, Global and Indian energy scenario. Solar Energy: Introduction – Solar Radiation Measurement and Instruments – Data and estimation.					
UNIT II	**SOLAR ENERGY COLLECTORS, SOLAR ENERGY STORAGE AND APPLICATIONS OF SOLAR ENERGY**	**9**	**0**	**0**	**9**
Flat Plate and Concentrating Collectors –Solar direct Thermal Applications – Solar thermal Power Generation – Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation –Solar Energy Storage: Thermal energy, Chemical Energy and Electromagnetic energy storage; Solar PV Applications: Solar water heating, Space heating and cooling, Solar distillation, Solar pumping, Solar furnace, Solar cooking.					
UNIT III	**BIOMASS AND ITS CONVERSION TECHNOLOGIES**	**9**	**0**	**0**	**9**
Bio-mass conversion Techniques: Direct combustion (incineration); Thermo-chemical conversion-Gasification and its types; Wet Process- Classification of biogas plant- types of Anaerobic digestion (Khadi and Village Industries type, Pragati design, Gasnesh biogas plant and Ferro-cement digester biogas plant) – Fermentation process;					
UNIT IV	**WIND, GEOTHERMAL AND TIDAL ENERGY**	**9**	**0**	**0**	**9**
Basic principle of wind energy conversion, types of wind energy conversion; Geothermal sources – hydrothermal geothermal resources, geopressurised resources, hot dry rock resources of petrothermal systems, Magma resources – Comparison of flashed steam and total flow concept. Basic principle of tidal power, components of tidal power plants, operation methods of utilization of tidal power.					
UNIT V	**CHEMICAL ENERGY, HYDROGEN ENERGY AND MAGNETO HYDRO DYNAMIC**	**9**	**0**	**0**	**9**
Design and principle operation of a Fuel cells, classification of fuel cells, types of fuel cells, Advantages, disadvantages and applications of fuel cells. Basic principle of Magneto Hydro Dynamic – Open cycle and closed cycle system.					
					Total (45L) = 45Periods

REFERENCE BOOKS:

1	G.D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
2	Suhas P. Sukhatme, “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., 2007.
3	Khan, B.H., "Non-Conventional Energy Resources", The McGraw Hill Companies, 2009.
4	Twidell, J.W. & Weir, A., "Renewable Energy Resources", EFN Spon Ltd., UK, 2005.
5	Solanki: Renewable Energy Technologies: Practical Guide for Beginners, PHI Learning Pvt.Ltd., 2008
6	D. Mukherjee: Fundamentals of Renewable Energy Systems, New Age International publishers, 2007.
7	Gilbert M. Masters: Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

E-REFERENCES:

1.	https://en.wikipedia.org/wiki/Renewable_energy

2.	Ellabban, Omar; Abu-Rub, Haitham; Blaabjerg, Frede (2014). "Renewable energy resources: Current status, future prospects and their enabling technology". Renewable and Sustainable Energy Reviews. 39: 748–764 [749]

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Understand the principles of solar radiation and its measuring devices	Understand
CO2	Comprehend the ideology of solar energy collectors, solar photovoltaic power generationsolar energy storage and applications of solar energy	Analyze
CO3	Acquire awareness about biomass sources of energy technologies	Understand
CO4	Design various renewable energy gadgets such as wind and tidal plant	Create
CO5	Learn about extracting energy from chemical methods	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	3	2	1		2	2	3	1	1	2	2	1
CO2	1	2	3	2	1		2	2	3	1	1	2	2	1
CO3		2	3	2	1		2	2	3	1	1	2	2	1
CO4	1	2	3	2			2	2	3	1	1	2	2	1
CO5	1	2	3	2	1		2	2	3	1	1	2	2	1
Avg	**1**	**2**	**3**	**2**	**1**		**2**	**2**	**3**	**1**	**1**	**2**	**2**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

2MEOE08	ROBOTIC PROCESS AUTOMATION						SEMESTER VI/VIII			
Pre-requisite:				CATEGORY			OE	Credit		3
Basics in kinematics and dynamics				Hours/Week			L	T	P	TH
							3	0	0	3

COURSEOBJECTIVES

1.	To study the various parts of robots and fields of robotics.
2.	To study the various kinematics and inverse kinematics of robots.
3.	To study the Euler, Lagrangian formulation of Robot dynamics.
4.	To study the trajectory planning for robot.
5.	To study the control of robots for some specific applications

UNIT I	**BASIC CONCEPTS**	**9**	**0**	**0**	**9**
Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov‟s laws of robotics – dynamic stabilization of robots.					
UNIT II	**POWER SOURCES AND SENSORS**	**9**	**0**	**0**	**9**
Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors					
UNIT III	**MANIPULATORS, ACTUATORS AND GRIPPERS**	**9**	**0**	**0**	**9**
Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.					
UNIT IV	**KINEMATICS AND PATH PLANNING**	**9**	**0**	**0**	**9**
Solution of inverse kinematics problem – multiple solution jacobian work envelop – Hill Climbing Techniques – robot programming languages					
UNIT V	**CASE STUDIES**	**9**	**0**	**0**	**9**
Multiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.					
					Total (45L) = 45 Periods

REFERENCE BOOKS:

1	Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", Mc Graw-Hill Singapore, 1996.
2	Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
3	Deb. S.R., "Robotics Technology and flexible Automation", John Wiley, USA 1992.
4	Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An integrated approach", Prentice Hall of India, New Delhi, 1994.
5	Barry Leatham – Jones, "Elements of industrial Robotics" PITMAN Publishing, 1987.
6	Mikell P.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications ", McGraw Hill Book Company 1986.
7	Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence" McGraw Hill International Editions, 1987.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		Bloom Taxonomy Mapped
CO1	Explain the basic concepts of working of robot.	Understand
CO2	Analyze the function of sensors in the robot.	Analyze
CO3	Analyze the working of manipulates, actuators and grippers.	Analyze
CO4	Write program to use a robot for a typical application.	Create
CO5	Use robots in different applications.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	2		2					1		2	2	2
CO2	1	3	2	1	1							2	1	3
CO3		2	2	1	1							2	1	3
CO4		1	1	2	3			1	3	2	1	2		
CO5		1	2	2	2	1	2	2	3	2	1	2		
Avg	**1**	**1.6**	**1.8**	**1.5**	**2**	**1**	**2**	**1.5**	**3**	**1.7**	**1**	**2**	**1.3**	**2.7**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEOE09	TOTAL QUALITY MANAGEMENT					SEMESTER VI/VIII	
		CATEGORY	OE	Credit		3	
		Hours/Week	L	T	P	TH	
			3	0	0	3	

COURSE OBJECTIVES

1.	Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
2.	Explain the TQM Principles for application.
3.	Define the basics of six sigma and apply traditional tools, new tools, Benchmarking and FMEA.
4.	Describe Taguchi's Quality Loss Function, Performance measures and apply techniques like QFD, TPM, COQ and BPR.
5.	Illustrate and apply QMS and EMS in any organization.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Definition of Quality - Dimensions of Quality - Quality planning - Quality costs, Analysis techniques for quality costs- Basic concepts of total quality management (TQM) - Historical review - Principles of TQM – Leadership - Role of senior management - Quality council, Quality statements - Strategic planning- Deming philosophy - Barriers to TQM implementation					
UNIT II	**TQM PRINCIPLES**	**9**	**0**	**0**	**9**
Customer satisfaction - Customer perception of quality, Customer complaints, Service quality, Customer Retention, Employee involvement - Motivation, Empowerment, Teams, Recognition and reward, Performance appraisal - Continuous process improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen - Supplier Partnership, Sourcing, Supplier selection, Supplier rating, Relationship development - Performance measures, Basic concepts, Strategy					
UNIT III	**STATISTICAL PROCESS CONTROL (SPC)**	**9**	**0**	**0**	**9**
The seven tools of quality, Statistical fundamentals – Measures of central tendency and dispersion, Population and sample, Normal curve - Control charts for variables and attributes, Process capability - Concept of six sigma, New Seven Management Tools.					
UNIT IV	**TQM TOOLS**	**9**	**0**	**0**	**9**
Benchmarking – Reasons to benchmark, Benchmarking process, Quality function deployment (QFD) process – House of quality, Benefits - Taguchi quality loss function - Total productive maintenance (TPM) concept, Improvement needs - FMEA – Stages of FMEA.					
UNIT V	**QUALITY MANAGEMENT SYSTEMS**	**9**	**0**	**0**	**9**
Need for ISO 9000 and other quality systems, benefits of ISO registration, ISO 9001:2008 quality system – Elements, Implementation of quality system, Documentation, Quality auditing, AS 9100,TS 16949:2002 and TL 9000					
Total (45L) = 45Periods					

REFERENCE BOOKS:

1	Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field, MaryB.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
2	Feigenbaum.A.V. “Total Quality Management”, McGraw Hill, 1991.
3	Joel.E. Ross, “Total Quality Management – Text and Cases”, Routledge. 2017.
4	Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
5	Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
6	Suganthi.L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006
7	Narayana V and Sreenivasan, N.S, “Quality Management – Concepts and Tasks”, New Age International, 1996.

E-REFERENCES:	
1.	https://www.oreilly.com/library/view/total-quality-management/9780815330486/xhtml/Reference1.xhtml
2.	https://www.sanfoundry.com/best-reference-books-total-quality-management/
3.	https://www.routledge.com/Total-Quality-Management-TQM-Principles-Methods-and-Applications/Luthra-Garg-Agarwal-Mangla/p/book/9780367512835

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		Bloom Taxonomy Mapped
CO1	Ability to apply TQM concepts in a selected enterprise.	Apply
CO2	Ability to apply TQM principles in a selected enterprise.	Apply
CO3	Ability to understand Six Sigma and apply Traditional tools, new tools, Benchmarking and FMEA.	Understand
CO4	Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.	Understand
CO5	Ability to apply QMS and EMS in any organization.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	3			2		1		2			2	1	2
CO2	1	2							2			2		
CO3	1	2	2		1			1				2	1	
CO4	1	2			2	3		2		3		2	2	2
CO5	1	2	2		2	2	1	2	2	3		2	2	2
Avg	**1**	**2.2**	**2**		**1.75**	**2.5**	**1**	**1.7**	**2**	**3**		**2**	**1.5**	**2**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MTOE01	FOUNDRY AND WELDING TECHNOLOGY				
PREREQUISITES: Manufacturing Technology	**Category**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To know the basic concepts of metal casting technology and to apply them to produce of new materials.
2.	To know the concepts of different materials joining technology and emphasis on underlying science and engineering principle of every processes.

		L	T	P	TH
UNIT I	**MOULDING MATERIALS AND PATTERNS**	**9**	**0**	**0**	**9**

Introduction to foundry operations, patterns - functions, types, allowances, selection of pattern materials, colourcodes, core boxes, moulding practice, ingredients of moulding sand and core sand, Testing of Moulding sands. Sand preparation, Sand reclamation in foundries.

		L	T	P	TH
UNIT II	**MOULDING AND CASTING TECHNIQUES**	**9**	**0**	**0**	**9**

Sand moulding: green sand moulding, dry sand moulding, skin dry sand moulding, shell moulding, carbon- di-oxide process, permanent mould casting, die casting, centrifugal casting, investment casting, squeeze casting, full mould process, Rheocasting, Thixo casting.

		L	T	P	TH
UNIT III	**MELTING PRACTICE**	**9**	**0**	**0**	**9**

Melting practice and special precautions for steels, alloy steels, cast irons, aluminium alloys, copper alloysand magnesium alloys, Cleaning and repair of castings. Casting defects and remedies

		L	T	P	TH
UNIT IV	**WELDING AND OTHER JOINING PROCESSES**	**9**	**0**	**0**	**9**

Classification of welding processes- oxy-acetylene welding, arc welding-manual, submerged arc welding, gas tungsten arc and gas metal arc welding, electro slag and electro gas welding. Brazing, soldering and cutting processes

		L	T	P	TH
UNIT V	**SPECIAL WELDING PROCESSES**	**9**	**0**	**0**	**9**

Principle, equipment, process variables, merits, limitations and applications of Electron beam, plasma arc andlaser beam welding processes. Friction, friction stir welding, ultrasonic explosive and diffusion welding.

Total (45+0) = 45 Hours

Text Books:

1.	Heine R W., Loper, C.R.Rosenthal, P.C.,"Principles of Metal Casting",Tata-McGraw Hill PublishingCo Ltd, New Delhi, 2008.
2.	Srinivasan N K.,"Foundry Engineering", Khanna Tech Publications, New Delhi, 2005.
3.	Parmar, R.S., –Welding Processes and Technology‖, 2nd edn. Khanna Publishers, New Delhi, 2001
4.	Srinivasan N K ,"Welding Technology", Khanna Publications, Delhi, 2000

Reference Books:

1.	Beeley P R., "Foundry Technology", Butterworths, London, 1982.
2.	Howard B. Cary, "Modern Welding Technology", Prentice Hall, New Jersey, USA, 1998.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the alloying element effect on the steels and mention the precaution to be taken in mouldingand melting of steels.	L2: Understanding
CO2	:	Distinguish different moulding and casting techniques.	L3:Applying
CO3	:	Apply the melting procedure for the various alloys like steels, stainless steels,discuss the slag-metal reactions	L3:Applying
CO4	:	Illustrate the conventional welding processes and allied joining processes.	L2: Understanding
CO5	:	Compare the various special welding processes.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1	1										2			
CO2	1	1		1	1								1			1
CO3	2	1	1				1						2			
CO4	1	1	1	1	1	1							1			1
CO5	2	1		1	1								1			
Avg.	1.6	1.0	1.0	1.0	1.0	1.0	1.0						1.4			1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22MTOE02	ADVANCED SURFACE ENGINEERING					
PREREQUISITES: **Manufacturing Technology**	**Category**	**OE**	**Credit**			**3**
	Hours/Week	**L**	**T**		**P**	**TH**
		3	**0**		**0**	**3**

Course Objectives:

1. Analyze the various concepts of surface engineering and comprehend the design difficulties

UNIT I	**TRIBOLOGY AND PLATING PROCESSES**	**9**	**0**	**0**	**9**
Introduction to tribology, Wear: Types of wear - adhesive, abrasive, oxidative, corrosive, erosive and trotting wear, roles of friction and lubrication and wear testing. Plating Processes: Fundamentals of electrode position, plating of nickel, chromium, tin and copper, pulsed plating, hydrogen embrittlement, plating adhesion, electroless plating, electrochemical conversion coating, selective plating for repair, plating properties, hard anodizing.					
UNIT II	**HARD FACING PROCESSES**	**9**	**0**	**0**	**9**
SMAW, GTAW, GMAW, FCAW, SAW, PAW, Oxy-Acetylene Welding, Furnace fusing, Thermal-spray, Flamespray processes - HVOF, Detonation gun and Jet kote processes, Hard facing consumables.					
UNIT III	**SPECIAL DIFFUSION PROCESSES**	**9**	**0**	**0**	**9**
Principle of diffusion processes - Boriding, Aluminising, Siliconising, Chromising - Selection of diffusion processes - Characteristics of diffused layer - micro structure and micro hardness evaluation - properties andapplications.					
UNIT IV	**THIN FILM COATINGS**	**9**	**0**	**0**	**9**
Physical vapour deposition processes - Thermal evaporation - sputter coating - Ion plating - Chemical vapour deposition - reactive sputtering - TiC, TiN, Alumina, CBN, Diamond and DLC coatings. Structure, properties and applications.					
UNIT V	**HIGH ENERGY MODIFICATION AND SPECIAL PROCESSES**	**9**	**0**	**0**	**9**
Electron beam hardening, glazing, Laser beam hardening glazing ion implantation, Composite surface created by laser and Electron beam. Surface cements, Wear tiles, Electro spark deposition, fused carbide cloth,thermal / chemical. Ceramic coatings, centrifugal cast wear coatings, Wear sleeves and Wear plates.					
Total (L+T) = 45 Hours					

Text Books:

1.	Chattopadhyay R., Surface Wear: Analysis, Treatment, Prevention, ASM International, USA, 2001
2.	Kenneth G. Budinski, Surface Engineering for Wear Resistance, Prentice Hall, Englewood Cliff, 1990.

Reference Books:

1.	ASM Metals Handbook, Vol 5: Surface Engineering, ASM International, Ohio, 1994.
2.	Ernest Rabinowicz, Friction and Wear of Materials, 2nd ed., John Wiley & Sons, NY, 1995.
3.	Davis J.R., Surface Engineering for Corrosion and Wear resistance, ASM International, 2001.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the influence of the tribological characteristics.	L2: Understanding
CO2	:	Discuss the various hard facing processes.	L3:Applying
CO3	:	Demonstrate the surface properties with diffusion of foreign atoms into the outer surface of thematerial such as boriding, aluminizing, etc.	L2: Understanding
CO4	:	Demonstrate the various vapour deposition processes of different materials on the surface of native materials using the Chemical, Physical and Thermal vapour deposition processes.	L2: Understanding
CO5	:	Describe the Modern processes and high energy processes like electron beam hardening, laser beamhardening.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1		1	1								1	1		1
CO2	2	1			1	1						1	1			1
CO3	1	1		1	1		1					1	2			1
CO4	2	1	1		1									2		1
CO5	1			1	1								1			1
Avg.	1.4	1.0	1.0	1.0	1.0	1.0	1.0					1.0	1.3	1.5		1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

22MTOE03	DESIGN AND SELECTION OF MATERIALS				
PREREQUISITES: Manufacturing Technology	**Category**	**OE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To know different types of materials and properties and to select better materials forDifferent applications.

UNIT I	**DESIGN PROCESS**	**9**	**0**	**0**	**9**
Materials in Design, Evolution of Engineering Materials, Design process, Types of design, Design flow chart-tools and material data, Interaction between Function, Material, Shape and Process.					
UNIT II	**MATERIAL PROPERTIES**	**9**	**0**	**0**	**9**
Revision of engineering materials and properties, Material properties inter-relationship charts such as Young"s modulus-density, Strength-density, Young"s modulus-Strength, wear rate-hardness, Young's modulus– relative cost, strength relative cost and others.					
UNIT III	**MATERIAL SELECTION**	**9**	**0**	**0**	**9**
Materials selection, selection strategy: material attributes, attribute limits, selection procedure, computer aided selection, structural index; Case studies: table legs, flywheel, springs, pressure vessels, bearings, heat exchangers, airframes, ship structures, automobile structures.					
UNIT IV	**PROCESSES AND PROCESS SELECTION**	**9**	**0**	**0**	**9**
The processes: shaping, joining and finishing, Process selection, ranking processes, cost, computer based process selection, Case studies: fan, pressure vessel, optical table, economical casting.					
UNIT V	**MULTIPLE CONSTRAINTS AND OBJECTIVES**	**9**	**0**	**0**	**9**
Selection under multiple constraints, conflicting objectives, penalty-functions, exchange constants, Case studies: connecting rods for high performance engines, windings of high field magnets.					
					Total (L+T) = 45 Hours

Text Books:	
1.	Michael F. Ashby, Materials Selection in Mechanical Design, third edition, Butterworth-Heinemann,2005
2.	J. Charles, F.A.A. Crane, J. A.G. Furness, Selection and Use of Engineering Materials, third edition,Butterworth-Heinemann, 2006
Reference Books:	
1.	ASM Metals Handbook, Vol.20: Materials Selection and Design, ASM International,1997
2.	Myer Kutz, Handbook of Materials Selection, John Wiley & Sons, Inc., New York, 2002

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Explain the design process and design flow chart tools for the materials selection criterion.	L2: Understanding
CO2	:	Apply the materials for corrosion and wear resistance processes.	L3:Applying
CO3	:	Apply the materials for auto and aero industry.	L3:Applying
CO4	:	Classify the process selection criterion for high temperature materials.	L2: Understanding
CO5	:	Suggest the process selection criterion for high performance materials..	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1		1	1								1		1	
CO2	2	1	1			1	1							2		
CO3	1	1		1	1								1	1		
CO4	2	1	1		1									2		
CO5	1	1		1	1											1
Avg.	1.4	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.7	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22MTOE04	NANOSCIENCE AND TECHNOLOGY				
PREREQUISITES: Engineering material and metallurgy	Category	OE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1. To study about nanomaterials and its application

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Definition, Length scales, surface area/volume ratio of micron to nanoscale materials, Importance of Nanoscale and Technology, Top down and bottom up approaches, Classification of nanomaterials, Properties of selected nanomaterials including carbon nanotubes (CNT), graphene, metal nanoparticles, clays, nanowires, quantum dots (QDs), effect of size on thermal, mechanical and electrical properties of nanomaterials.

UNIT II	**SYNTHESIS OF NANOMATERIALS**	**9**	**0**	**0**	**9**

Fabrication of Nanomaterials: Top-down approaches-lithography, Mechanical alloying milling, Severe PlasticDeformation, Bottom-up approaches-chemical vapour deposition, physical vapour deposition, atomic layer deposition (ALD), and Sol-gel method, Synthesis and purification of CNT, synthesis of expanded graphite (EG) orgraphene.

UNIT III	**NANOCOMPOSITES**	**9**	**0**	**0**	**9**

Fabrication of nanocomposites: Fabrication of Clay-rubber, Clay-polymer, CNT-polymer, EG-polymer, magnetic particle-polymer, CNT-metal, trade off between the composites and nanocomposites etc. Consolidation of nanomaterials.

UNIT IV	**CHARACTERIZATION OF NANOMATERIALS**	**9**	**0**	**0**	**9**

Characterization of Nanomaterials:, X-ray diffraction (XRD), Dynamic Light Scattering, Scanning electron microscope (SEM), Transmission Electron Microscope (TEM), UV-Visible spectroscopy, Scanning probe microscopy- Atomic force microscope (AFM) and scanning tunneling microscope (STM). Nanoindentation.

UNIT V	**APPLICATIONS OF NANOMATERIALS**	**9**	**0**	**0**	**9**

Applications of nanomaterials: Electronics, structural, biomedical, sensors nanofluids, optical, magnetic, biomedicalfields, solar cells, LED, LCD, electrically conducting polymers, batteries, fuel cells, SMART Materials. Environmental and health issues related to nanomaterials.

Total (L+T) = 45 Hours

Text Books:

1.	B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Textbook of Nanoscience and Nanotechnology,University Press (I) Pvt. Ltd., 2013.
2.	Bharat Bhushan (Ed), Springer Handbook of Nanotechnology, Springer-Verlag Berlin Heidelberg, 2004

Reference Books:

1.	Charles P Poole and Frank J Owens, –Introduction to Nanotechnology‖, John Wiley and Sons, New York, 2003.
2.	Michael Wilson, KamaliKannagara and Geoff Smith, ―Nanotechnology: Basic Science and Emerging Technology‖, Chapman and Hall, New York, 2002.
3.	Pradeep T, –Nano: The Essentials‖, Tata McGraw Hill, New Delhi, 2007.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Define and differentiate engineering materials on the basis of structure and properties for engineeringapplications.	L2: Understanding
CO2	:	Explain the various applications of nanomaterials.	L3:Applying
CO3	:	Discuss the fabrications of composites and nano composites.	L2: Understanding
CO4	:	Describe the charactrization of nanomaterials using SEM & TEM.	L4: Analyzing
CO5	:	Apply the applications of nanomaterials.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	1	2		1	1								1			1
CO2	2	2		1	1		1						1			1
CO3	3	2	1		1									1	1	
CO4	1	1		1	1	1							1	2		
CO5	1	1		1	1									1		
Avg.	1.6	1.6	1.0	1.0	1.0	1.0	1.0						1.0	1.3	1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

22MTOE05	MATERIALS FOR AUTOMOTIVE COMPONENTS					
PREREQUISITES: Engineering material and metallurgy		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To give an overview of material properties, use of materials selection chart and considerations for material selection
2.	To impart knowledge about the basis of materials selection
3.	To give insight about the factors that influence materials selection for engines and transmission system
4.	To instill the knowledge required for the selection of materials for automotivestructures
5.	To render the basis of material selection for electronics devices in the automobile.

UNIT I	ENGINEERING MATERIALS AND THEIR PROPERTIES	9	0	0	9

Classes of engineering materials - the evolution of engineering materials, Definition of materials properties, Displaying material properties using materials selection charts, Forces for change in materials selection and design, Materials and the environment. Selection of materials for automotive, aerospace, marine and defence applications.

UNIT II	BASIS OF MATERIAL SELECTION	9	0	0	9

Selection strategy, Attribute limits and Material indices, structural index Selection procedure: Design process - types of design, design requirements, Function, Material attributes, Shape and Manufacturing processes - Materials processing and design processes and their influence on design, Process attributes, Systematic process selection, Process selection diagrams, Process cost, Energy consumption for production, Material costs, Availability, Recyclability, Environmental consideration. Computer aided selection.

UNIT III	MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS	9	0	0	9

Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.

UNIT IV	MATERIALS FOR AUTOMOTIVE STRUCTURES	9	0	0	9

Materials selection for bearings, leaf springs, chasis& frames, Bumper, shock absorbers, Damping fluid, wind screens, panels, brake shoes, Disc, wheels, differentials , damping and Antifriction fluids, Tyres and tubes.

UNIT V	ELECTRONIC MATERIALS FOR AUTOMOTIVE APPLICATIONS	9	0	0	9

Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, Temperature sensors forclimate control, anti-collision, Anti-fog, Head lamps.

Total (L+T) = 45 Hours

Text Books:

1.	Charles J A and Crane. F A. A., ‒Selection and Use of Engineering Materials‖, 3rd Edition, Butterworths, London UK, 1996.
2.	Jason Rowe, ―Advanced Materials in Automotive Engineering‖, Wood Head Publishing, 2012.

Reference Books:

1.	Ahmed E, ―Advanced composite materials for Automotive applications, Wiley, 2013
2.	Don H Wright,‖ Testing Automotive Materials and Components‖, SAE 1993.
3.	Geoff Davis, ― Materials for Automobile bodies‖, Butter Worth Heinemann, 2012
4.	Hiroshi Yamagata, ‒The Science and Technology of Materials in Automotive Engines‖, Elsvier, 2005

5.	Mstislav A M, Valentin N A, Gleb V M, ―Automotive materials: a handbook for the mechanical engineer‖, NTIS, 1972.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Identify the criteria and forces that cause the changes in materials selection.	L3:Applying
CO2	:	Investigate the influence of structural index, manufacturing process, design and Functional requirements on selection strategies.	L4:Analysing
CO3	:	Recognize the temperature regime, nature of load and property requirements of materials for engines and transmission system.	L4:Analysing
CO4	:	Analyse the various stresses acting on the structural members of automobile underDynamic loading and select suitable material.	L4:Analysing
CO5	:	Prepare the apt material for electronic devices used in automobiles	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1		1	1									2		1
CO2	3	2		1		1								2	1	
CO3	2	3	1		1								1			1
CO4	2	1		1	1								2			
CO5	1	1			1		1							1		
Avg.	1.8	1.6	1.0	1.0	1.0	1.0	1.0						1.5	1.7	1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

ELECTIVES FOR HONOURS

PROFESSIONAL ELECTIVE COURSES: VERTICALS -Honours

22CSH101	EXPLORATORY DATA ANALYSIS					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To outline an overview of exploratory data analysis.
2	To implement data visualization using Matplotlib.
3	To perform univariate data exploration and analysis.
4	To apply bivariate data exploration and analysis.
5	To use Data exploration and visualization techniques for multivariate and time series data.

UNIT I	**EXPLORATORY DATA ANALYSIS**	**9**	**0**	**0**	**9**

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT II	**EDA USING PYTHON**	**9**	**0**	**0**	**9**

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT III	**UNIVARIATE ANALYSIS**	**9**	**0**	**0**	**9**

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

UNIT IV	**BIVARIATE ANALYSIS**	**9**	**0**	**0**	**9**

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

UNIT V	**MULTIVARIATE AND TIME SERIES ANALYSIS**	**9**	**0**	**0**	**9**

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

Total (45 L) =45 Periods

Text Books:	
1	Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020. (Unit 1)
2	Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017. (Unit 2)
3.	Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)

Reference Books:	
1	Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2	Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.
3	Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Understand the fundamentals of exploratory data analysis.	Understand
CO2	Implement the data visualization using Matplotlib.	Create
CO3	Perform univariate data exploration and analysis.	Apply
CO4	Apply bivariate data exploration and analysis.	Apply
CO5	Use Data exploration and visualization techniques for multivariate and time series data	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	3	3	-	-	-	2	2	3	2	2	2
CO 2	2	2	2	3	3	-	-	-	3	2	2	2	2	2
CO 3	2	3	2	2	3	-	-	-	2	2	2	1	2	2
CO 4	2	2	2	2	3	-	-	-	3	2	2	1	2	2
CO 5	2	2	3	2	1	-	-	-	1	2	2	1	2	2
Avg	**2.2**	**2.2**	**2.4**	**2.4**	**2.6**	**-**	**-**	**-**	**2.2**	**2**	**2.2**	**1.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH102	RECOMMENDER SYSTEMS					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the foundations of the recommender system.
2	To learn the significance of machine learning and data mining algorithms for Recommender systems
3	To learn about collaborative filtering
4	To make students design and implement a recommender system.
5	To learn collaborative filtering

UNIT I	INTRODUCTION	9	0	0	9

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

Suggested Activities:

- Practical learning – Implement Data similarity measures.
- External Learning – Singular Value Decomposition (SVD) applications

Suggested Evaluation Methods:

- Quiz on Recommender systems.
- Quiz of python tools available for implementing Recommender systems

UNIT II	CONTENT-BASED RECOMMENDATION SYSTEMS	9	0	0	9

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

Suggested Activities:

- Assignment on content-based recommendation systems
- Assignment of learning user profiles

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.
- Quiz of content-based filtering

UNIT III	COLLABORATIVE FILTERING	9	0	0	9

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection.

Suggested Activities:

- Practical learning – Implement collaborative filtering concepts
- Assignment of security aspects of recommender systems

Suggested Evaluation Methods:

- Quiz on collaborative filtering
- Seminar on security measures of recommender systems

UNIT IV	ATTACK-RESISTANT RECOMMENDER SYSTEMS	9	0	0	9

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

Suggested Activities:

- Group Discussion on attacks and their mitigation
- Study of the impact of group attacks
- External Learning – Use of CAPTCHAs

Suggested Evaluation Methods:

- Quiz on attacks on recommender systems
- Seminar on preventing attacks using the CAPTCHAs

UNIT V	EVALUATING RECOMMENDER SYSTEMS	9	0	0	9

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures.

Suggested Activities:

- Group Discussion on goals of evaluation design
- Study of accuracy metrics

Suggested Evaluation Methods:

- Quiz on evaluation design
- Problems on accuracy measures

Total (45 L) =45 Periods

Text Books:

1	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2	Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3	Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011)
4	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of recommender systems.	Understand
CO2	Implement machine-learning and data-mining algorithms in recommender systems data sets.	Apply
CO3	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.	Apply
CO4	Design and implement a simple recommender system.	Create
CO5	Learn about advanced topics of recommender systems	Understand
CO6	Learn about advanced topics of recommender systems applications	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	1	2	1	-	-	-	1	-	-	1	2	2
CO 2	1	2	-	-	1	-	-	-	-	-	-	1	2	2
CO 3	2	3	1	-	1	-	-	-	**2**	-	-	-	2	2
CO 4	3	2	2	2	1	-	-	-	**2**	-	-	2	2	2
CO 5	1	1	-	2	1	-	-	-	-	-	-	1	2	2
CO 6	2	2	1	1	1	-	-	-	-	-	-	1	2	2
Avg	**1.83**	**2**	**1.3**	**1.8**	**1**	**-**	**-**	**-**	**1.7**	**-**	**-**	**1.2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH103	NEURAL NETWORKS AND DEEP LEARNING					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics in deep neural networks
2	To understand the basics of associative memory and unsupervised learning networks
3	To apply CNN architectures of deep neural networks
4	To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
5	To apply autoencoders and generative models for suitable applications.

UNIT I	INTRODUCTION	9	0	0	9

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II	ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS	9	0	0	9

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT III	THIRD-GENERATION NEURAL NETWORKS	9	0	0	9

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuro scientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT IV	DEEP FEEDFORWARD NETWORKS	9	0	0	9

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Back propagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT V	RECURRENT NEURAL NETWORKS	9	0	0	9

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Auto encoder, Stochastic Encoders and Decoders, Contractive Encoders.

Total (45L) = 45 Periods

Text Books:

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2	Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications,2021.

Reference Books:	
1	Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly,2018.
2	Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media,2017.
3	Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6	Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
7	S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
8	Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9	James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Apply Convolution Neural Network for image processing.	Apply
CO2	Understand the basics of associative memory and unsupervised learning networks.	Understand
CO3	Apply CNN and its variants for suitable applications.	Apply
CO4	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.	Analyze
CO5	Apply autoencoders and generative models for suitable applications.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	2	3	1	-	-	2	1	-	-	1	2
CO 2	3	1	2	1	-	-	-	-	-	1	2	2	2	2
CO 3	3	3	3	3	3	1	-	-	2	1	-	-	2	2
CO 4	3	3	3	3	3	-	-	-	2	-	2	3	2	2
CO 5	1	1	3	2	3	-	-	-	2	-	-	-	2	2
Avg	**2.6**	**2**	**2.8**	**2.2**	**3**	**1**			**2**	**1**	**2**	**2.5**	**1.8**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH104	TEXT AND SPEECH ANALYSIS					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Understand natural language processing basics
2	Apply classification algorithms to text documents
3	Build question-answering and dialogue systems
4	Develop a speech recognition system
5	Develop a speech synthesizer

UNIT I	**NATURAL LANGUAGE BASICS**	**9**	**0**	**0**	**9**

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs

UNIT II	**TEXT CLASSIFICATION**	**9**	**0**	**0**	**9**

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model –FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

- Assignment on above topics
- Quiz on RNN, Transformers
- Implementing NLP with RNN and Transformers

UNIT III	**QUESTION ANSWERING AND DIALOGUE SYSTEMS**	**9**	**0**	**0**	**9**

Information retrieval – IR-based question answering – knowledge-based question answering –language models for QA – classic QA models – chatbots – Design of dialogue systems -–evaluating dialogue systems

Suggested Activities

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

UNIT IV	**TEXT-TO-SPEECH SYNTHESIS**	**9**	**0**	**0**	**9**

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

Suggested Activities

- Flipped classroom on Speech signal processing
- Exploring Text normalization
- Data collection
- Implementation of TTS systems

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on wavenet, deep learning-based TTS systems
- Finding accuracy with different TTS systems

UNIT V	AUTOMATIC SPEECH RECOGNITION	9	0	0	9

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Suggested Activities

- Flipped classroom on Speech recognition.
- Exploring Feature extraction

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on acoustic modelling

Total (45L) = 45 Periods

Text Books:	
1	Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processin Computational Linguistics, and Speech Recognition", Third Edition, 2022
Reference Books:	
1	Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2	Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4	Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain existing and emerging deep learning architectures for text and speech processing	Understand
CO2	Apply deep learning techniques for NLP tasks, language modelling and machine translation	Apply
CO3	Explain coreference and coherence for text processing	Understand
CO4	Build question-answering systems, chatbots and dialogue systems.	Create
CO5	Apply deep learning models for building speech recognition and text-to-speech systems	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	3	1	3	-	-	-	1	2	1	2	2	2
CO 2	3	1	2	1	2	-	-	-	2	2	1	3	2	2
CO 3	2	2	1	3	1	-	-	-	3	3	1	2	2	2
CO 4	2	1	1	1	2	-	-	-	2	1	2	2	2	2
CO 5	1	3	2	2	1	-	-	-	3	2	1	1	2	2
Avg	**2.2**	**1.8**	**1.8**	**1.6**	**2**	**-**	**-**	**-**	**2.2**	**2**	**1.2**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH105	BUSINESS ANALYTICS					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives	
1	To understand the Analytics Life Cycle.
2	To comprehend the process of acquiring Business Intelligence
3	To understand various types of analytics for Business Forecasting
4	To model the supply chain management for Analytics.
5	To apply analytics for different functions of a business

UNIT I	INTRODUCTION TO BUSINESS ANALYTICS	9	0	0	9
Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration					
UNIT II	**BUSINESS INTELLIGENCE**	**9**	**0**	**0**	**9**
Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions .					
UNIT III	**BUSINESS FORECASTING**	**9**	**0**	**0**	**9**
Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.					
UNIT IV	**HR & SUPPLY CHAIN ANALYTICS**	**9**	**0**	**0**	**9**
Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.					
UNIT V	**MARKETING & SALES ANALYTICS**	**9**	**0**	**0**	**9**
Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.					
					Total (45L) = 45 Periods

Text Books:	
1	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5	Mahadevan B, “Operations Management -Theory and Practice”,3rd Edition, Pearson Education,2018.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the real world business problems and model with analytical solutions.	Understand
CO2	Identify the business processes for extracting Business Intelligence	Apply
CO3	Apply predictive analytics for business fore-casting	Apply
CO4	Apply analytics for supply chain and logistics management	Apply
CO5	Use analytics for marketing and sales.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	1	1	-	-	-	1	2	1	1	2	2
CO 2	3	3	3	2	3	-	-	-	1	2	2	2	2	2
CO 3	2	2	3	3	2	-	-	-	3	1	1	3	2	2
CO 4	2	1	1	2	2	-	-	-	3	3	2	1	2	2
CO 5	2	3	2	3	2	-	-	-	3	3	1	3	2	2
Avg	**2.2**	**2.2**	**2.4**	**2.2**	**2**	**-**	**-**	**-**	**2.2**	**2.2**	**1.4**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH106	IMAGE AND VIDEO ANALYTICS					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics of image processing techniques for computer vision.
2	To learn the techniques used for image pre-processing.
3	To discuss the various object detection techniques.
4	To understand the various Object recognition mechanisms.
5	To elaborate on the video analytics techniques.

UNIT I	INTRODUCTION	9	0	0	9

Computer Vision – Image representation and image analysis tasks - Image representations –digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT II	IMAGE PRE-PROCESSING	9	0	0	9

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multisperalct images - Local pre-processing in the frequency domain - Line detection by local preprocessing operators - Image restoration.

UNIT III	OBJECT DETECTION USING MACHINE LEARNING	9	0	0	9

Object detection– Object detection methods – Deep Learning framework for Object detection–bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT IV	FACE RECOGNITION AND GESTURE RECOGNITION	9	0	0	9

Face Recognition-Introduction-Applications of Face Recognition-Process of Face RecognitionDeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNetGesture Recognition

UNIT V	VIDEO ANALYTICS	9	0	0	9

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problemRestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architectureImprovement in Inception v2-Video analytics-RestNet and Inception v3.

Total (45 L) =45 Periods

Text Books:

1	Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4nd edition, Thomson Learning, 2013.
2	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architecture with Python and Keras,Apress 2021(UNIT-III,IV and V)

Reference Books:

1	VSRichard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited,2011.
2	Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.
3	D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.

4	E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Understand the basics of image processing techniques for computer vision and video analysis.	Understand
CO2	Explain the techniques used for image pre-processing.	Understand
CO3	Develop various object detection techniques.	Create
CO4	Understand the various face recognition mechanisms.	Understand
CO5	Elaborate on deep learning-based video analytics.	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	2	2	2	-	-	-	3	3	2	1	2	2
CO 2	2	2	3	3	3	-	-	-	3	2	1	1	2	2
CO 3	1	2	2	2	3	-	-	-	1	2	1	2	2	2
CO 4	1	2	3	2	3	-	-	-	2	2	2	3	2	2
CO 5	3	2	1	3	2	-	-	-	2	1	1	3	2	2
Avg	**2**	**1.8**	**2.2**	**2.4**	**2.6**	**-**	**-**	**-**	**2.2**	**2**	**1.4**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSH107	COMPUTER VISION					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the fundamental concepts related to Image formation and processing.
2	To learn feature detection, matching and detection.
3	To become familiar with feature based alignment and motion estimation
4	To develop skills on 3D reconstruction
5	To understand image based rendering and recognition

UNIT I	**INTRODUCTION TO IMAGE FORMATION AND PROCESSING**	**9**	**0**	**0**	**9**

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighbourhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II	**FEATURE DETECTION, MATCHING AND SEGMENTATION**	**9**	**0**	**0**	**9**

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III	**FEATURE-BASED ALIGNMENT & MOTION ESTIMATION**	**9**	**0**	**0**	**9**

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV	**3D RECONSTRUCTION**	**9**	**0**	**0**	**9**

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

UNIT V	**IMAGE-BASED RENDERING AND RECOGNITION**	**9**	**0**	**0**	**9**

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes -Video-based rendering-Object detection - Face recognition - Instance recognition – Category recognition - Context and scene understanding- Recognition databases and test sets.

Total (45 L) =45 Periods

Text Books:	
1	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
Reference Books:	
1	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand basic knowledge, theories and methods in image processing and computer vision.	Understand
CO2	Implement basic and some advanced image processing techniques in OpenCV.	Apply
CO3	Apply 2D a feature-based based image alignment, segmentation and motion estimations.	Apply
CO4	Apply 3D image reconstruction techniques	Apply
CO5	Design and develop innovative image processing and computer vision applications.	Create

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	1	1	1	-	-	-	2	1	3	2	2	2
CO 2	3	3	3	2	3	-	1	-	2	1	2	2	2	2
CO 3	3	3	2	2	3	-	-	-	1	1	2	2	2	2
CO 4	2	3	3	2	3	-	-	-	2	1	2	3	2	2
CO 5	2	3	3	2	2	2	-	-	3	1	2	3	2	2
Avg	**2.6**	**2.6**	**2.4**	**1.8**	**2.4**	**2**	**1**	**-**	**2**	**1**	**2.2**	**2.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH108	BIG DATA ANALYTICS						
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives	
1	To understand big data
2	To learn and use NoSQL big data management.
3	To learn map reduce analytics using Hadoop and related tools.
4	To work with map reduce applications
5	To understand the usage of Hadoop related tools for Big Data Analytics

UNIT I	**UNDERSTANDING BIG DATA**	**9**	**0**	**0**	**9**

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT II	**NOSQL DATA MANAGEMENT**	**9**	**0**	**0**	**9**

Introduction to NoSQL – aggregate data models – key-value and document data models –relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients

UNIT III	**MAP REDUCE APPLICATIONS**	**9**	**0**	**0**	**9**

Map Reduce workflows – unit tests with MR Unit – test data and local tests – anatomy of Map Reduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – Map Reduce types – input formats – output formats.

UNIT IV	**BASICS OF HADOOP**	**9**	**0**	**0**	**9**

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow –Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures -Cassandra – Hadoop integration.

UNIT V	**HADOOP RELATED TOOLS**	**9**	**0**	**0**	**9**

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis.
Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts.
Hive – data types and file formats – Hive QL data definition – Hive QL data manipulation – Hive QL queries.

Total (45 L) =45 Periods

Text Books:	
1	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2	Eric Sammer, "Hadoop Operations", O'Reilley, 2012
3	Sadalage, Pramod J. “NoSQL distilled”, 2013

Reference Books:	
1	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4	Alan Gates, "Programming Pig", O'Reilley, 2011.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe big data and use cases from selected business domains. .	Remember
CO2	Explain NoSQL big data management	Understand
CO3	Install, configure, and run Hadoop and HDFS.	Apply
CO4	Perform map-reduce analytics using Hadoop	Apply
CO5	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	3	3	-	-	-	2	2	3	1	2	2
CO 2	3	3	2	3	2	-	-	-	2	2	3	3	2	2
CO 3	3	3	3	2	3	-	-	-	2	2	1	2	2	2
CO 4	2	3	3	3	3	-	-	-	2	2	3	2	2	2
CO 5	3	3	3	3	3	-	-	-	3	1	3	2	2	2
Avg	**2.8**	**3**	**2.8**	**2.8**	**2.8**	**-**	**-**	**-**	**2.2**	**1.8**	**2.6**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH201	FULL STACK WEB APPLICATION DEVELOPMENT					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Develop TypeScript Application
2	Develop Single Page Application (SPA)
3	Able to communicate with a server over the HTTP protocol
4	Learning all the tools need to start building applications with Node.js
5	Implement the Full Stack Development using MEAN Stack

UNIT I	FUNDAMENTALS & TYPESCRIPT LANGUAGE	9	0	0	9

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.

UNIT II	ANGULAR	9	0	0	9

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. Http Client. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.

UNIT III	NODE.js	9	0	0	9

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Call back functions. call back errors. Abstracting call backs. Chaining call backs. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Call back API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and Typed Arrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.

UNIT IV	EXPRESS.Js	9	0	0	9

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router. route(path). Router Class. Request Object. Response Object. Error Handling.

UNIT V	MONGODB	9	0	0	9

Introduction to Mongo DB. Documents. Collections. Sub collections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

Total (45 L) =45 Periods

Text Books:	
1	Adam Freeman, Essential TypeScript, Apress, 2019
2	Mark Clow, Angular Projects, Apress, 2018
3	Alex R. Young, Marc Harter,Node.js in Practice, Manning Publication, 2014
4	Pro Express.js, Azat Mardan, Apress, 2015
5	MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, Manning Publication, Second edition, 2016

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop basic programming skills using Javascript .	Create
CO2	Implement a front-end web application using Angular.	Apply
CO3	Create modules to organise the server	Create
CO4	Build RESTful APIs with Node, Express and MongoDB with confidence.	Create
CO5	Will learn to Store complex, relational data in MongoDB using Mongoose .	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	3	3	3	-	-	-	1	3	3	1	2	2
CO 2	2	2	2	1	2	-	-	-	2	2	1	3	2	2
CO 3	1	1	3	2	3	-	-	-	1	2	1	1	2	2
CO 4	2	3	3	1	2	-	-	-	3	1	2	2	2	2
CO 5	1	2	3	2	2	-	-	-	2	1	3	1	2	2
Avg	**1.8**	**2**	**2.8**	**1.8**	**2.4**	**-**	**-**	**-**	**1.8**	**1.8**	**2**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH202	APP DEVELOPMENT					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To learn development of native applications with basic GUI Components
2	To develop cross-platform applications with event handling
3	To develop applications with location and data storage capabilities
4	To develop web applications with database access

UNIT I	**FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT**	**9**	**0**	**0**	**9**

Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design

UNIT II	**NATIVE APP DEVELOPMENT USING JAVA**	**9**	**0**	**0**	**9**

Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Dev elopment Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props

UNIT III	**HYBRID APP DEVELOPMENT**	**9**	**0**	**0**	**9**

Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova

UNIT IV	**CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE**	**9**	**0**	**0**	**9**

What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Crossplatform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props

UNIT V	**NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS**	**9**	**0**	**0**	**9**

Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability

Total (45 L) =45 Periods

Text Books:	
1	Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2	Apache Cordova in Action, Raymond K. Camden, Manning. 2015
3	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing

Reference Books:	
1	Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2	Native Mobile Development by Shaun Lewis, Mike Dunn
3	Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras
4	Apache Cordova 4 Programming, John M Wargo, 2015
5	React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop Native applications with GUI Components. .	Create
CO2	Develop hybrid applications with basic event handling.	Create
CO3	Implement cross-platform applications with location and data storage capabilities.	Apply
CO4	Implement cross platform applications with basic GUI and event handling.	Apply
CO5	Develop web applications with cloud database access.	Create

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	1	2	3	-	-	-	1	1	2	1	2	2
CO 2	2	1	3	2	2	-	-	-	3	2	2	3	2	2
CO 3	2	2	2	1	2	-	-	-	1	1	1	1	2	2
CO 4	1	3	1	1	3	-	-	-	1	1	3	2	2	2
CO 5	1	1	3	1	3	-	-	-	1	1	2	1	2	2
Avg	**1.6**	**1.8**	**2**	**1.4**	**2.6**	**-**	**-**	**-**	**1.4**	**1.2**	**2**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH203	SERVICE ORIENTED ARCHITECTURE					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To provide an overview of XML Technology and modeling databases in XML
2	To provide an Basics concepts of Service Oriented Architecture
3	To provide an Basics concepts of Service Oriented Architecture
4	To introduce Security solutions in XML and Web Services and to introduce Security standards for Web Services
5	To provide concepts about Big data and SOA with its Business case analysis.

UNIT I	**XML TECHNOLOGY**	**9**	**0**	**0**	**9**

XML – XML and Web - Name Spaces – XML Document Structure - Structuring with Schemas and DTD - Modeling Databases in XML – XQuery.

UNIT II	**SOA BASICS**	**9**	**0**	**0**	**9**

Service Oriented Architecture (SOA) – Comparing SOA with Client-Server and Distributed architectures - Characteristics of SOA – Benefits of SOA -- Principles of Service orientation – Service layers - Business Process management

UNIT III	**WEB SERVICES**	**9**	**0**	**0**	**9**

SOA and Web Services – Web Services Protocol Stack – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI. Service-Level Interaction patterns – XML and Web Services - Enterprise Service Bus - .NET and J2EE Interoperability.

UNIT IV	**WS TECHNOLOGIES AND STANDARDS**	**9**	**0**	**0**	**9**

Web Services Technologies - JAX-RPC, JAX-WS. Web Service Standards – WS-RM, WSAddressing, WS-Policy. Service Orchestration and Choreography – Composition Standards - BPEL. Service Oriented Analysis and Design.

UNIT V	**BIG DATA AND SOA**	**9**	**0**	**0**	**9**

Big Data and SOA: Concepts, Big Data and its characteristics, Technologies for Big Data, Service-orientation for Big Data Solutions.

Business Case for SOA: Stakeholder Objectives, Benefits of SOA, Cost Savings, Return on Investment (ROI), Build a Case for SOA

Total (45 L) =45 Periods

Text Books:

1	Ron Schmelzer et al. “XML and Web Services”, Pearson Education, 2008. (Unit 1 and 3)
2	Thomas Erl, “ Service Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005 (Unit 2, 3, 4, and 5)
3	Frank P.Coyle, “XML, Web Services and the Data Revolution”, Pearson Education, 2002 (Unit 5)
4	Shankar Kambhampaty; Service - Oriented Architecture & Microservices Architecture: For Enterprise, Cloud, Big Data and Mobile; Wiley; 3rd Edition; 2018; ISBN: 9788126564064.

Reference Books:	
1	Eric Newcomer, Greg Lomow, “Understanding SOA with Web Services”, Addison Wesley, 2005.
2	James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, “Java Web Services Architecture”, Elsevier, 2011.
3	Sandeep Chatterjee and James Webber, “Developing Enterprise Web Services: An Architect's Guide”, Prentice Hall, 2004

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Explain the basics of XML	Understand
CO2	Describe the concepts of SOA	Remember
CO3	Apply the Web services, some of the prevailing standards and technologies of Web Services	Apply
CO4	Design approaches for providing security for XML documents as well as messages exchanged among Web Services	Create
CO5	Explain the concepts about Big data and SOA with its Business case analysis	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	1	-	-	-	2	1	3	2	2	2
CO 2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO 3	1	1	3	1	3	-	-	-	3	3	1	1	2	2
CO 4	1	1	1	2	3	-	-	-	2	3	3	1	2	2
CO 5	1	3	3	2	2	-	-	-	1	3	1	2	2	2
Avg	**1.8**	**1.8**	**2**	**1.8**	**2.2**	**-**	**-**	**-**	**1.8**	**2.4**	**2.2**	**1.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH204	UI AND UX DESIGN					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To provide a sound knowledge in UI & UX
2	To understand the need for UI and UX
3	To understand the various Research Methods used in Design
4	To explore the various Tools used in UI & UX
5	Creating a wireframe and prototype

UNIT I	**FOUNDATIONS OF DESIGN**	**9**	**0**	**0**	**9**
UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy.					
UNIT II	**FOUNDATIONS OF UI DESIGN**	**9**	**0**	**0**	**9**
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides					
UNIT III	**FOUNDATIONS OF UX DESIGN**	**9**	**0**	**0**	**9**
Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals					
UNIT IV	**WIREFRAMING, PROTOTYPING AND TESTING**	**9**	**0**	**0**	**9**
Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration					
UNIT V	**RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE**	**9**	**0**	**0**	**9**
Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture					
					Total (45L) = 45 Periods

Text Books:	
1	Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2	Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021
Reference Books:	
1	Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2	Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3	Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
4	https://www.nngroup.com/articles/
5	https://www.interaction-design.org/literature

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Build UI for user Applications	Create
CO2	Evaluate UX design of any product or application	Evaluate
CO3	Demonstrate UX Skills in product development	Remember
CO4	Implement Sketching principles	Apply
CO5	Create Wireframe and Prototype	Create

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	1	3	1	-	-	-	3	3	2	1	2	2
CO 2	2	3	1	3	2	-	-	-	1	2	2	2	2	2
CO 3	1	3	3	2	2	-	-	-	2	3	1	2	2	2
CO 4	1	2	3	3	1	-	-	-	3	2	1	3	2	2
CO 5	1	2	3	2	1	-	-	-	2	1	1	1	2	2
Avg	**1.6**	**2.2**	**2.2**	**2.6**	**1.4**	**-**	**-**	**-**	**2.2**	**2.2**	**1.4**	**1.8**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH205	SOFTWARE TESTING AND AUTOMATION					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics of software testing
2	To learn how to do the testing and planning effectively
3	To build test cases and execute them
4	To focus on wide aspects of testing and understanding multiple facets of testing
5	To get an insight about test automation and the tools used for test automation

UNIT I	FOUNDATIONS OF SOFTWARE TESTING	9	0	0	9

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT II	TEST PLANNING	9	0	0	9

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III	TEST DESIGN AND EXECUTION	9	0	0	9

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV	ADVANCED TESTING CONCEPTS	9	0	0	9

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT V	TEST AUTOMATION AND TOOLS	9	0	0	9

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

Total (45 L) =45 Periods

Text Books:

1	Yogesh Singh, "Software Testing", Cambridge University Press, 2012
2	Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018

Reference Books:

1	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc
2	Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3	Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group.
4	Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
5	Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc

6	Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing
7	Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of software testing and the need for software testing	Understand
CO2	Design Test planning and different activities involved in test planning	Create
CO3	Design effective test cases that can uncover critical defects in the application	Create
CO4	Carry out advanced types of testing	Understand
CO5	Automate the software testing using Selenium and TestNG	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	1	2	-	-	-	1	1	3	2	2	2
CO 2	2	3	1	1	1	-	-	-	2	2	1	2	2	2
CO 3	2	2	1	3	1	-	-	-	1	3	1	2	2	2
CO 4	2	1	3	2	1	-	-	-	1	1	1	2	2	2
CO 5	2	2	1	3	1	-	-	-	1	3	2	1	2	2
Avg	**2.2**	**2.2**	**1.6**	**2**	**1.2**	**-**	**-**	**-**	**1.2**	**2**	**1.6**	**1.8**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH206	**WEB APPLICATION SECURITY**						
PREREQUISITES		**Category**	**PE**	**Credit**		**3**	
		Hours/Week	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Learning Objectives

1	To understand the fundamentals of web application security
2	To focus on wide aspects of secure development and deployment of web applications
3	To learn how to build secure APIs
4	To learn the basics of vulnerability assessment and penetration testing
5	To get an insight about Hacking techniques and Tools

UNIT I	**FUNDAMENTALS OF WEB APPLICATION SECURITY**	**9**	**0**	**0**	**9**

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II	**SECURE DEVELOPMENT AND DEPLOYMENT**	**9**	**0**	**0**	**9**

Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III	**SECURE API DEVELOPMENT**	**9**	**0**	**0**	**9**

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV	**VULNERABILITY ASSESSMENT AND PENETRATION TESTING**	**9**	**0**	**0**	**9**

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Databasebased vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V	**HACKING TECHNIQUES AND TOOLS**	**9**	**0**	**0**	**9**

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

Total (45 L) =45 Periods

Text Books:

1	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O’Reilly Media, Inc.
2	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGrawHill Companies.
3	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA

Reference Books:	
1	Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc
2	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4	Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understanding the basic concepts of web application security and the need for it	Understand
CO2	Be acquainted with the process for secure development and deployment of web applications	Understand
CO3	Acquire the skill to design and develop Secure Web Applications that use Secure APIs	Understand
CO4	Be able to get the importance of carrying out vulnerability assessment and penetration testing	Understand
CO5	Acquire the skill to think like a hacker and to use hackers tool sets	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	2	1	3	-	-	-	-	-	-	1	2	2
CO 2	2	1	2	1	3	-	-	-	-	-	-	-	2	2
CO 3	1	1	1	2	3	-	-	-	-	-	-	1	2	2
CO 4	1	2	1	1	2	-	-	-	-	-	-	-	2	2
CO 5	1	2	2	2	2	-	-	-	-	-	-	1	2	2
Avg	**1.2**	**1.6**	**1.6**	**1.4**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH207	**DEVOPS**						
PREREQUISITES		**Category**	**PE**	**Credit**		**3**	
		Hours/Week	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Learning Objectives	
1	To introduce DevOps terminology, definition & concepts
2	To understand the different Version control tools like Git, Mercurial
3	To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4	To understand Configuration management using Ansible
5	Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I	**INTRODUCTION TO DEVOPS**	**9**	**0**	**0**	**9**
Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.					
UNIT II	**COMPILE AND BUILD USING MAVEN & GRADLE**	**9**	**0**	**0**	**9**
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle					
UNIT III	**CONTINUOUS INTEGRATION USING JENKINS**	**9**	**0**	**0**	**9**
Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.					
UNIT IV	**CONFIGURATION MANAGEMENT USING ANSIBLE**	**9**	**0**	**0**	**9**
Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible					
UNIT V	**BUILDING DEVOPS PIPELINES USING AZURE**	**9**	**0**	**0**	**9**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines. yaml file					
Total (45L) = 45 Periods					

Text Books:	
1	Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2	Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014.

Reference Books:	
1	Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
2	Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
3	David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016..
4	Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.
5	https://www.jenkins.io/user-handbook.pd
6	https://maven.apache.org/guides/getting-started/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Understand different actions performed through Version control tools like Git.	Understand
CO2	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.	Apply
CO3	Ability to Perform Automated Continuous Deployment	Apply
CO4	Ability to do configuration management using Ansible	Apply
CO5	Understand to leverage Cloud-based DevOps tools using Azure DevOps	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	3	-	-	-	-	-	-	-	2	2
CO 2	3	3	3	2	3	-	-	-	-	-	-	-	2	2
CO 3	3	3	3	2	3	-	-	-	-	-	-	-	2	2
CO 4	3	3	3	2	3	-	-	-	-	-	-	-	2	2
CO 5	3	3	3	2	3	-	-	-	-	-	-	-	2	2
Avg	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSH208	PRINCIPLES OF PROGRAMMING LANGUAGES					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand and describe syntax and semantics of programming languages
2	To understand data, data types, and basic statements
3	To understand call-return architecture and ways of implementing them
4	To understand object-orientation, concurrency, and event handling in programming languages
5	To develop programs in non-procedural programming paradigms

UNIT I	SYNTAX AND SEMANTICS	9	0	0	9

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing

UNIT II	DATA, DATA TYPES, AND BASIC STATEMENTS	9	0	0	9

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT III	SUBPROGRAMS AND IMPLEMENTATIONS	9	0	0	9

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping.

UNIT IV	OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING	9	0	0	9

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling

UNIT V	FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES	9	0	0	9

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

Total (45 L) =45 Periods

Text Books:

1	Robert W. Sebesta, "Concepts of Programming Languages", Twelfth Edition (Global Edition), Pearson, 2022.
2	Michael L. Scott, "Programming Language Pragmatics", Fourth Edition, Elsevier, 2018
3	R. Kent Dybvig, "The Scheme programming language", Fourth Edition, Prentice Hall, 2011.
4	Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Pearson, 1997.
5	W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe syntax and semantics of programming languages	Remember
CO2	Explain data, data types, and basic statements of programming languages	Understand
CO3	Design and implement subprogram constructs	Apply
CO4	Apply object-oriented, concurrency, and event handling programming constructs and Develop programs in Scheme, ML, and Prolog	Apply
CO5	Understand and adopt new programming languages	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	2	1	-	-	-	-	-	-	3	2	2
CO 2	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO 3	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO 4	3	3	3	3	2	2	-	-	-	-	-	-	2	2
CO 5	3	3	3	3	3	3	2	2	1	3	1	3	2	2
Avg	**2.8**	**2.8**	**3**	**2.4**	**2**	**2.5**	**2**	**2**	**1**	**3**	**1**	**3**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH301	CLOUD COMPUTING					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives	
1	To understand the principles of cloud architecture, models and infrastructure.
2	To understand the concepts of virtualization and virtual machines.
3	To gain knowledge about virtualization Infrastructure
4	To explore and experiment with various Cloud deployment environments.
5	To learn about the security issues in the cloud environment.

UNIT I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	9	0	0	9
Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges					
UNIT II	**VIRTUALIZATION BASICS**	**9**	**0**	**0**	**9**
Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.					
UNIT III	**VIRTUALIZATION INFRASTRUCTURE AND DOCKER**	**9**	**0**	**0**	**9**
Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.					
UNIT IV	**CLOUD DEPLOYMENT ENVIRONMENT**	**9**	**0**	**0**	**9**
Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.					
UNIT V	**CLOUD SECURITY**	**9**	**0**	**0**	**9**
Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.					
					Total (45 L) =45 Periods

Text Books:	
1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2	James Turnbull, “The Docker Book”, O’Reilly Publishers, 2014
3	Krutz, R. L., Vines, R. D, “Cloud security. A Comprehensive Guide to Secure Cloud Computing”, Wiley Publishing, 2010.
Reference Books:	
1	James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy: an enterprise perspective on risks and compliance”, O’Reilly Media, Inc., 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the design challenges in the cloud.	Understand
CO2	Apply the concept of virtualization and its types	Apply
CO3	Experiment with virtualization of hardware resources and Docker	Apply
CO4	Develop and deploy services on the cloud and set up a cloud environment.	Create
CO5	Explain security challenges in the cloud environment	Analyze

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	1	1	1	-	-	-	2	3	1	3	2	2
CO 2	3	1	2	2	1	-	-	-	1	2	1	3	2	2
CO 3	2	3	2	3	1	-	-	-	3	1	1	3	2	2
CO 4	1	2	3	3	3	-	-	-	3	3	1	2	2	2
CO 5	2	3	3	1	3	-	-	-	2	2	1	2	2	2
Avg	**2.2**	**2.2**	**2.2**	**2**	**1.8**	**-**	**-**	**-**	**2.2**	**2.2**	**1**	**2.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH302	VIRTUALIZATION					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To Learn the basics and types of Virtualization
2	To understand the Hypervisors and its types.
3	To Explore the Virtualization Solutions
4	To Experiment the virtualization platforms

UNIT I	**INTRODUCTION TO VIRTUALIZATION**	**9**	**0**	**0**	**9**
Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisor					
UNIT II	**SERVER AND DESKTOP VIRTUALIZATION**	**9**	**0**	**0**	**9**
Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization					
UNIT III	**NETWORK VIRTUALIZATION**	**9**	**0**	**0**	**9**
Introduction to Network Virtualization-Advantages- Functions-Tools for Network VirtualizationVLAN-WAN Architecture-WAN Virtualization					
UNIT IV	**STORAGE VIRTUALIZATION**	**9**	**0**	**0**	**9**
Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID.					
UNIT V	**VIRTUALIZATION TOOLS**	**9**	**0**	**0**	**9**
VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.					
Total (45 L) =45 Periods					

Text Books:	
1	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3	David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
4	Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.
5	James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
6	David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Analyse the virtualization concepts and Hypervisor	Analyze
CO2	Apply the Virtualization for real-world applications	Apply
CO3	Install & Configure the different VM platforms	Apply
CO4	Experiment with the VM with various software	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	3	1	3	2	-	-	-	1	1	3	1	2	2
CO 2	3	2	2	1	2	-	-	-	1	2	2	3	2	2
CO 3	3	2	1	3	1	-	-	-	2	2	1	3	2	2
CO 4	1	1	2	3	3	-	-	-	3	3	1	1	2	2
CO 5	1	3	2	3	1	-	-	-	2	1	3	3	2	2
Avg	**1.8**	**2.2**	**1.6**	**2.6**	**1.8**	**-**	**-**	**-**	**1.8**	**1.8**	**2**	**2.2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH303	CLOUD SERVICES MANAGEMENT				
PREREQUISITES		Category	PE	Credit	3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	Introduce Cloud Service Management terminology, definition & concepts
2	Compare and contrast cloud service management with traditional IT service management
3	Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
4	Select appropriate structures for designing, deploying and running cloud-based services in a business environment
5	Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT I	CLOUD SERVICE MANAGEMENT FUNDAMENTALS	9	0	0	9

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

UNIT II	CLOUD SERVICES STRATEGY	9	0	0	9

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III	CLOUD SERVICE MANAGEMENT	9	0	0	9

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT IV	CLOUD SERVICE ECONOMICS	9	0	0	9

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT V	CLOUD SERVICE GOVERNANCE & VALUE	9	0	0	9

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

Total (45 L) =45 Periods

Text Books:

1	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

Reference Books:

1	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.	Remember
CO2	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services	Understand
CO3	Solve the real world problems using Cloud services and technologies	Apply
CO4	Understand the pricing model of cloud.	Understand
CO5	Understand the Cloud service Governance and value	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	1	-	-	-	2	1	3	2	2	2
CO 2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO 3	1	1	3	1	3	-	-	-	3	3	1	1	2	2
CO 4	1	1	1	2	3	-	-	-	2	3	3	1	2	2
CO 5	1	3	3	2	2	-	-	-	1	3	1	2	2	2
Avg	**1.8**	**1.8**	**2**	**1.8**	**2.2**	**-**	**-**	**-**	**1.8**	**2.4**	**2.2**	**1.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH304	DATA WAREHOUSING					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To know the details of data warehouse Architecture
2	To understand the OLAP Technology
3	To understand the partitioning strategy
4	To differentiate various schema
5	To understand the roles of process manager & system manager

UNIT I	INTRODUCTION TO DATA WAREHOUSE	9	0	0	9

Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse

UNIT II	ETL AND OLAP TECHNOLOGY	9	0	0	9

What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP

UNIT III	META DATA, DATA MART AND PARTITION STRATEGY	9	0	0	9

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition

UNIT IV	DIMENSIONAL MODELING AND SCHEMA	9	0	0	9

Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools

UNIT V	SYSTEM & PROCESS MANAGERS	9	0	0	9

Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing

Total (45 L) =45 Periods

Text Books:

1	Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2	Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013

Reference Books:

1	Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.
2	K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Design data warehouse architecture for various Problems	Create
CO2	Apply the OLAP Technology	Apply
CO3	Analyse the partitioning strategy	Analyze
CO4	Critically analyze the differentiation of various schema for given problem	Analyze
CO5	Frame roles of process manager & system manager	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	2	-	-	-	3	-	-	3	2	2
CO 2	3	2	2	2	3	-	-	-	2	-	2	2	2	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	3	2	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	3	2	2
CO 5	3	2	2	2	-	2	-	-	-	-	2	2	2	2
Avg	**3**	**2.6**	**2.6**	**1.2**	**2.5**	**2**	**-**	**-**	**2.5**	**-**	**2**	**2.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH305	STORAGE TECHNOLOGIES			Semester		
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Characterize the functionalities of logical and physical components of storage
2	Describe various storage networking technologies
3	Identify different storage virtualization technologies
4	Discuss the different backup and recovery strategies
5	Understand common storage management activities and solutions

UNIT I	STORAGE SYSTEMS	9	0	0	9

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT II	INTELLIGENT STORAGE SYSTEMS AND RAID	9	0	0	9

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scaleout storage Architecture.

UNIT III	STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION	9	0	0	9

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT IV	BACKUP, ARCHIVE AND REPLICATION	9	0	0	9

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V	SECURING STORAGE INFRASTRUCTURE	9	0	0	9

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

Total (45 L) =45 Periods

Text Books:

1	EMC Corporation, Information Storage and Management, Wiley, India
2	Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017
3	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein ,Storage Networks Explained, Second Edition, Wiley, 2009

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment	Remember
CO2	Illustrate the usage of advanced intelligent storage systems and RAID	Apply
CO3	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization	Analyze
CO4	Examine the different role in providing disaster recovery and remote replication technologies	Analyze
CO5	Infer the security needs and security measures to be employed in information storage management	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	1	3	3	-	-	-	1	1	1	3	2	2
CO 2	3	1	2	3	3	-	-	-	3	2	3	2	2	2
CO 3	1	1	3	2	2	-	-	-	3	1	1	2	2	2
CO 4	3	2	1	2	2	-	-	-	1	1	3	1	2	2
CO 5	1	3	2	1	2	-	-	-	1	2	3	1	2	2
Avg	**1.8**	**1.8**	**1.8**	**2.2**	**2.4**	**-**	**-**	**-**	**1.8**	**1.4**	**2.2**	**1.8**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH306	SOFTWARE DEFINED NETWORKS					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the need for SDN and its data plane operations
2	To understand the functions of control plane
3	To comprehend the migration of networking functions to SDN environment
4	To explore various techniques of network function virtualization
5	To comprehend the concepts behind network virtualization

UNIT I	**SDN: INTRODUCTION**	**9**	**0**	**0**	**9**
Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane					
UNIT II	**SDN DATA PLANE AND CONTROL PLANE**	**9**	**0**	**0**	**9**
Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers.					
UNIT III	**SDN APPLICATIONS**	**9**	**0**	**0**	**9**
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking					
UNIT IV	**NETWORK FUNCTION VIRTUALIZATION**	**9**	**0**	**0**	**9**
Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture					
UNIT V	**NFV FUNCTIONALITY**	**9**	**0**	**0**	**9**
NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV					
					Total (45 L) =45 Periods

Text Books:

1	William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1 Edition, 2015.

Reference Books:

1	Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016
2	Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
4	Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016
5	Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe the motivation behind SDN	Remember
CO2	Identify the functions of the data plane and control plane	Apply
CO3	Design and develop network applications using SDN	Create
CO4	Orchestrate network services using NFV	Analyze
CO5	Explain various use cases of SDN and NFV	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	3	1	3	-	-	-	2	3	1	3	2	2
CO 2	2	1	2	2	3	-	-	-	2	2	2	2	2	2
CO 3	2	2	2	3	3	-	-	-	3	1	1	2	2	2
CO 4	2	2	2	3	1	-	-	-	1	3	1	2	2	2
CO 5	3	3	1	1	3	-	-	-	1	2	1	2	2	2
Avg	**2**	**2**	**2**	**2**	**2.6**	**-**	**-**	**-**	**1.8**	**2.2**	**1.2**	**2.2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

<table>
<tr><td>22CSH307</td><td colspan="4">STREAM PROCESSING</td><td colspan="3"></td><td></td></tr>
<tr><td colspan="4">PREREQUISITES</td><td>Category</td><td>PE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="4" rowspan="2"></td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="9">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="8">Introduce Data Processing terminology, definition & concepts</td></tr>
<tr><td>2</td><td colspan="8">Define different types of Data Processing</td></tr>
<tr><td>3</td><td colspan="8">Explain the concepts of Real-time Data processing</td></tr>
<tr><td>4</td><td colspan="8">Select appropriate structures for designing and running real-time data services in a business environment</td></tr>
<tr><td>5</td><td colspan="8">Illustrate the benefits and drive the adoption of real-time data services to solve real world problems</td></tr>
<tr><td>UNIT I</td><td colspan="4">FOUNDATIONS OF DATA SYSTEMS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges</td></tr>
<tr><td>UNIT II</td><td colspan="4">REAL-TIME DATA PROCESSING</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing,Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage</td></tr>
<tr><td>UNIT III</td><td colspan="4">DATA MODELS AND QUERY LANGUAGES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Manyto-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL</td></tr>
<tr><td>UNIT IV</td><td colspan="4">EVENT PROCESSING WITH APACHE KAFKA</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API</td></tr>
<tr><td>UNIT V</td><td colspan="4">REAL-TIME PROCESSING USING SPARK STREAMING</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication</td></tr>
<tr><td colspan="9">Total (45 L) =45 Periods</td></tr>
</table>

Text Books:	
1	Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2	Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media
3	Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing
Reference Books:	
1	https://spark.apache.org/docs/latest/streaming-programming-guide.html
2	Kafka.apache.org

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the applicability and utility of different streaming algorithms.	Understand
CO2	Describe and apply current research trends in data-stream processing.	Remember
CO3	Analyze the suitability of stream mining algorithms for data stream systems.	Analyze
CO4	Program and build stream processing systems, services and applications.	Create
CO5	Solve problems in real-world applications that process data streams.	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	3	1	-	-	-	2	3	1	2	2	2
CO 2	2	1	1	2	2	-	-	-	3	2	2	3	2	2
CO 3	3	1	2	3	3	-	-	-	2	2	1	1	2	2
CO 4	2	1	3	3	3	-	-	-	3	3	1	1	2	2
CO 5	3	3	1	2	2	-	-	-	3	3	2	3	2	2
Avg	**2.6**	**1.8**	**1.8**	**2.6**	**2.2**	**-**	**-**	**-**	**2.6**	**2.6**	**1.4**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSH308	SECURITY AND PRIVACY IN CLOUD					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives	
1	To Introduce Cloud Computing terminology, definition & concepts
2	To understand the security design and architectural considerations for Cloud
3	To understand the Identity, Access control in Cloud
4	To follow best practices for Cloud security using various design patterns
5	To be able to monitor and audit cloud applications for security

UNIT I	FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	9	0	0	9

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures

UNIT II	SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	9	0	0	9

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III	ACCESS CONTROL AND IDENTITY MANAGEMENT	9	0	0	9

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT IV	CLOUD SECURITY DESIGN PATTERNS	9	0	0	9

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V	MONITORING, AUDITING AND MANAGEMENT	9	0	0	9

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

Total (45 L) =45 Periods

Text Books:	
1	Raj Kumar Buyya , James Broberg, andrzejGoscinski, "Cloud Computing:‖, Wiley 2013
2	Dave shackleford, "Virtualization Security‖, SYBEX a wiley Brand 2013.
3	Mather, Kumaraswamy and Latif, "Cloud Security and Privacy‖, OREILLY 2011
Reference Books:	
1	Mark C. Chu-Carroll "Code in the Cloud‖,CRC Press, 2011
2	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the cloud concepts and fundamentals.	Understand
CO2	Explain the security challenges in the cloud.	Understand
CO3	Define cloud policy and Identity and Access Management.	Remember
CO4	Understand various risks and audit and monitoring mechanisms in the cloud.	Understand
CO5	Define the various architectural and design considerations for security in the cloud.	Remember

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	1	2	-	-	-	1	1	1	3	2	2
CO 2	1	3	2	3	1	-	-	-	2	2	3	2	2	2
CO 3	3	2	2	3	2	-	-	-	3	1	1	2	2	2
CO 4	2	1	2	3	3	-	-	-	3	2	3	3	2	2
CO 5	1	3	3	1	1	-	-	-	2	3	3	2	2	2
Avg	**2**	**2.4**	**2.4**	**2.2**	**1.8**	**-**	**-**	**-**	**2.2**	**1.8**	**2.2**	**2.4**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

<table>
<tr><td>22CSH401</td><td colspan="4">CYBER PHYSICAL SYSTEMS</td><td colspan="3"></td><td></td></tr>
<tr><td colspan="4">PREREQUISITES</td><td>Category</td><td>PE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="4" rowspan="2"></td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="9">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="8">To provide introduction to Microcontroller and Embedded Systems.</td></tr>
<tr><td>2</td><td colspan="8">To equip students with essential tools for Embedded systems.</td></tr>
<tr><td>3</td><td colspan="8">To foster understanding through real-world applications related to embedded systems</td></tr>
<tr><td>4</td><td colspan="8">To know logics towards solving a unknown problem</td></tr>
<tr><td>5</td><td colspan="8">To Familiarize cyber physical systems applications.</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Cyber-Physical System, Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.</td></tr>
<tr><td>UNIT II</td><td colspan="4">CPS PLATFORM COMPONENTS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model.</td></tr>
<tr><td>UNIT III</td><td colspan="4">SYNCHRONOUS AND ASYNCHRONOUS MODEL</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Reactive Components, Components Properties, Components Composing, Synchronous Designs and Circuits, Asynchronous Processes and operations, Design Primitives in Asynchronous Process, Coordination Protocols in Asynchronous Process, Leader Election, Reliable Transmission..</td></tr>
<tr><td>UNIT IV</td><td colspan="4">SECURITY OF CYBER-PHYSICAL SYSTEMS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Countermeasures, Advanced Techniques in CPS Securities.</td></tr>
<tr><td>UNIT V</td><td colspan="4">CPS APPLICATION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Health care and Medical Cyber-Physical Systems, Smart grid and Energy Cyber Physical Systems, WSN based Cyber-Physical Systems, Smart Cities</td></tr>
<tr><td colspan="9" align="right">Total (45 L) =45 Periods</td></tr>
</table>

<table>
<tr><td colspan="2">Text Books:</td></tr>
<tr><td>1</td><td>E. A. Lee and S. A. Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”, 2011.</td></tr>
<tr><td>2</td><td>R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.</td></tr>
<tr><td colspan="2">Reference Books:</td></tr>
<tr><td>1</td><td>Raj Rajkumar, Dionisio de Niz and Mark Klein, “Cyber-Physical Systems”, Addison- Wesley, 2017</td></tr>
<tr><td>2</td><td>Rajeev Alur, “Principles of Cyber-Physical Systems”, MIT Press, 2015</td></tr>
<tr><td>3</td><td>Fei Hu, “Cyber-Physical Systems”, CRC Press 2013</td></tr>
</table>

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Apply Embedded system concepts to solve real word problems.	Apply
CO2	Present solution to automated systems to make life easier.	Understand
CO3	Apply concepts of embedded systems and microcontroller to enhance existing systems	Apply
CO4	Ability to develop concepts, logics towards solving a unknown problem in research and industry..	Understand
CO5	Describe cyber physical systems applications	Remember

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	2	1	-	-	-	1	2	2	1	2	2
CO 2	1	2	1	2	1	-	-	-	2	2	1	1	2	2
CO 3	2	2	3	3	1	-	-	-	1	2	1	2	2	2
CO 4	2	1	1	2	1	-	-	-	1	3	3	3	2	2
CO 5	2	3	1	1	2	-	-	-	2	1	1	1	2	2
Avg	**1.8**	**2**	**1.8**	**2**	**1.2**	**-**	**-**	**-**	**1.4**	**2**	**1.6**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH402	ETHICAL HACKING					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the basics of computer based vulnerabilities.
2	To explore different foot printing, reconnaissance and scanning methods.
3	To expose the enumeration and vulnerability analysis methods.
4	To understand hacking options available in Web and wireless applications
5	To explore the options for network protection.
6	To practice tools to perform ethical hacking to expose the vulnerabilities.

UNIT I	INTRODUCTION	9	0	0	9

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware – Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

UNIT II	FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS	9	0	0	9

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT III	ENUMERATION AND VULNERABILITY ANALYSIS	9	0	0	9

Enumeration Concepts - NetBIOS Enumeration ‑ SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

UNIT IV	SYSTEM HACKING	9	0	0	9

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network ‑ Wardriving- Wireless Hacking - Tools of the Trade

UNIT V	NETWORK PROTECTION SYSTEMS	9	0	0	9

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams ‑ Honeypots.

Total (45 L) =45 Periods

Text Books:

1	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3	The Web Application Hacker’s Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

Reference Books:

1	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Express knowledge on basics of computer based vulnerabilities.	Remember
CO2	Gain understanding on different foot printing, reconnaissance and scanning methods	Understand
CO3	Demonstrate the enumeration and vulnerability analysis methods.	Remember
CO4	Gain knowledge on hacking options available in Web and wireless applications.	Understand
CO5	Acquire knowledge on the options for network protection	Remember
CO6	Use tools to perform ethical hacking to expose the vulnerabilities	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	2	1	-	-	-	1	2	2	1	2	2
CO 2	1	2	1	2	1	-	-	-	2	2	1	1	2	2
CO 3	2	2	3	3	1	-	-	-	1	2	1	2	2	2
CO 4	2	1	1	2	1	-	-	-	1	3	3	3	2	2
CO 5	2	3	1	1	2	-	-	-	2	1	1	1	2	2
Avg	**1.8**	**2**	**1.8**	**2**	**1.2**	**-**	**-**	**-**	**1.4**	**2**	**1.6**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH403	DIGITAL AND MOBILE FORENSICS					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand basic digital forensics and techniques..
2	To understand digital crime and investigation.
3	To understand how to be prepared for digital forensic readiness.
4	To understand and use forensics tools for iOS devices
5	To understand and use forensics tools for Android devices.

UNIT I	INTRODUCTION TO DIGITAL FORENSICS	9	0	0	9

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase

UNIT II	DIGITAL CRIME AND INVESTIGATION	9	0	0	9

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

UNIT III	DIGITAL FORENSIC READINESS	9	0	0	9

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics

UNIT IV	iOS FORENSICS	9	0	0	9

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud

UNIT V	ANDROID FORENSICS	9	0	0	9

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

Total (45L) = 45 Periods

Text Books:

1	Andre Arnes, “Digital Forensics”, Wiley, 2018.
2	Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.

Reference Books:

1	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-38

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Have knowledge on digital forensics..	Remember
CO2	Know about digital crime and investigations	Remember
CO3	Be forensic ready.	Remember
CO4	Investigate, identify and extract digital evidence from iOS devices	Analyze
CO5	Investigate, identify and extract digital evidence from Android devices	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	3	2	1	-	-	-	1	1	3	3	2	2
CO 2	3	3	3	3	3	-	-	-	2	2	1	2	2	2
CO 3	3	3	2	3	1	-	-	-	3	2	1	1	2	2
CO 4	3	1	2	2	3	-	-	-	1	3	3	2	2	2
CO 5	1	3	2	3	2	-	-	-	2	3	2	3	2	2
Avg	**3**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH404	SOCIAL NETWORK SECURITY					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To develop semantic web related simple applications
2	To explain Privacy and Security issues in Social Networking
3	To explain the data extraction and mining of social networks
4	To discuss the prediction of human behavior in social communities
5	To describe the Access Control, Privacy and Security management of social networks.

UNIT I	**FUNDAMENTALS OF SOCIAL NETWORKING**	**9**	**0**	**0**	**9**

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security

UNIT II	**SECURITY ISSUES IN SOCIAL NETWORKS**	**9**	**0**	**0**	**9**

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world

UNIT III	**EXTRACTION AND MINING IN SOCIAL NETWORKING DATA**	**9**	**0**	**0**	**9**

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy

UNIT IV	**PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES**	**9**	**0**	**0**	**9**

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties.

UNIT V	**ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT**	**9**	**0**	**0**	**9**

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network,Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning

Total (45 L) =45 Periods

Text Books:	
1	Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2	BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3	Learning Neo4j 3.x Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing
4	David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World, First Edition, Cambridge University Press, 2010.

Reference Books:	
1	Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World, Cambridge University Press, 2010
2	Jackson, Matthew O., Social and Economic Networks, Princeton University Press, 2008.
3	GuandongXu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
4	Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
5	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling, IGI Global Snippet, 2009
6	John G. Breslin, Alexander Passant and Stefan Decker, The Social Semantic Web, Springer, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop semantic web related simple applications	Apply
CO2	Address Privacy and Security issues in Social Networking	Remember
CO3	Explain the data extraction and mining of social networks	Understand
CO4	Discuss the prediction of human behavior in social communities	Understand
CO5	Describe the applications of social networks	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	2	3	2	-	-	-	3	2	1	2	2	2
CO 2	2	2	2	3	3	-	-	-	1	2	2	3	2	2
CO 3	2	1	1	3	2	-	-	-	1	2	1	1	2	2
CO 4	3	3	3	3	3	-	-	-	1	1	1	1	2	2
CO 5	1	3	2	2	2	-	-	-	1	1	3	1	2	2
Avg	**2.2**	**2**	**2**	**2.8**	**2.2**	**-**	**-**	**-**	**1.4**	**1.6**	**1.6**	**1.6**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH405	MODERN CRYPTOGRAPHY					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To learn about Modern Cryptography
2	To focus on how cryptographic algorithms and protocols work and how to use them.
3	To build a Pseudorandom permutation.
4	To construct Basic cryptanalytic techniques.
5	To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT I	INTRODUCTION	9	0	0	9

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II	FORMAL NOTIONS OF ATTACKS	9	0	0	9

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NMCCA2, Inter-relations among the attack model

UNIT III	RANDOM ORACLES	9	0	0	9

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)

UNIT IV	BUILDING A PSEUDORANDOM PERMUTATION	9	0	0	9

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT V	MESSAGE AUTHENTICATION CODES	9	0	0	9

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.

Total (45 L) =45 Periods

Text Books:

1	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)

Reference Books:

1	ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2	OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3	William Stallings, “Cryptography and Network Security: Principles and Practice”, PHI 3rd Edition, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Interpret the basic principles of cryptography and general cryptanalysis.	Understand
CO2	Determine the concepts of symmetric encryption and authentication.	Remember
CO3	Identify the use of public key encryption, digital signatures, and key establishment.	Apply
CO4	Articulate the cryptographic algorithms to compose build and analyze simple cryptographic solutions.	Understand
CO5	Express the use of Message Authentication Codes	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	3	1	-	-	-	2	1	1	2	2	2
CO 2	1	3	2	1	2	-	-	-	3	2	2	2	2	2
CO 3	1	1	2	3	2	-	-	-	1	1	1	3	2	2
CO 4	3	1	2	1	3	-	-	-	3	2	1	2	2	2
CO 5	2	3	3	3	3	-	-	-	3	1	1	1	2	2
Avg	**2**	**2.2**	**2.4**	**2.2**	**2.2**	**-**	**-**	**-**	**2.4**	**1.4**	**1.2**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSH406	ENGINEERING SECURE SOFTWARE SYSTEMS					
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives	
1	Know the importance and need for software security.
2	Know about various attacks.
3	Learn about secure software design.
4	Understand risk management in secure software development.
5	Know the working of tools related to software security.

UNIT I	NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS	9	0	0	9

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory- Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

UNIT II	SECURE SOFTWARE DESIGN	9	0	0	9

Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UNIT III	SECURITY RISK MANAGEMENT	9	0	0	9

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV	SECURITY TESTING	9	0	0	9

Traditional Software Testing – Comparison - Secure Software Development Life Cycle – Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT V	SECURE PROJECT MANAGEMENT	9	0	0	9

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

Total (45 L) =45 Periods

Text Books:	
1	Julia H. Allen, "Software Security Engineering", Pearson Education, 2008.
2	Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011
3	Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006

Reference Books:	
1	Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional 2005.
2	Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3	Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4	Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5	Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012
6	Jason Grembi, "Developing Secure Software"

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Identify various vulnerabilities related to memory attacks	Apply
CO2	Apply security principles in software development	Apply
CO3	Evaluate the extent of risks. .	Evaluate
CO4	Involve selection of testing techniques related to software security in the testing phase of software development. .	Understand
CO5	Use tools for securing software.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	3	2	3	2	-	-	-	2	1	2	2	2	2
CO 2	2	2	2	3	3	-	-	-	2	1	2	2	2	2
CO 3	1	2	2	2	1	-	-	-	1	1	2	1	2	2
CO 4	2	3	2	2	2	-	-	-	2	1	2	2	2	2
CO 5	2	1	2	2	3	-	-	-	2	1	1	2	2	2
Avg	**1.8**	**2.2**	**2**	**2.4**	**2.2**	**-**	**-**	**-**	**1.8**	**1**	**1.8**	**1.8**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22CSH407	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics of Blockchain
2	To learn Different protocols and consensus algorithms in Blockchain
3	To learn the Blockchain implementation frameworks.
4	To understand the Blockchain Applications
5	To experiment the Hyperledger Fabric, Ethereum networks

UNIT I	INTRODUCTION TO BLOCKCHAIN	9	0	0	9

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic –Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT II	BITCOIN AND CRYPTOCURRENCY	9	0	0	9

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT III	BITCOIN CONSENSUS	9	0	0	9

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

UNIT IV	HYPERLEDGER FABRIC & ETHEREUM	9	0	0	9

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V	BLOCKCHAIN APPLICATIONS	9	0	0	9

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

Total (45 L) =45 Periods

Text Books:

1	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2	Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.

Reference Books:

1	Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
2	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3	Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015
4	Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing
5	Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Understand emerging abstract models for Blockchain Technology	Understand
CO2	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.	Apply
CO3	Provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.	Understand
CO4	Apply hyper ledger Fabric and Ethereum platform to implement the Block chain Application.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	2	1	-	-	-	1	-	-	2	2	2
CO 2	3	3	3	3	1	-	-	-	2	-	-	2	2	2
CO 3	3	3	3	3	2	-	-	-	3	-	-	2	2	2
CO 4	3	2	3	2	3	-	-	-	3	-	-	2	2	2
Avg	**3**	**2.75**	**2.75**	**2.5**	**1.75**	**-**	**-**	**-**	**2.25**	**-**	**-**	**2**	**2**	**2**

3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)

22CSH408	CYBER SECURITY					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To Learn the basics of computer forensics
2	To be familiar with forensics tools
3	To Learn to analyze and validate forensics data.
4	To Expose how to evaluate the security and how to identify vulnerabilities in systems.
5	To learn how to detect a cyb er attack.

UNIT I	**INTRODUCTION TO COMPUTER FORENSICS**	**9**	**0**	**0**	**9**
Introduction to Traditional Computer Crime-Traditional problems associated with Computer Crime-Introduction to Identity Theft & Identity Fraud- Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.					
UNIT II	**EVIDENCE COLLECTION AND FORENSICS TOOLS**	**9**	**0**	**0**	**9**
Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.					
UNIT III	**ANALYSIS AND VALIDATION**	**9**	**0**	**0**	**9**
Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics					
UNIT IV	**ETHICAL HACKING**	**9**	**0**	**0**	**9**
Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing					
UNIT V	**INTRUSION DETECTION**	**9**	**0**	**0**	**9**
Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.					
					Total (45L) = 45 Periods

Text Books:	
1	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2	Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021
3	CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015
Reference Books:	
1	John R.Vacca, ―Computer Forensics‖, Cengage Learning, 2005
2	MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3	William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015
4	AnkitFadia ― Ethical Hacking‖ Second Edition, Macmillan India Ltd, 2006
5	Kenneth C.Brancik ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group–2008.

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Explain the basic concepts of computer forensics	Understand
CO2	Apply a number of different computer forensic tools for various crime and incident scenes	Apply
CO3	Choose appropriate technique to validate forensics data	Understand
CO4	Identify the vulnerabilities in a given network infrastructure and the role of ethical hacking	Apply
CO5	Apply intrusion techniques to detect intrusion.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	2	2	-	-	-	2	1	2	1	2	2
CO 2	1	1	3	2	2	-	-	-	2	2	1	1	2	2
CO 3	1	2	1	1	2	-	-	-	3	3	1	3	2	2
CO 4	2	2	3	2	3	-	-	-	3	3	2	1	2	2
CO 5	2	1	3	2	2	-	-	-	2	1	1	3	2	2
Avg	**1.8**	**1.8**	**2.4**	**1.8**	**2.2**	**-**	**-**	**-**	**2.4**	**2**	**1.4**	**1.8**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

ELECTIVES FOR MINOR

VERTICALS FOR B.E MINOR DEGREE

MINOR DEGREE - VERTICALS

22CEM01	**CONSTRUCTION MATERIALS**		**Semester**			
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To study the characteristics and Properties of Stones and Brick
2	To impart knowledge on Cement, Aggregate and Mortar
3	To understand the behaviour of concrete and seasoning timber
4	To study the Parts and types of flooring and roofing
5	To study carpentry, arches, lintels and finishing works.

Unit I	**STONES, BRICKS**	**9**	**0**	**0**	**9**

Building Stone –classification of rocks-characteristics of good building stone – deterioration and preservation of stone work – tests on stones - Bricks- manufacture of clay bricks -classification - tests on bricks- bricks for special use- refractory bricks.

Unit II	**CEMENT, AGGREGATES, MORTAR**	**9**	**0**	**0**	**9**

Cement- composition- manufacturing process-wet and dry processes. Aggregates –coarse and fine aggregates-characteristics and function. Mortar- properties- uses- types of mortars- selection of mortars for various Civil Engineering construction.

Unit III	**CONCRETE, TIMBER AND OTHER MATERIALS**	**9**	**0**	**0**	**9**

Concrete- ingredients - principles of hardened concrete- Special concrete- types.
Timber- characteristics- seasoning-preservation- Panels of laminates. Glass- properties- uses. Steel- Uses - market forms. Aluminum and other metallic materials for construction.
Paints, Varnishes and Distempers-types-properties.

Unit IV	**FLOORING AND ROOFING**	**9**	**0**	**0**	**9**

Components of floor- selection of flooring materials- suitability of floors for various applications. damp proof course, causes of dampness- effect of dampness - requirements of good stairs - classification of stairs -Roofs - types of roofs- requirements - pitched roof - lean to roof-gable roof-hip roof-flat roof-RCC roof.

Unit V	**CARPENTARY, ARCHES, LINTELS AND FINISHING WORKS**	**9**	**0**	**0**	**9**

Location of doors and windows - size of doors - types of doors - fixture and fastenings for doors and windows - arches - classification - stability of an arch - lintels - classification of lintels - steel lintel. scaffolding - component parts - shoring - methods of plastering - defects in plastering - pointing - objectives- methods of pointing

Total= 45 Periods

Text Books:	
1	B.C. Punmia, Building Construction, Laxmi Publications; Eleventh edition -2021
2	S.C.Rangwala, Building Construction,CharotarPublishing House Pvt. Ltd, 34th Edition - 2022
3	P. Purushothama Raj., Building Construction Materials and Techniques, Pearson Education India, First Edition - 2017

Reference Books:	
1	Shetty M.S., Concrete Technology (Theory and Practice), S.Chand& Company Ltd.,2021.
2	Rangwala S.C., Engineering Materials (Material Science) revised and enlarged by Rangwala K.S. and Rangwala P.S., Charotar Publishing House, 2010.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify and characterize and properties of Stone and brick	Remember
CO2	Understand the manufacturing process of cement and functions of mortar	Understand
CO3	Identify the age of timber and preservation methods of timber	Remember
CO4	Differentiate the types of roofing and flooring	Understand
CO5	Understand the miscellaneous works such as carpentry, lintels, Arch, etc.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	2	3	-	-	-	-	-	-	-	-
CO3	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO4	1	-	2	-	2	3	2	-	-	-	-	-	-	-	-
CO5	1	-	-	-	3	-	2	-	-	-	-	-	-	-	-
Avg	1	2	2	-	2	3	2	-	-	-	-	-	-	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22CEM02	BUILDING CONSTRUCTION & EQUIPMENT			Semester			
PREREQUISITES			**Category**	**OE**	**Credit**		**3**
NIL			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Learning Objectives

1	Able to gain basic knowledge in construction methods.
2	Able to gain basic knowledge in equipment.
3	Able to gain basic knowledge in machineries.
4	Able to gain basic knowledge in fire safety principles.
5	Able to gain basic knowledge in green technology.

Unit I	**CLASSIFICATION OF BUILDINGS, FOUNDATIONS AND TYPES OF MASONRY**	**9**	**0**	**0**	**9**

Component parts of a building -Their functions. Classification of buildings according to National building code.
Site investigation for foundation as per N.B.C, Types of foundation and prevention of dampness at basement level,Classification of stone masonry

Unit II	**DOORS, WINDOWS, LINTELS, SCAFFOLDING AND STAIRCASES**	**9**	**0**	**0**	**9**

Doors and windows – parts of door and window – Types of Door and windows–Ventilators – fixed, swinging type and louvered. Lintels – Functions, Scaffolding – Purpose and types –Location of stairs.Types of stairs

Unit III	**ROOFS, FLOORINGS, PROTECTIVE AND DECORATIVE FINISHES**	**9**	**0**	**0**	**9**

Roof Beams and Roof Slabs – Types of Roofing Systems – Methods of Termite Proofing – Methods of Damp proofing.
Types of floors- Plastering (Interior and Exterior) – Pointing for Walls and Floors using Grouts – White Washing, Color Washing with different Color Shades available in the Markets – Painting – Types of Painting for Interior and Exterior application.

Unit IV	**CONSTRUCTION EQUIPMENTS**	**9**	**0**	**0**	**9**

Selection of equipment for earthwork excavation, drilling, blasting, tunnelling, erection and dewatering and pumping, concreting, material handling and erection of structures

Unit V	**GREEN BUILDING TECHNOLOGY**	**9**	**0**	**0**	**9**

Introduction to green technology – types and importance; zero waste and r concept, green materials – green concrete (purpose and limitations), green buildings, green engineering.

Total= 45 Periods

Text Books:

1	Building Construction by S.C.Rangawala
2	Construction Technology by Sarkar Oxford University Press
3	Building Material & Construction by S.P. Arora& S. P. Bindra

Reference Books:	
1	Hopkinson And Kay J.D., The Lighting of Building, Faber and Faber, London.
2	Koerner, R.M, Construction & Geotechnical Methods in Foundations Engineering, McGraw Hill, 1984
3	Varna M., Construction Equipment and Its Planning & Applications, Metropolitan Books Co, 1979

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Organize the construction technique to be followed in brick and stone masonry, concreting, flooring, roofing and plastering etc.	Create
CO2	Select safe practices in building construction activities	Evaluate
CO3	Clarify the different types of roofs, floor and productive materials of buildings	understand
CO4	Select the relevant equipment for building construction	Evaluate
CO5	Apply the Principles of green building technology.	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	3	2	2	2	1	1	-	-	-	-	1
CO2	-	-	-	-	3	2	2	2	2	2	-	-	-	-	1
CO3	-	-	-	-	2	3	2	2	2	1	-	-	-	-	1
CO4	-	-	-	-	2	2	3	1	1	2	-	-	-	-	1
CO5	-	-	-	-	2	3	2	2	2	2	-	-	-	-	1
Avg	-	-	-	-	2.4	2.4	2.2	1.8	1.6	1.6	-	-	-	-	1
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22CEM03	CONCRETE TECHNOLOGY				Semester		
PREREQUISITES		Category	OE	Credit			3
NIL		Hours/Week	L	T	P		TH
			3	0	0		3

Course Learning Objectives

1	To understand the properties of ingredients of concrete.
2	To study the behavior of concrete at its fresh and hardened state.
3	To study about the concrete design mix.
4	To know about the procedures in concrete at different stage.
5	To understand special concrete and their uses.

Unit I	INTRODUCTION	9	0	0	9
Concrete materials, Cement: Field and laboratory tests on cement, Types of cement and their uses, different tests for aggregates. Methods for manufacturing of cement- Wet and dry process. Hydration of cement, Bogue's compound.					
Unit II	**ADMIXTURES**	**9**	**0**	**0**	**9**
Accelerating admixtures, Retarding admixtures, water reducing admixtures, Air entraining admixtures, coloring agent, Plasticizers. Batching, Mixing, Transportation, placing of concrete, curing of Concrete					
Unit III	**MIX DESIGN**	**9**	**0**	**0**	**9**
Factors influencing mix proportion, Mix design by ACI method and I.S. code method, Design of high strength concrete.					
Unit IV	**BEHAVIOUR OF CONCRETE**	**9**	**0**	**0**	**9**
Strength of concrete, Shrinkage and temperature effects, creep of concrete, permeability of concrete, durability of concrete, Corrosion, Causes and effects, remedial measures, Thermal properties of concrete, Micro cracking of concrete.					
Unit V	**SPECIAL CONCRETE**	**9**	**0**	**0**	**9**
Light-weight concrete, Fibre reinforced concrete, Polymer modified concrete, Ferro cement, Mass concrete, Ready-mix concrete, Self-compacting concrete, Quality control, Sampling and testing, Acceptance criteria.					
					Total= 45 Periods

Text Books:

1	Neville A.M Properties of Concrete, Pearson publication, 2012.
2	Shetty M.S Concrete technology, S.Chand and Company Ltd, New Delhi 2022.
3	Santha Kumar A.R Concrete Technology, Oxford university Press, NewDelhi, 2022.
4	Mehta K.P Concrete Technology, Chand & Co, NewDelhi, 2006.
5	Robert RatayForensic Structural Engineering Handbook, McGraw Hill LLC, 2009

Reference Books:	
1	Indian Standard Recommended Guide lines for Concrete Mix Design, IS:10262 – 2019, Bureau of Indian Standards, NewDelhi.
2	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete IS:383-1970 R2011, Bureau of Indian Standards, NewDelhi.
3	Gambhir.M.L,Concrete Technology, Volume I & II, Tata McGraw-HillBookCompany,Third print, 2003
4	Krishna Raju N. Design of Concrete Mixes, CBS publishers. NewDelhi, 2002.
5	Stephen E. Petty,Forensic Engineering: Damage Assessments for Residential and Commercial Structures,CRCpress,Taylor& Francis,2013.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	To identify suitable materials to be used in the cement concrete by conducting various tests as per BIS code.	Evaluate
CO2	To know about the specific applications and uses of admixtures.	Understand
CO3	Design the concrete mix using ACI and BIS code methods.	Create
CO4	Determine the properties of fresh and hardened of concrete.	Evaluate
CO5	Design special concretes and to Ensure quality control while testing/ sampling and acceptance criteria for pre and post construction work.	Apply

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	3	-	1	1	1	2	1	1	1	-	1
CO2	-	-	-	-	3	-	3	-	1	1	-	-	2	-	1
CO3	-	-	-	-	3	-	3	-	-	1	-	-	1	-	1
CO4	-	-	-	-	3	2	1	-	-	-	-	-	-	-	1
CO5	-	-	-	-	3	3	3	1	1	3	1		3	-	1
Avg	-	-	-	-	3	2.5	2.2	1	1	1.75	1	1	1.75	-	1
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22CEM04	ENVIRONMENTAL ENGINEERING				Semester		
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To evaluate the sources of water and analyse its characteristics and processes in water treatment, express the analysis of distribution network
2	To design sewer system, basic design of the biological treatment processes, gain knowledge on sludge treatment and its disposal
3	To predict the sources, effects, dispersion of air pollutants air quality management and its control measures
4	To identify the characteristics and sources of municipal solid wastes, its collection methods, off-site processing of municipal solid wastes and its recovery, disposal methods
5	To assess the sources, effects and control measures of noise pollution

Unit I	**WATER TREATMENT**	**9**	**0**	**0**	**9**

Water Quality and its Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment.

Unit II	**WASTEWATER TREATMENT**	**9**	**0**	**0**	**9**

Sewerage system design, quantity and quality of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.

Unit III	**AIR POLLUTION**	**9**	**0**	**0**	**9**

Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality Index and limits.

Unit IV	**SOLID WASTE MANAGEMENT**	**9**	**0**	**0**	**9**

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Unit V	**NOISE POLLUTION**	**9**	**0**	**0**	**9**

Noise pollution: Sources; Health effects; Standards; Measurement and control methods

Total= 45 Periods

Text Books:

1	Garg, S.K. Water supply Engineering, Khanna Publishers, New Delhi, 2010.
2	Garg, S.K. Sewage water disposal and Air pollution, Khanna Publishers, New Delhi, 2010.
3	George Tchobanoglous et.al., Integrated Solid Waste Management, McGraw-Hill, Publishers, 1993.
4	Rao, C.S., Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996.

Reference Books:	
1	Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2	Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, NewDelhi, 1985.
3	Metcalf and Eddy,M.C., Wastewater Engineering – Treatment &Reuse,TataMcGraw-Hill Publications, New Delhi,2003.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the sources of water supply, analyze the characteristics of water with its standards and various unit operations and processes in water treatment, express the analysis of distribution network	Remember
CO2	Expertise design sewer system, basic design of the biological treatment processes, gain knowledge on sludge treatment and disposal and justify the methods for disposal of sewage	Analyze
CO3	Predict the sources, effects, dispersion of air pollutants air quality management and its control measures	Apply
CO4	Aware about the characteristics, types and sources of municipal solid wastes, Learn the collection methods, Know about off-site processing of municipal solid wastes and its recovery, disposal methods	Remember
CO5	Understand the sources, effects and control methods of noise pollution	Understand

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**3**	**-**	**2**
CO2	**2**	**1**	**3**	**1**	**1**	**3**	**1**	**-**	**1**	**2**	**2**	**1**	**3**	**-**	**2**
CO3	**2**	**1**	**3**	**1**	**1**	**3**	**1**	**-**	**1**	**2**	**2**	**1**	**3**	**-**	**2**
CO4	**2**	**1**	**3**	**1**	**1**	**3**	**1**	**-**	**-**	**2**	**2**	**1**	**3**	**-**	**2**
CO5	**2**	**-**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**2**	**1**	**1**	**3**	**-**	**2**
Avg	**2**	**1**	**3**	**1.3**	**1**	**3**	**1.3**	**1**	**1**	**2**	**1.6**	**1**	**3**	**-**	**2**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22CEM05	BASICS OF TRANSPORTATION ENGINEERING				Semester		
PREREQUISITES		**Category**	**OE**	**Credit**			**3**
NIL		**Hours/Week**	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Learning Objectives

1	The objective of the course is to educate the students on various components of highway engineering.
2	To educate the geometric design concepts of highway engineering
3	To develop skills on construction and maintenance of highway.
4	Ability to plan various civil engineering aspects of railways and educate various components of railways
5	The course enables the students to develop skill on evaluation and maintenance of railway track.

Unit I	**CROSS SECTIONAL ELEMENTS OF HIGHWAYS**	**9**	**0**	**0**	**9**

Classification of Highways - Classification and Cross Section of Urban and Rural Roads (IRC), Highway Cross Sectional Elements- Right of Way, Carriage Way, Camber, Kerbs, Shoulders and Footpaths (IRC Standards), Sight Distances - Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate Sight Distance and Illumination Sight Distance - Cross Sections of Different Class of Roads -

Unit II	**GEOMETRIC DESIGN OF HIGHWAYS**	**9**	**0**	**0**	**9**

Horizontal Alignments – Superelevation, Widening of Pavements on Horizontal Curves, Vertical Alignments - Rolling. Limiting, Exceptional and Minimum Gradients, Summit and Valley Curves -Geometric Design of Hill Roads (IRC Standards Only)

Unit III	**CONSTRUCTION AND MAINTENANCE OF HIGHWAY**	**9**	**0**	**0**	**9**

Construction of Flexible and Rigid Pavements – Defects in Flexible and Rigid Pavements -Highway Drainage – Evaluation and Maintenance of Pavements.

Unit IV	**RAILWAY PLANNING AND DESIGN**	**9**	**0**	**0**	**9**

Permanent Way, its Components and Functions of Each Component: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps Sleepers - Functions, Materials, Density. Ballasts - Functions, Materials, Ballast less Tracks Geometric Design of Railway Tracks Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves.

Unit V	**RAILWAY TRACK CONSTRUCTION MAINTENANCE AND OPERATION**	**9**	**0**	**0**	**9**

Points and Crossings – Turnouts, Track circuiting, Signaling, Interlocking, Lay Outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings.

Total= 45 Periods

Text Books:

1	Khanna K., Justo C.E.G., Highway Engineering Revised 10th Edition Khanna Publishers, Roorkee, 2014
2	Kadiyalil. R, Engineering Traffic and Transport Planning, Khanna Publishers, New Delhi, 2019.
3	Chandola S.P. Transportation Engineering-2019

Reference Books:	
1	Sharma S.K., Principles Practice and Design of Highway Engineering, S. Chand & Co Ltd. New Delhi, 2006
2	Guidelines Of Ministry of Road Transport and Highways, Government of India.
3	Agarwal M.M., Indian Railway Track, 14th Edition, Prabha and Co., New Delhi, 2002.
4	Saxena S.C. Highway & Traffic Engineering, 2014.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Classify roads as per Indian Road Congress and describe the principles of highway alignment	Understand
CO2	Determine the highway geometric elements	Analyse
CO3	Differentiate between types of pavements, their construction and design principles	Analyse
CO4	Explain the functions of components of Railways	Understand
CO5	Carry out the various methods for track alignment & procedure for construction of railway & maintenance of track	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	2	2	3	1	2	-	-	-	1	-	-
CO2	2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	2	2	3	1	3	-	-	-	1	-	-
CO4	-	-	-	-	2	2	3	1	2	-	-	-	-	-	-
CO5	-	-	-	-	2	2	3	1	2	-	-	-	1	-	-
Avg	2	3	2	2	2	2	3	1	2.25	-	-	-	1	-	-

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

22CEM06	REPAIR AND REHABILITATION OF STRUCTURES				Semester		
PREREQUISITES			Category	OE	Credit		3
NIL			Hours/Week	L	T	P	TH
				3	0	0	3

Course Learning Objectives

1	Study the various types and properties of repair materials
2	Learn various distress and damages to concrete structures
3	Understand the importance of maintenance of structures
4	Assess the damage to structures using various tests
5	Learn various repair techniques of damaged structures, corroded structures

Unit I	**MAINTENANCE AND REPAIR STRATEGIES**	**9**	**0**	**0**	**9**
Maintenance, repair and rehabilitation, Facts of Maintenance, importance of Maintenance various aspects of inspection, assessment procedure for evaluating a damaged structure, causes of deterioration.					
Unit II	**SERVICEABILITY AND DURABILITY OF CONCRETE**	**9**	**0**	**0**	**9**
Quality assurance for concrete construction, concrete properties- strength, permeability, thermal properties and cracking- effects due to climate, temperature, chemical, corrosion- Design and construction errors-effects of cover thickness and cracking.					
Unit III	**MATERIALS AND TECHNIQUES FOR REPAIR**	**9**	**0**	**0**	**9**
Special concretes and mortar, concrete chemical, special elements for accelerated strength gain, expansive cement, polymer concrete, Sulphur infiltrated concrete, ferro cement, fibre reinforced concrete, rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, gunite and shotcrete, epoxy injection, mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection.					
Unit IV	**REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES**	**9**	**0**	**0**	**9**
Strengthening of Structural elements, deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.					
Unit V	**DEMOLITION TECHNIQUES**	**9**	**0**	**0**	**9**
Demolition methods by machines, explosives, Advanced techniques-Demolition sequences, dismantling techniques, safety precautions in dismantling and demolition, Engineered demolition techniques for dilapidated structures- case studies					
					Total= 45 Periods

Text Books:

1	Shetty, M.S, Concrete Technology- Theory and Practice, S. Chand and company, New Delhi,2019
2	Repair and protection of concrete structures by Noel P. Mailvaganam, CRC Press,1991.
3	CPWD: Handbook on Repair & Rehabilitation of R.C.C. Buildings, CPWD, Govt. of India, 2002, updated reprint 2011

Reference Books:	
1	Santhakumar A.R, Training Course notes on Damage Assessment and Repair in Low-cost housing, "RHDC.NBO" Anna University, July 1992.
2	Raikar R.N.,Learning from failures- deficiencies in design, construction and services – R&D Centre (SDCPL), Raikar bhavan, Bombay,1987
3	Palaniyappan, N., Estate management, Anna Institute of Management, Chennai,1992.
4	Lakshmipathy, M. etal., Lecture notes of workshop on Repairs and Rehabilitation of structures, 29-30th October 1999.
5	https://nptel.ac.in/courses/114106035/38

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Demonstrate the condition of structures	Understand
CO2	Inspect and evaluate the damaged structure	Analyze
CO3	Implement the repairing techniques of a structure	Analyze
CO4	Identify and Use different materials for repairing works	Apply
CO5	Demonstrate the dismantling and demolishing structures	Apply

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO2	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO3	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO4	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO5	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
Avg	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22CEM07	GREEN BUILDING TECHNOLOGY			Semester			
PREREQUISITES		Category		OE	Credit		3
NIL		Hours/Week		L	T	P	TH
				3	0	0	3

Course Learning Objectives

1	To Know various aspects of green buildings
2	To Learn the principles of planning and orientation of buildings.
3	To Relate the construction of green building with prevailing energy conservation policy and regulations.
4	To Know and identify different green building construction materials.
5	To Learn different rating systems and their criteria

Unit I	INTRODUCTION TO GREEN BUILDING	9	0	0	9

Introduction, Necessity, Definition & concept of Green Building, Issues and strategies of Green Building, Principles and Benefits of Green Building, Components/ features of Green Building, Energy Efficiency, Water efficiency, Material Efficiency, Indoor Air Quality.

Unit II	SITE SELECTION AND PLANNING	9	0	0	9

Site selection, Site selection strategies, Landscaping, building form, orientation, building envelope and fenestration, material and construction techniques, roofs, walls, fenestration and shaded finishes, Environmental design (ED) strategies for building construction, Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, recycle and reuse systems, Waste Management.

Unit III	ENERGY AND ENERGY CONSERVATION	9	0	0	9

Introduction, Environmental impact of building constructions, present scenario, Need of energy conservation, Concepts of embodied energy,

operational energy and life cycle energy, Methods to reduce operational energy, Energy efficient building, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

Unit IV	BUILDING MATERIALS	9	0	0	9

Green building materials and products- Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board, Insulated concrete forms. use of materials with recycled content such as blended cements, pozzolana cements, flyash bricks, vitrified tiles, materials from agro and industrial waste, reuse of waste material-Plastic, rubber, Newspaper wood, Nontoxic paint, green roofing.

Unit V	RATING SYSTEM	9	0	0	9

Introduction to Leadership in Energy and Environmental Design (LEED) criteria, Indian Green Building council (IGBC) Green rating, Green Rating for Integrated Habitat Assessment. (GRIHA) criteria, National Productivity council (NPC) Ministry of New and Renewable Energy (MNRE) Bureau of Energy efficiency (BEE) -BER (Building Energy Rating) – Certificates.

Total= 45 Periods

Text Books:

1	Kibert, C.J., Sustainable construction: Green Building design and Delivery, John Wiley Hobouken, NewJersey, 3rd Edition, 2012.
2	Chauhan, D S Sreevasthava, S K., Non-conventional Energy Resources, New Age International Publishers, NewDelhi, 4th Edition, 2021

Reference Books:	
1	O.P. Gupta, Energy Technology, Khanna Publishing House, NewDelhi
2	Jagadeesh, K S, Reddy Venkatta Rama &Nanjunda Rao, K S., Alternative Building Materials and Technologies, New Age International Publishers,Delhi.
3	Sam Kubba., Handbook of Green Building Design and Construction, Butterworth- Heinemann.
4	Means R S, Green Building - Project Planning and Cost Estimating, John Wiley &Sons
5	Sharma K V, Venkataseshaiah P., Energy Management and Conservation, IK International.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the concepts of Green Building	Understand
CO2	Discuss the Planning of Green Building.	Understand
CO3	Explain the concept of Energy and Energy Conservation.	Understand
CO4	Select appropriate green building material and technique.	Understand
CO5	Summarize the Green Building Functions in various organizations.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	-	2	3	-	-	-	2	1	2	-	-
CO2	1	1	1	2	1	-	-	-	-	-	-	-	2	-	-
CO3	-	1	3	-	2	-	-	-	-	-	-	-	2	-	-
CO4	-	1	2	-	3	-	-	-	-	-	2	-	2	-	-
CO5	1	1	2	3	2	-	-	-	-	-	2	-	2	-	-
Avg	1	1	2	2	2	2	3	-	-	-	2	1	2	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22CSM01	PROGRAMMING IN C++						
PREREQUISITES		Category	OE	Credit		3	
		Hours/Week	L	T	P	TH	
			3	0	0	3	

Course Learning Objectives	
1	To understand and develop the object oriented programming concepts.
2	To familiarize and design the template functions and classes
3	To disseminate and apply exception handling mechanisms.
4	To learn and exploit stream classes.

Unit I	INTRODUCTION	9	0	0	9
Procedure oriented programming paradigm - Object oriented programming paradigm - Basic concepts of object oriented programming, benefits of OOP, application of OOP - C++ fundamentals –structure of C++ program, tokens, data types - Operators and expressions - Control structures - Functions.					
Unit II	**INHERITANCE AND VIRTUAL FUNCTIONS**	**9**	**0**	**0**	**9**
Classes and objects - friend functions- constructors and destructors- Operator overloading – binary and unary operator overloading using member function and friend function - Type conversions.					
Unit III	**INHERITANCE AND VIRTUAL FUNCTIONS**	**9**	**0**	**0**	**9**
Inheritance – defining derived classes, types, virtual base classes, abstract classes, constructor in derived classes - Pointers- pointers to objects, this pointer, pointer to derived classes - Virtual functions.					
Unit IV	**TEMPLATES AND EXCEPTION HANDLING**	**9**	**0**	**0**	**9**
Generic Classes – class template, class templates with multiple parameters - Generic Functions - function templates, function templates with multiple parameters, member function templates - Exception handling – basics, exception handling mechanism, rethrowing an exception – Exception handling options – understanding terminate() and unexpected() – the uncaught_exception() function – bad_exception().					
Unit V	**CONSOLE I/O AND FILE HANDLING**	**9**	**0**	**0**	**9**
C++ Stream Classes – unformatted I/O operations, formatted console I/O operations, manipulators - Files-classes for file operation, opening and closing a file, detecting end of file, files modes, sequential file operations, random file operations.					
					Total (45 L) =45 Periods

Text Books:	
1	E. Balagurusamy “Object –Oriented Programming with C++” Sixth Edition Tata McGraw-Hill
Reference Books:	
1	Herbert Schildt, "The Complete Reference C++", Fifth Edition, Tata McGraw Hill
2	Bjarne Stroustrup, “The C++ programming language”, Fourth Edition Addison Wesley
3	K.R.Venugopal, Rajkumar Buyya, T.Ravishankar , Mastering in C++, Second Edition, Tata McGraw Hill

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Build the object oriented programming concepts.	Apply
CO2	Familiarize and build the template functions and classes	Understand
CO3	Disseminate and apply exception handling mechanisms.	Apply
CO4	Depict and exploit steam classes.	Understand

22CSM02	ADVANCED DATA STRUCTURES AND ALGORITHMS						
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the concepts of ADTs
2	To Learn linear data structures – lists, stacks, and queues
3	To have knowledge about non-linear data structures like trees and graphs
4	To understand concepts about searching and sorting and hashing techniques

Unit I	**LINEAR DATA STRUCTURES – LIST**	**9**	**0**	**0**	**9**

Abstract Data Types (ADTs) – List ADT - Array based Implementation - Linked List Implementation – Singly Linked Lists - Circularly Linked Lists - Doubly-Linked Lists - Applications of Lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

Unit II	**LINEAR DATA STRUCTURES –STACKS AND QUEUES**	**9**	**0**	**0**	**9**

Stack ADT - Operations - Applications of Stacks - Evaluating Arithmetic Expression - Conversion of infix to postfix Expression - Queue ADT - Operations - Circular Queue - DeQueue - Applications of Queue

Unit III	**NON LINEAR DATA STRUCTURES – TREES**	**9**	**0**	**0**	**9**

Tree ADT – Tree traversals – Binary Tree ADT – Expression Trees – Applications of Trees – Binary Search Tree ADT – Threaded Binary Trees- AVL Trees – B-Tree – Heaps - Operations of Heaps - Priority Queues - Binary Heap - Max Heap - Min Heap - Applications of Heap.

Unit IV	**NON LINEAR DATA STRUCTURES – GRAPHS**	**9**	**0**	**0**	**9**

Definition – Representation of Graphs –Types of Graphs - Graph Traversals - Breadth First Search - Depth First Search - Application of Graph Structures: Shortest Path Problem: Dijkstra's Algorithm - Minimum Spanning Trees: Prim's Algorithm - Kruskal's Algorithms

Unit V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**	**0**	**0**	**9**

Searching: Linear Search - Binary Search - Sorting Algorithms - Insertion Sort - Selection Sort - Shell Sort - Bubble Sort - Quick Sort - Merge Sort - Radix Sort - Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

Total (45 L) =45 Periods

Text Books:

1	Mark Allen Weiss, " Data Structures and Algorithm Analysis in C ", 4/E Pearson Education, 2013.

Reference Books:

1	Seymour Lipschutz, "Data Structures With C ",(Schaum`s Outline Series) Published by Tata McGraw-Hill Education Pvt. Ltd., 2015
2	Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures In C", Second Edition, Silicon Press, 2008.
3	Richard F.Gilberg & Behrouz A.Forouzan, "Data Structures: A Pseudo code Approach With C", Second Edition, Cengage Learning Publishers,2005.
4	Classic Data Structures", Second Edition by Debasis Samanta, PHI Learning, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Level
CO1	Implement various abstract data types to solve real time problems by using Linear Data Structures	Apply
CO2	Apply the different Non-Linear Data Structures to solve problems	Apply
CO3	Analyze and implement graph data structures to solve various computing problems.	Analyze
CO4	Critically analyze the various sorting and searching algorithms	Analyze

22CSM03	COMPUTER ORGANIZATION AND DESIGN					
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basic structure and operations of digital computer
2	To learn the working of different arithmetic operations
3	To understand the different types of control and the concept of pipelining
4	To study the hierarchical memory system including cache memory and virtual memory
5	To understand the different ways of communication with I/O devices and standard I/O interfaces

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Functional units ,Basic Operational Concepts, Bus Structure ,Memory Locations and Addresses, MemoryOperations, Instruction and Instruction Sequencing, Addressing modes.					
UNIT II	**ARITHMETIC UNIT**	**9**	**0**	**0**	**9**
Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, BoothAlgorithm, Fast Multiplication, Integer Division, Floating point number operations.					
UNIT III	**PROCESSOR UNIT AND PIPELINING**	**9**	**0**	**0**	**9**
Fundamental Concepts, Execution of Instruction, Multi Bus Organization, Hardwired control, Micro programmed control, Basic Concepts of pipelining, Data Hazards, Instruction Hazards ,Data path & Control Considerations.					
UNIT IV	**MEMORY SYSTEMS**	**9**	**0**	**0**	**9**
Basic Concepts, Semiconductor RAM, ROM, Cache memory, Improving Cache Performance, Virtual memory,Memory Management requirements, Secondary Storage Device.					
UNIT V	**INPUT AND OUTPUT ORGANIZATION**	**9**	**0**	**0**	**9**
Accessing I/O devices, Programmed I/O, Interrupts, Direct Memory Access, Interface circuits, Standard I/O Interfaces (PCI, SCSI, USB).					
					Total (45 L) =45 Periods

Text Books:

1	Carl Hamacher V.,Zvonko G.Vranesic, Safwat G. Zaky, " Computer organization ", Tata McGraw Hill,5th Edition, 200

Reference Books:

1	Patterson and Hennessey, “Computer Organization and Design ". The Hardware/Software interface,Harcourt Asia Morgan Kaufmann, 3rd Edition, 2007
2	Hayes, “Computer Architecture and Organization ", 3rd edition,Tata McGraw Hill, 2006
3	Heuring V.P., Jordan H.F., " Computer System Design and Architecture ", 6th edition ,Addison Wesley,2008

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the working principles of computer componets	Understand
CO2	Design the arithmetic and processing units	Create
CO3	Analyze the various computer components	Analyze

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22CSM04	ADVANCED OPERATING SYSTEMS			Semester			
PREREQUISITES		**Category**	**OE**	**Credit**			**3**
		Hours/Week	**L**	**T**		**P**	**TH**
			3	**0**		**0**	**3**

Course Learning Objectives

1	To understand the structure and functions of Operating systems
2	To understand the process concepts and scheduling algorithms
3	To understand the concept of process synchronization and deadlocks
4	To learn various memory management schemes
5	To illustrate various file systems and disk management strategies

UNIT I	**INTRODUCTION AND OPERATING SYSTEM STRUCTURES**	**9**	**0**	**0**	**9**

Main frame Systems, Desktop Systems, Multiprocessor Systems, Distributed Systems, Clustered Systems, Real Time systems, Hand held Systems; Operating Systems Structures - System Components, Operating System Services, System calls, System Programs, System Design and Implementation.

UNIT II	**PROCESS MANAGEMENT**	**9**	**0**	**0**	**9**

Processes-Process Concepts, Process Scheduling, Operation on Processes, Co-Operating Processes, InterProcess Communication; Threads- Multithreading Models, Threading Issues; CPU Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT III	**PROCESS SYNCHRONIZATION AND DEADLOCKS**	**9**	**0**	**0**	**9**

Process Synchronization- The Critical Section Problem, Synchronization Hardware, Semaphores, Classical Problem of Synchronization, Monitors; Deadlocks- Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance ,Deadlock Detection, Recovery from Deadlock.

UNIT IV	**MEMORY MANAGEMENT AND VIRTUAL MEMORY**	**9**	**0**	**0**	**9**

Memory Management- Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging; Virtual Memory - Demand paging, Page Replacement, Thrashing.

UNIT V	**FILE SYSTEM AND MASS-STORAGE STRUCTURE**	**9**	**0**	**0**	**9**

File System Interface - File Concepts, Access methods, Directory Structure, File Sharing, File Protection; File System Implementation- File System Structure and Implementation, Directory Implementation, Allocation Methods, Free Space Management; Mass-Storage Structure - Disk Structure, Disk scheduling, Disk Management, RAID Structure; Case study: Linux system.

Total (45 L) =45 Periods

Text Books:

1	Abraham Silberschatz, P.B.Galvin, G.Gagne —Operating System Concepts 6th edition, John Wiley & Sons, 2003.

Reference Books:

1	Andrew S. Tanenbaum, —Modern Operating Systems, PHI , 2nd edition, 2001
2	D.M.Dhamdhere, “Systems Programming and Operating Systems ", 2nd edition, Tata McGraw Hill Company, 1999.
3	Maurice J. Bach, —The Design of the Unix Operating System, 1st edition, PHI, 2004.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Identify the components and their functionalities in the operating system	Apply
CO2	Apply various CPU scheduling algorithms to solve problems	Apply
CO3	Analyze the needs and applications of process synchronization and deadlocks	Analyze
CO4	Apply the concepts of memory management including virtual memory and page replacement to the issues that occur in real time applications	Apply
CO5	Solve issues related to file system implementation and disk management	Apply

22CSM05	DATA COMMUNICATION AND COMPUTER NETWORKS			Semester		
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To study the concepts of data communications and functions of different ISO/OSI reference architecture
2	To understand the error detection and correction methods and also the types of LAN
3	To study the concepts of subnetting and routing mechanisms
4	To understand the different types of protocols and congestion control
5	To study the application protocols and network security

UNIT I	**DATA COMMUNICATIONS AND PHYSICAL LAYER**	**9**	**0**	**0**	**9**

Data Communication; Networks- Physical Structures (Types of Connections, Physical Topology),Categories of Networks, Interconnection of Networks: Internetwork; Protocols and Standards; Network Models-The OSI Model, Layers in the OSI Model, Addressing; Transmission media-Guided Media, Unguided Media.

UNIT II	**DATA LINK LAYER**	**9**	**0**	**0**	**9**

Introduction-Types of errors, Redundancy, Detection versus Correction, Modular Arithmetic; Block Coding-Error Detection and Correction (VRC,LRC,CRC, Checksum, Hamming Code);Data link Control- Flow Control (Stop- and-Wait, Sliding Window),Error Control (Automatic Repeat Request, Stop-and-wait ARQ, Sliding Window ARQ), HDLC; Local Area Networks-Ethernet, Token Bus, Token Ring, FDDI.

UNIT III	**NETWORK LAYER**	**9**	**0**	**0**	**9**

Network Layer services-Packet Switching-Network Layer Performance-IPv4 addresses-IPv6 addressing- Subnetting-Bridges-Gateways- Routers-Routing Algorithm-Distance Vector Routing, Link State Routing.

UNIT IV	**TRANSPORT LAYER**	**9**	**0**	**0**	**9**

Duties of the Transport layer-User Datagram Protocol-Transmission Control Protocol- Congestion Control and Quality of Service-Congestion, Congestion Control, Quality of Service, Techniques to improve QoS, Integrated Services.

UNIT V	**PRESENTATION LAYER AND APPLICATION LAYER**	**9**	**0**	**0**	**9**

Domain Name System - Domain Name Space, DNS in the Internet; Electronic Mail-FTP- HTTP- World Wide Web.

Total (45 L) =45 Periods

Text Books:

1	Behrouz A.Ferouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, 2007.

Reference Books:

1	Andrew S. Tanenbaum, "Computer networks "PHI, 4th edition 2008
2	William Stallings," Data and computer communications", 10th edition,PHI, 2012
3	Douglas E. comer," Internetworking with TCP/IP-Volume-I", 6th edition,PHI, 2008

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Classify the fundamentals of data communications and functions of layered architecture	Understand
CO2	Apply the error detection and correction methods and also identify the different network technologies	Apply
CO3	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and routing technologies	Analyze
CO4	Illustrate the transport layer principles and reliable data transfer using protocols	Apply
CO5	Analyze the application layer protocols and also the use of network security	Analyze

22CSM06	PROGRAMMING ESSENTIALS IN PYTHON			Semester			
PREREQUISITES		**Category**	**OE**	**Credit**		**3**	
		Hours/Week	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Learning Objectives	
1	To learn Python data structures, conditional and control structures and files
2	To study Python Modules, packages, Functions and Exceptions.
3	To describe Object oriented programming features and Regular Expressions.
4	To learn about Web programming, GUI Programming and Database programming

		L	T	P	TH
UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Python: Features - The Basics-Python Objects-Numbers-Sequences-Mapping and set types- Conditionals and loops-if statement-else statement-elif-Conditional Expressions-while statement-for statement-break-continue.					
UNIT II	**FUNCTIONS, MODULES AND PACKAGES**	**9**	**0**	**0**	**9**
Functions-Calling functions-Creating functions-Passing Functions-Formal Arguments-Variable length arguments-variable scope-Recursion, Modules-Packages.					
UNIT III	**FILES AND EXCEPTIONS**	**9**	**0**	**0**	**9**
Files and Input/ Output –Errors and Exceptions-Introduction-Detecting and handling Exceptions-Context Management-Raising Exceptions-Assertions-Standard Exceptions.					
UNIT IV	**OBJECT ORIENTED PROGRAMMING AND REGULAR EXPRESSIONS**	**9**	**0**	**0**	**9**
Object Oriented Programming Introduction-Classes-class Attributes-Instances-Instances attributes-Building and Method Invocation-Static methods and class Methods-Inheritance-Operator overloading - Regular Expressions-Network Programming – Multithreaded Programming					
UNIT V	**ADVANCED TOPICS**	**9**	**0**	**0**	**9**
GUI Programming- Web Programming-Database Programming					
					Total (45 L) =45 Periods

Text Books:	
1	Wesley J.Chun-"Core Python Programming" –Prentice Hall, Second Edition, 2006.
Reference Books:	
1	Swaroop C N, " A Byte of Python ", ebshelf Inc., 1st Edition, 2013
2	"A Practical Introduction to python programming", Brian Heinold,Mount St.Mary's University,2012
3	Learning to Program with Python," Richard L. Halterman"., Southern Adventist University

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop programs using control structures and files. .	Create
CO2	Create own Python Modules, packages, functions and Exceptions. .	Create
CO3	Illustrate Object oriented programming features and Regular Expressions.	Apply
CO4	Create own Web programs, GUI and database programs.	Create

22CSM07	ADVANCED DATABASE SYSTEM CONCEPTS			Semester			
PREREQUISITES			**Category**	**OE**	**Credit**		**3**
			Hours/Week	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the fundamentals of data models ,SQL queries and relational databases
2	To make a study of database design using ER Diagram and normalize
3	To impart knowledge in transaction processing.
4	To make the students to understand the file operations and indexing
5	To familiarize the students with advanced databases

UNIT I	**RELATIONAL DATABASES**	**9**	**0**	**0**	**9**

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT II	**DATABASE DESIGN**	**9**	**0**	**0**	**9**

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III	**TRANSACTION**	**9**	**0**	**0**	**9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV	**IMPLEMENTATION TECHNIQUES**	**9**	**0**	**0**	**9**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT V	**ADVANCED TOPICS**	**9**	**0**	**0**	**9**

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL – XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Data Warehousing and Data Mining - information Retrieval:
IR Concepts, Retrieval Models, Queries in IR systems.

Total (45 L) =45 Periods

Text Books:

1	Abraham Silberschatz, Henry F.Korth and S.Sundarshan "Database System Concepts", Sixth Edition,Tata McGraw Hi 2011.

Reference Books:

1	Ramez Elamassri and Shankant B-Navathe, "Fundamentals of Database Systems", Sixth Edition,Pearson Education, 2011.
2	C.J. Date, "An Introduction to Database Systems", Eighth Edition, Pearson Education Delhi, 2008.
3	Raghu Ramakrishnan, ―Database Management Systems, Fourth Edition, McGraw-Hill CollegePublications, 2015.
4	G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011.

E-References:

1.	Lecture Series on Database Management System by Dr.S.Srinath, IIIT Bangalore, nptl

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of the database and data models.	Understand
CO2	Design a database using ER diagrams and map ER into Relations and normalize the relations.	Create
CO3	Develop a simple database for applications	Create

22CSM08	VIRTUALIZATION AND CLOUD COMPUTING			Semester			
PREREQUISITES		Category	OE	Credit		3	
		Hours/Week	L	T	P	TH	
			3	0	0	3	

Course Learning Objectives	
1	To introduce the broad perceptive of Parallel Computing, Distributed Computing and Cloud Computing.
2	To understand the concept of Virtualization
3	To identify the approaches of SLA and programming model in Cloud
4	To understand the Cloud Platforms in Industry and Software Environments.
5	To learn to design the trusted Cloud Computing system

UNIT I	INTRODUCTION	9	0	0	9
Principles of Parallel and Distributed Computing – Elements of Parallel and Distributed Computing, Technologies for Distributed Computing; Vision of Cloud, Defining a Cloud, characteristics and benefits; Cloud Computing Architecture- Cloud Reference Model, Types of Clouds, Open Challenges.					
UNIT II	**VIRTUALIZATION**	**9**	**0**	**0**	**9**
Introduction, Characteristics of Virtualized environments, Virtualization techniques-Machine Reference Model, Hardware-Level Virtualization, Programming Language-Level Virtualization, Application-Level Virtualization ,Other types of Virtualization, Virtualization and Cloud computing, Pros and cons of Virtualization, Technology examples-Xen: Para virtualization, VMware: Full Virtualization.					
UNIT III	**SLA MANAGEMENT IN CLOUD COMPUTING AND PROGRAMMING MODEL**	**9**	**0**	**0**	**9**
Traditional Approaches to SLA Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud; Data Intensive Computing - Technologies for Data Intensive Computing, MapReduce Programming Model.					
UNIT IV	**CLOUD INDUSTRIAL PLATFORMS AND SOFTWARE ENVIRONMENTS**	**9**	**0**	**0**	**9**
Cloud Platforms in Industry - Amazon Web Service, Google App Engine; Cloud Software Environments –Eucalyptus, OpenNebula; Aneka Cloud Application Platform-Aneka Framework Overview, Anatomy of Aneka Container.					
UNIT V	**CLOUD SECURITY AND APPLICATIONS**	**9**	**0**	**0**	**9**
An Introduction to the Idea of Data Security, The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risk, Cloud Computing and Identity; The Cloud, Digital Identity, and Data Security, Content Level Security, Pros and Cons; Cloud Scientific Applications.					
Total (45L) = 45 Periods					

Text Books:	
1	Rajkumar Buyya, Christian Vecchiola, S.Tamarai Selvi, ‘Mastering Cloud Computing-Foundations and Applications Programming”, TMGH,2013.(Unit- I,II & IV)
2	RajKumar Buyya, James Broberg, Andrezei M.Goscinski, “Cloud Computing: Principles and paradigms”,2011(Unit-III & V)
Reference Books:	
1	Kai Hwang.GeoffreyC.Fox.JackJ.Dongarra, “ Distributed and Cloud Computing ,From Parallel Processing to The Internet of Things”, 2012 Elsevier
2	Barrie Sosinsky, “Cloud Computing Bible”, Wiley Publisher, 2011

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the main concepts and architecture of Parallel computing, Distributed Computing and Cloud Computing.	Understand
CO2	Analyze the concept of Virtualization	Analyze
CO3	Identify the approaches of SLA and programming model in Cloud	Apply
CO4	Analyze the Cloud Platforms in Industry and Software Environments.	Analyze
CO5	Identify the security issues in scientific and real time applications.	Apply

22ECM01	ELECTRON DEVICES						
PREREQUISITES		CATEGORY	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To introduce components such as diodes, BJTs and FETs, their characteristics and applications
2.	To understand, analyse and design of simple diode and transistor circuits.
3.	To know the switching characteristics of components and the concept of rectifiers and power supplies

Unit I	**EXTRINSIC SEMICONDUCTOR AND PN JUCTIONS**	**9**	**0**	**0**	**9**
N and P type semiconductor and their energy band structures- Law of electrical neutrality-calculation of location of Fermi level and free electron and hole densities in extrinsic semiconductors-Mobility, drift current and conductivity-diffusion current-continuity equation- Hall effect and its applications. Band structure of PN junction – current component in a PN junction- derivation of diode equation-temperature dependence of diode characteristics and equivalent models.					
Unit II	**SWITCHING CHARACTERISTICS OF PN JUNTION AND SPECIAL DIODES**	**9**	**0**	**0**	**9**
Calculation of transition and diffusion capacitance- varactor diode-charge control description of diode-switching characteristics of diode- mechanism of avalanche and Zener breakdown-temperature dependence of breakdown voltages- backward diode-tunneling effect in thin barriers - tunnel diode-photo diode-light emitting diodes.					
Unit III	**BIPOLAR JUNCTION TRANSISTORS**	**9**	**0**	**0**	**9**
Construction of PNP and NPN transistors- BJT current components-emitter to collector and base to collector current gains-base width modulation CB, CE and CC characteristics- breakdown characteristics- Ebers-Moll model - transistor switching times- Photo translator.					
Unit IV	**FIELD EFFECT TRANSISTORS**	**9**	**0**	**0**	**9**
Construction and characteristics of JFET-relation between pinch off voltage and drain current derivation. MOSFETS - enhancement and depletion types. CMOS circuits. MOS capacitance, BICMOS, SOI CMOS.					
Unit V	**RECTIFIERS AND POWER SUPPLIES**	**9**	**0**	**0**	**9**
Half-wave, full-wave and bridge rectifiers with resistive load. Analysis for Vdc and ripple voltage with C, CL, L-C and C-L-C filters. Voltage multipliers Zener diode regulator. Electronically regulated d.c power supplies. Line regulation, output resistance and temperature coefficient.					
					Total (45L)= 45 Periods

Text Books:

1.	JaconMillman& Christos C. Halkias, “ Electronic Devices and Circuits” Tata McGraw-Hill, 1991.
2.	Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory 8th edition.”, PHI, 2002

Reference Books:

1.	Donald A. Neaman. “ Semiconductor Physics and Devices” 3rd Ed., Tata McGraw-Hill 2002
2.	S. Salivahanan, N. Suresh kumar and A. Vallavaraj, Electronic Devices and Circuits, TMH, 1998.
3.	Ben, G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, Pearson Education 2000
4.	Floyd, “Electronic Devices”, Sixth edition, Pearson Education, 2003.

E-References:

1.	https://archive.nptel.ac.in/courses/108/108/108108122/
2.	https://www.youtube.com/watch?v=qqQ8wO-lNmI
3.	https://slideplayer.com/slide/12438044/

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom’s Taxonomy Mapped
CO1	Interpret various applications of diode.	Applying
CO2	Classify various configurations and biasing technique of BJT	Applying
CO3	Apply the knowledge of using special devices for various applications	Understanding
CO4	Discuss operation, biasing and applications of JFET.	Analysing
CO5	Design power supplies and rectifiers	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1
CO5	2	2	1	-	-	-	-	-	-	-	-	-	3	2	2
Avg	2	2	1	-	-	-	-	-	-	-	-	-	2.2	2	1.5
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECM02	DIGITAL ELECTRONICS					
PREREQUISITES		CATEGORY	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives	
1	To introduce basic postulates of boolean algebra and show the correlation between expressions
2	To Introduce the methods for Simplifying Boolean expressions
3	To Outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
4	To introduce the Concept of Memories and programmable logic devices
5	To illustrate the concept of synchronous and Asynchronous sequential circuits

Unit I	NUMBER SYSTEMS AND LOGIC GATES	9	0	0	9

Number Systems - signed Binary numbers - Binary Arithmetic - Binary codes -conversion from one code to another - Boolean Algebra and Minimization Techniques - Canonical forms – Conversion between canonical forms – Simplifications of Boolean expressions using Karnaugh map - LOGIC GATES - Implementations of Logic Functions using gates.

Unit II	COMBINATIONAL CIRCUITS	9	0	0	9

Design procedure – Adders/Subtractor – Serial adder/ Subtractor - Parallel adder/ Subtractor- BCD adder- Multiplexer/ Demultiplexer - encoder / decoder – code converters.

Unit III	SEQUENTIAL CIRCUITS	9	0	0	9

Design Procedure - Flip flops: SR, JK, T, D and JKMS – Triggering of Flip-flop - Realization of flip flops – Moore and Mealy – Counters: Asynchronous / Ripple counters – Synchronous counters – Modulo n counter. Register: shift registers- Universal shift register.

Unit IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS	9	0	0	9

Design of fundamental mode circuits – primitive state / flow table – Minimization of primitive state table –state assignment. Problems in Asynchronous Circuits: Cycles – Races – Hazards. Design of Hazard Free Circuits: Static, Dynamic Hazards elimination

Unit V	PLD AND MEMORY DEVICES	9	0	0	9

Classification of memories –RAM organization –ROM organization. Programmable Logic Devices: Programmable Logic Array (PLA) - Programmable Array Logic (PAL). Implementation of combinational logic using MUX, ROM, PAL and PLA.

Total (45 L) = 45 Periods

Text Books:

1	M. Morris Mano, Digital Design, 4.ed.,Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2008
2	R.P.Jain, Modern Digital Electronics, 4th edition, TMH, 2010.

Reference Books:

1	S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 2nd ed., Vikas Publishing House Pvt. Ltd, New Delhi, 2004
2	Charles H.Roth. "Fundamentals of Logic Design", Thomson Publication Company, 2003.
3	Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 5 ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
4	John F.Wakerly, Digital Design: Principles and practices, PHI, 2006

E-Reference:

1	http://nptel.ac.in/noc/individual_course.php?id=noc15-ec01
2	https://nptel.ac.in/courses/117105080/6
3	https://nptel.ac.in/courses/117105080/12

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Minimize Boolean expressions and implement using logic gates	Applying
CO2	Design and analyse combinational logic circuits.	Analysing
CO3	Design and analyse synchronous and asynchronous sequential logic circuits	Analysing
CO4	Understand the concepts of memories and PLDs	Understanding
CO5	Implement circuits using memory and PLDs.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	2	3	2	-	-	-	-	2	1	-
CO2	3	3	2	2	3	3	2	1	1	-	-	-	3	2	-
CO3	2	2	3	3	2	1	2	1	1	-	-	-	2	2	-
CO4	2	1	2	1	2	2	3	1	-	-	-	-	2	1	-
CO5	2	1	2	1	3	2	1	2	-	-	-	-	3	2	-
Avg	2.4	1.8	2.2	1.8	2.6	2	2.2	1.4	1	-	-	-	2.4	1.6	-
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECM03	ELECTRONIC CIRCUITS						
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**	
Electron Devices		**Hours/Week**	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives

1	To perform analysis on Small signal amplifiers and large signal amplifiers.
2	To give a comprehensive exposure to all types of discrete amplifiers and oscillators.
3	To understand the various linear and non-linear applications of op-amp

Unit I	**MIDBAND ANALYSIS OF SMALL SIGNAL AMPLIFIERS**	**9**	**0**	**0**	**9**

BJT – Need for biasing - Fixed bias circuit - Load line and quiescent point. Different types of biasing circuits. Use of Self bias circuit as a constant current circuit. CE, CB and CC amplifiers. Method of drawing small-signal equivalent circuit. Mid-band analysis of various types of single stage amplifiers to obtain gain - input impedance and output impedance. Miller's theorem. Darlington connection using similar and Complementary transistors. Methods of increasing input impedance using Darlington connection and bootstrapping. CS, CG and CD (FET) amplifiers. Multistage amplifiers-Basic emitter coupled differential amplifier circuit. Differential gain - CMRR. Use of constant current circuit to improve CMRR.

Unit II	**LARGE SIGNAL AMPLIFIERS**	**9**	**0**	**0**	**9**

Low frequency & High frequency analysis of amplifiers -Hybrid – pi equivalent circuit of BJTs.-High frequency equivalent circuit of FETs. Gain-bandwidth product of FETs. General expression for frequency response of multistage amplifiers. Calculation of overall upper and lower cut off frequencies of multistage amplifiers. Amplifier rise time and sag time and their relation to cut off frequencies. Classification of amplifiers (Class A, B, AB, C&D), Efficiency of class A, RC coupled and transformer-coupled power amplifiers. Class B complementary-symmetry, push-pull power amplifiers. Calculation of power output, efficiency and power dissipation. Crossover distortion and methods of eliminating it. Calculation of actual power handling capacity of transistors with and without heat sink. Heat sink design.

Unit III	**OSCILLATORS**	**9**	**0**	**0**	**9**

Feedback Amplifier: Block diagram - Gain with feedback - Barkhausen Criterion - Mechanism for start of oscillation and stabilization of amplitude - Analysis of Oscillator using Cascade connection of RC and LC filters - RC phase shift Oscillator - Wien bridge Oscillator and Twin-T Oscillators - Analysis of LC Oscillators: Colpitts – Hartley – Clapp - Miller and Pierce oscillators - Frequency range of RC Oscillators - Electrical equivalent circuit of Crystal.

Unit IV	**TUNED AMPLIFIERS AND MULTIVIBRATORS**	**9**	**0**	**0**	**9**

Analysis of single tuned and synchronously tuned amplifiers - Class C tuned amplifiers and their applications - Efficiency of Class C tuned Amplifier- Collector coupled and Emitter coupled Astable Multi vibrator – Mono stable Multi vibrator – Bistable Multi vibrator - Triggering methods – Mono stable and Astable Blocking Oscillators using Emitter and base timing.

Unit V	**OPERATIONAL AMPLIFIERS AND ITS APPLICATIONS**	**9**	**0**	**0**	**9**

Basic structure and principle of operation - Calculation of differential gain - Common Mode gain, CMRR - OP-AMP design - DC and AC characteristics of OP-AMP. Applications: Inverting and non-inverting amplifiers - Integrator and Differentiator - Summing amplifier - Precision rectifier - Schmitt trigger and its applications - Active filters: Low pass, high pass, band pass and band stop filters - Sine wave oscillators – Comparator – Multi vibrator.

Total (45 L) = 45 Periods

Text Books:

1	B.Visvesvara Rao, K.Raja Rajeswari, P.Chalam Raju Pantulu, K.Bhaskara Rama Murthy, "Electronic Circuits-II", Pearson Education,2012
2	D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2011.

Reference Books:

1	Millman J. and Taub H., "Pulse Digital and Switching waveform", 3rd Edition, McGraw-Hill International , 2011.
2	Sedera& Smith, “Micro Electronic Circuits”, 4 th Edition, Oxford University Press, Chennai.
3	Michael Jacob, ‘Applications and Design with Analog Integrated Circuits’, Prentice Hall of India, 1996.
4	K.R.Botkar, ‘Integrated Circuits’, 10th edition, Khanna Publishers, 2010.
e-Reference:	
1	http://nptel.ac.in/courses/117105080/40
2	http://nptel.ac.in/courses/117108038/1
3	https://freevideolectures.com/course/2915/linear-integrated-circuits

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom’s Taxonomy Mapped
CO1	To analyze small signal amplifiers and Large signal Amplifiers.	Applying
CO2	Analyze the frequency response characteristics of amplifiers	Applying
CO3	Develop insight of on oscillator design.	Applying
CO4	Construct and analyse tuned amplifiers and multivibrators.	Applying
CO5	Develop competence in linear and nonlinear Op amp circuit analysis.	Applying

COURSE ARTICULATION MATRIX														
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO2	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO4	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO5	1	2	1	2	-	-	-	-	-	-	-	-	1	2	1
Avg	2.4	2	1	2	-	-	-	-	-	-	-	-	1	2	1
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECM04	SIGNAL PROCESSING					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand and perform Fourier and Laplace analysis on signals and systems respectively.
2.	To analyse the Discrete Fourier Transform, Fast Fourier Transform algorithms.
3.	To design and realize IIR, FIR filters.

Unit I	INTRODUCTION TO SIGNALS AND SYSTEMS	9	0	0	9
Classification of Signals: Even and Odd Signal - Energy and power signals - Continuous time (CT) and Discrete time (DT) signals - Continuous and Discrete amplitude signal -. System properties and representation: linearity - Tme-invariance – Causality – Stability - Realizability. - Linear Time-Invariant (LTI) systems: Impulse response and step response – Convolution – Correlation - System representation through differential equations and difference equations.					
Unit II	**ANALYSIS OF SIGNAL AND SYSTEMS**	**9**	**0**	**0**	**9**
Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems. Introduction to z- Transform.					
Unit III	**DISCRETE FOURIER TRANSFORM**	**9**	**0**	**0**	**9**
Introduction to DFT – Properties of DFT - Circular convolution - FFT algorithms – Radix-2 FFT algorithms – Decimation in Time and Decimation in Frequency algorithms.					
Unit IV	**INFINITE IMPULSE RESPONSE FILTER DESIGN**	**9**	**0**	**0**	**9**
Characteristics of Analog Butterworth filter - Chebyshev filter - Low pass filter, High pass filter, Band pass filter and Band stop filter - Transformation of analog filters in to equivalent digital filters using bilinear transformation method - Realization structure for IIR filters-Direct form - Cascade form - Parallel form.					
Unit V	**FINITE IMPULSE RESPONSE FILTER DESIGN**	**9**	**0**	**0**	**9**
Linear phase response of FIR filter - FIR design using window method: Rectangular, Hamming, Hanning and Blackmann Windows - Park-McClellan's method - Realization structures for FIR filters - Linear phase structures and Direct form structure - Comparison of FIR and IIR filters.					
					Total (45L)= 45 Periods

Text Books:	
1.	A.Anand Kumar, “Signals and Systems” , 3rd Edition, PHI, 2013.
2.	John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, 4th Edition, Pearson Education, 2009.
Reference Books:	
1.	Alan V Oppenheim, Alan S Willsky and S Hamid Nawab, “Signals and Systems”, 2nd edition, PHI Learning Private Limited, New Delhi, 2010.
2.	B.P. Lathi, "Principles of Signal Processing and Linear Systems", Oxford University Press, 2009.
3.	Emmanuel C. Ifeacher, Barry W. Jervis, “Digital Signal Processing: A Practical Approach”, 2nd Edition, Pearson Education, 2004.
4.	S.K. Mitra, “Digital Signal Processing, A Computer Based approach”, 4th Edition, McGraw-Hill, 2010.
E-References:	
1.	http://nptel.ac.in/courses/117104074/
2.	https://www.coursera.org/learn/dsp
3.	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Analyse and understands different types of signals.	Analysing
CO2	Represent continuous signals and systems in time and frequency domain using different transforms.	Analysing
CO3	Analyse the need for Discrete Fourier Transform, Fast Fourier Transform algorithms in digital signals & systems.	Analysing
CO4	Design and realize IIR filters.	Applying
CO5	Design and realize FIR filters.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	-	-	-	-	-	-	-	2	2	2
CO2	3	2	2	3	3	2	-	-	-	-	-	-	2	2	2
CO3	3	2	2	2	1	-	1	-	-	-	-	-	1	1	1
CO4	3	2	2	2	1	-	1	-	-	-	-	-	1	1	1
CO5	1	1	1	1	1	-	-	-	-	-	-	-	2	2	1
Avg	2.6	1.8	2	2.2	1.8	2	1						1.6	1.6	1.4
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECM05	FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS						
PREREQUISITES		**CATEGORY**	**OE**	**Credit**			**3**
		Hours/Week	**L**	**T**		**P**	**TH**
			3	**0**		**0**	**3**

Course Objectives:

1.	To familiarise with 8086 and 8051 architectures.
2.	To interface 8086 microprocessor and 8051 microcontrollers with peripherals by programming.
3.	To gain basic knowledge of PIC microcontrollers.

Unit I	**8086 MICROPROCESSOR ARCHITECTURE**	9	0	9
Overview of Microcomputer systems-8086 Architecture – Pin Assignments – Internal Architecture – Addressing modes- Instruction Formats- Directives and Operators-Assembly process.				
Unit II	**PROGRAMMING AND INTERFACING OF 8086**	9	0	9
Fundamental I/O considerations- Programmed I/O- Interrupt I/O- Basic 8086 Configurations- Minimum Mode-Maximum Mode-System Bus timing- I/O Interfaces-Peripheral Interfacing using 8255 PPI - 8279 Keyboard/Display controller - 8251 USART.				
Unit III	**8051 ARCHITECTURE**	9	0	9
8051 architecture - Registers in 8051 - Pin description - 8051 parallel I/O ports - memory organization - Instruction set — Addressing modes				
Unit IV	**PROGRAMMING AND INTERFACING OF 8051**	9	0	9
Assembly language programming.8051Timers - Serial Port Programming - Interrupts Programming - LCD and Keyboard Interfacing - ADC, DAC and Sensor Interfacing - Motor Control.				
Unit V	**PIC MICROCONTROLLERS**	9	0	9
Main characteristics of PIC microcontrollers – PIC microcontroller families-Memory-Program Memory – RAM Data Memory - Instruction set and timers in PIC				
				Total (L+T) = 45 periods

Text Books:

1.	Yu-Cheng Liu, Glenn A. Gibson," Microcomputer Systems, The 8086/8088 Family", Pearson, 2e, 2019.
2.	Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2e, 2022.

Reference Books:

1.	Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson education, 2011.
2.	Martin Bates,"PIC Microcontrollers-An Introduction to Microelectronics", 3e, Elsevier, 2011.
3.	Mathur Sunil,"Microprocessor 8086: Architecture, Programming and Interfacing" PHI Learning Pvt. Ltd. 2011.
4.	Salvador PinillosGimenez," 8051 Microcontrollers Fundamental Concepts, Hardware, Software and Applications in Electronics", Springer 2019.

E-References:

1.	Ashraf Almadhoun,"A Detailed Look Into PIC Microcontroller and Its Architecture", Amazon 2020.
2.	https://nptel.ac.in/courses/108105102
3.	http://www.satishkashyap.com/2012/02/video-lectures-on-microprocessors-and.html

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe and analyse the architecture of 8086 microprocessor and 8051 architectures.	Remembering
CO2	Develop assembly language programs and Interface peripherals with 8086.	Applying
CO3	Develop assembly language programs and Interface peripherals with 8051.	Applying
CO4	Determine application specific circuit for real-time applications.	Understanding
CO5	Associate appropriate PIC microcontroller for a given application.	Understanding

COURSE ARTICULATION MATRIX														
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	2	-	1	-	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	2	2	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	-
CO4	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	-	2	-	-	-	-	-	-	-	-	2	2	-
Avg	2	2	2	2	-	-	-	-	-	-	2	-	1.8	2	2

22ECM06	ANALOG AND DIGITAL COMMUNICATION					
PREREQUISITES		CATEGORY	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	Understand analog and digital communication techniques.
2.	Learn data and pulse communication techniques.
3.	Be familiarized with source and Error control coding.

Unit I	INFORMATION THEORY	9	0	0	9
Uncertainty, information and entropy – Source coding theorem – Shannon Fano coding – Huffman coding – Discrete memoryless channels – Mutual information – Channel capacity – Channel coding theorem.					
Unit II	**ANALOG COMMUNICATION**	**9**	**0**	**0**	**9**
Noise: Source of Noise – External Noise- Internal Noise- Noise Calculation. Introduction to Communication Systems: Modulation – Types – Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).					
Unit III	**DIGITAL COMMUNICATION**	**9**	**0**	**0**	**9**
Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).					
Unit IV	**PULSE COMMUNICATION AND MULTIPLE ACCESS TECHNIQUES**	**9**	**0**	**0**	**9**
Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM). Multiple access techniques: FDMA, CDMA, TDMA, SDMA.					
Unit V	**ERROR CONTROL CODING**	**9**	**0**	**0**	**9**
Linear block codes - Cyclic codes - Convolution codes – Maximum likelihood decoding of convolutional codes – Sequential decoding of convolutional codes – Trellis codes – Applications.					
					Total (45L)= 45 Periods

Text Books:

1.	Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2014.
2.	J.G.Proakis, M.Salehi, ―Fundamentals of Communication Systems‖, Pearson Education 2014.

Reference Books:

1.	B.P.Lathi, ―Modern Digital and Analog Communication Systems‖, 4th Edition, Oxford University Press,
2.	D.Roody, J.Coolen, ―Electronic Communications, 4th edition PHI 2015.
3.	B.Sklar, ―Digital Communications Fundamentals and Applications‖, 5th Edition Pearson Education 2017
4.	H P Hsu, Schaum Outline Series - ―Analog and Digital Communications‖ TMH, 5th edition 2006

E-References:

1.	https://onlinecourses.nptel.ac.in/noc21_ee74/preview
2.	https://nptel.ac.in/courses/117101051
3.	https://www.digimat.in/nptel/courses/video/117105143/L51.html

Course Outcomes: Upon completion of this course, the students will be able to:			Bloom's Taxonomy Mapped
CO	:	Apply the concepts of Random Process to the design of Communication	Applying
CO	:	Apply analog and digital communication techniques.	Applying
CO	:	Understand the use of data and pulse communication techniques.	Understanding
CO	:	Analyze Source and Error control coding.	Analysing
CO	:	Design AM communication systems and Angle modulated communication	Applying

COURSE ARTICULATION MATRIX															
COs /POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	3	2	1	1	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-	-	3	2	1
CO3	2	2	2	3	1	-	-	-	-	-	-	-	3	2	-
CO4	1	1	2	1	2	-	-	-	-	-	-	-	2	3	-
CO5	1	1	2	2	2	-	-	-	-	-	-	-	2	3	1
Avg	1.8	1.8	2	1.6	1.4	-	-	-	-	-	-	-	2.6	2.5	1
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECM07	COMMUNICATION NETWORKS					
PREREQUISITES		CATEGORY	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:	
1.	Understand the division of network functionalities into layers.
2.	Be familiar with the components required to build different types of networks
3.	Be exposed to the required functionality at each layer
4.	Learn the flow control and congestion control algorithms

Unit I	**FUNDAMENTALS & LINK LAYER**	9	0	0	9
Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction					
Unit II	**MEDIA ACCESS & INTERNETWORKING**	9	0	0	9
Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols (IP, ICMP, Mobile IP)					
Unit III	**ROUTING**	9	0	0	9
Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6					
Unit IV	**TRANSPORT LAYER**	9	0	0	9
Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmiision Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements					
Unit V	**APPLICATION LAYER**	9	0	0	9
Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need forCryptography and Network Security – Firewalls.					
Total (45L)= 45 Periods					

Text Books:	
1.	Behrouz A Forouzan, Data Communications and Networking, 4th Edition, 2020
2.	James F. Kurose, Keith W. Ross, Computer Networking - A Top-Down Approach Featuring the Internet, Seventh Edition, Pearson Education, 2016.
Reference Books:	
1.	Nader. F. Mir,“ Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2nd Edition, 2014.
2.	Alberto Leon-Garcia, IndraWidjajaCommunication Networks 2nd Edition McGraw-Hill Education, 2003
3.	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4.	Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.
E-References:	
1.	https://onlinecourses.nptel.ac.in/noc22_ee61/preview
2.	https://www.ee.iitb.ac.in/~sarva/courses/EE706/2012/EE706LecNotes.pdf
3.	http://www.cs.kent.edu/~farrell/net01/lectures/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the basic concept in modern data communication and different level of layers in the protocol	Understanding
CO2	Analyse the functions and services of data link layer	Analysing
CO3	Categorize the functions and services of network layer	Understanding
CO4	Examine the basic functions of transport layer and congestion in networks	Understanding
CO5	Analyse the concepts of various network applications and data security	Analysing

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	-	1	-	-	-	-	-	-	-	2	-	1
CO2	2	1	2	-	1	-	-	-	-	-	-	-	2	1	1
CO3	2	1	1	-	-	-	-	-	-	-	-	-	3	1	2
CO4	3	2	1	-	2	-	-	-	-	-	-	-	2	-	2
CO5	2	1	1	-	1	-	-	-	-	-	-	-	1	1	1
Avg	2.2	1.2	1.2	-	1.25	-	-	-	-	-	-	-	2	1	1.4
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECM08	FUNDAMENTALS OF IOT					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives	
1	To understand Smart Objects and IoT Architectures
2	To learn about various IOT-related protocols
3	To build simple IoT Systems using Arduino and Raspberry Pi
4	To understand data analytics and cloud in the context of IoT
5	To develop IoT infrastructure for popular applications

Unit I	**FUNDAMENTALS OF IOT**	**9**	**0**	**0**	**9**
Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects					
Unit II	**IoT PROTOCOLS**	**9**	**0**	**0**	**9**
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT					
Unit III	**DESIGN AND DEVELOPMENT**	**9**	**0**	**0**	**9**
Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.					
Unit IV	**DATA ANALYTICS AND SUPPORTING SERVICES**	**9**	**0**	**0**	**9**
Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG					
Unit V	**CASE STUDIES/INDUSTRIAL APPLICATIONS**	**9**	**0**	**0**	**9**
Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control					
Total (45 L) = 45 Periods					

Text Books:	
1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2	ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
Reference Books:	
1	Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).
2	Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

3	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
4	Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.
E-References:	
1	https://online.stanford.edu/courses/xee100-introduction-internet-things
2	https://www.udemy.com/topic/internet-of-things/
3	https://www.netacad.com/courses/iot

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the concept of IoT.	Understanding
CO2	Analyze various protocols for IoT.	Applying
CO3	Design a PoC of an IoT system using Rasperry Pi/Arduino	Applying
CO4	Apply data analytics and use cloud offerings related to IoT.	Applying
CO5	Analyze applications of IoT in real time scenario	Analysing

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	1	-	-	-	-	-	1	-	2	2	2
CO2	2	1	2	1	1	-	-	-	-	-	1	-	2	2	2
CO3	2	2	3	2	1	-	-	-	-	-	2	-	2	2	2
CO4	2	2	2	1	1	-	-	-	-	-	1	-	2	2	2
CO5	2	2	3	2	1	-	-	-	-	-	2	-	2	2	2
Avg	2	1.6	2.4	1.4	1	-	-	-	-	-	1.4	-	2	2	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECM09	WIRELESS SENSORS AND NETWORKING					
PREREQUISITE:		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:					
1.	Learn fundamental of Ad hoc network and architecture				
2.	Understand the MAC and routing protocols.				
3.	Have an in-depth knowledge on QoS, security and sensor network platforms				
Unit I	**ROUTING PROTOCOLS**	9	0	0	9
Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).					
Unit II	**ARCHITECTURES OF WSN**	9	0	0	9
WSN application examples, Types of applications, Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Single-Node Architecture: Hardware Components, Energy Consumption of Sensor Nodes, Operating systems and execution environments Network Architecture: Sensor Network Scenarios, Optimization goals and figures of merit, Design principles of WSN, Service interfaces of WSNs, gateway concepts.					
Unit III	**MAC PROTOCOLS AND ROUTING PROTOCOLS**	9	0	0	9
Image compression: Predictive techniques – PCM – DPCM - DM - Transform coding - Introduction to JPEG - JPEG-2000 - JBIG standards - Study of EZW. Video compression: Video signal representation – ITU-T Recommendation H.261 – Model based coding – The MPEG-1 Video Standard - The MPEG-2 Video Standard: H.262 - ITU-T Recommendation H.263.					
Unit IV	**QUALITY OF SERVICE AND ADVANCED APPLICATION SUPPORT**	9	0	0	9
Quality of Service: Coverage and deployment, Reliable data transport, Single packet delivery, Block delivery, Congestion control and rate control - Advanced application support: Advanced in-network processing, Security and Application-specific support.					
Unit V	**SENSOR NETWORK PLATFORMS AND TOOLS**	9	0	0	9
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.					
					Total (45L) = 45 Periods

Text Books:	
1.	C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education – 2008
2.	Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2007.
Reference Books:	
1.	Feng Zhao and LeonidesGuibas, "Wireless sensor networks ", Elsevier publication - 2004.
2.	Charles E. Perkins, ―Ad Hoc Networking‖, Addison Wesley, 2000.
3.	William Stallings, "Wireless Communications and Networks ", Pearson Education – 2004
4.	I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", Computer Networks, Elsevier, 2002, 394 - 422.
E-References:	
1.	https://nptel.ac.in/courses/106105183
2.	https://nptel.ac.in/courses/106105183
3.	https://archive.nptel.ac.in/courses/106/105/106105160/

Course Outcomes: Upon completion of this course, the students will be able to		Bloom's Taxonomy Mapped
CO1	Know the basics of Ad hoc networks and Wireless Sensor Networks	Understanding
CO2	Have a knowledge on architecture of Wireless Sensor Networks	Applying
CO3	Apply the knowledge to identify MAC and routing protocols	Applying
CO4	Understand the transport layer and security issues possible in Ad hoc and sensor networks	Understanding
CO5	Be familiar with the OS used in Wireless Sensor Networks and build basic modules	Remembering

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	3	3	1	3	3	3	2	-	-	-	3	3	3	-	2
CO2	3	3	2	3	3	3	2	-	-	-	3	3	3	-	2
CO3	3	3	3	3	3	3	2	-	-	-	3	3	3	-	2
CO4	3	3	2	3	3	3	2	-	-	-	2	3	3	-	2
CO5	3	3	2	3	3	3	2	-	-	-	3	3	3	-	2
Avg	3	3	2	3	3	3	2	-	-	-	2.8	3	3	-	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22ECM10	FUNDAMENTALS OF EMBEDDED SYSTEMS					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Microprocessors and Mmicrocontrollers		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1	To impart knowledge on embedded system architecture and embedded development Strategies
2	To understand the bus Communication in processors and peripheral interfacing
3	To understand basics of Real Time Operating System

UNIT I	**BASICS OF EMBEDDED SYSTEMS**	9	0	0	9

Introduction - Fundamental Components of Embedded Systems - Challenges for Embedded Systems - Examples - Programming Languages - Recent Trends in Embedded Systems - Architecture of Embedded Systems - Embedded Design Life Cycle - Selection Process - Hardware Software Partitioning - Development Environment.

UNIT II	**MEMORY MANAGEMENT AND INTERRUPTS**	9	0	0	9

Memory Access Procedure - Types of Memory - Memory Management Methods - DMA – Memory Interfacing - Polling Vs Interrupts - Types of Interrupts - Interrupt Latency - Interrupt Priority – Programmable Interrupt Controllers - Interrupt Service Routines

UNIT III	**COMMUNICATION INTERFACES**	9	0	0	9

Interfacing Buses - Serial Interfaces - RS232/UART - RS422/RS485 - I2C Interface - SPI Interface - USB – CAN - IRDA - Ethernet - IEEE 802.11 – Bluetooth

UNIT IV	**REAL TIME OPERATING SYSTEMS**	9	0	0	9

Real-Time Concepts - Task Management - Task Scheduling - Classification of Scheduling Algorithms - Clock Driven Scheduling - Event Driven Scheduling - Resource Sharing - Priority Inheritance Protocol - Priority Ceiling Protocol - Inter Task Communication - Mutex - Semaphores - Message Queues - Timers - Commercial RTOS.

UNIT V	**VALIDATION AND DEBUGGING**	9	0	0	9

Host and Target Machines - Validation Types and Methods - Host Testing - Host-Based Testing Setup - Target Testing - Remote Debuggers and Debug Kernels - ROM Emulator - Logical Analyzer – Background Debug Mode - InCircuit Emulator CASE STUDY: RFID Systems - GPS Navigation System – Development of Protocol Converter.

Total (45 L) = 45 Periods

Text Books:

1	Sriram V Iyer and Pankaj Gupta, ―Embedded Real-time Systems Programming‖, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
2	Arnold S Berger, ―Embedded Systems Design - An Introduction to Processes, Tools and Techniques, Elsevier, New Delhi, 2011.

Reference Books:

1	Prasad K V K K, ―Embedded/Real-Time Systems: Concepts, Design and Programming – The Ultimate Reference, Himal Impressions, New Delhi, 2003
2	Heath, "Embedded Systems Design‖", Newnes an Imprint of Elsevier, Massachusetts, 2003.
3	Tammy Noergaard, "Embedded Systems Architecture‖, Newnes an Imprint of Elsevier, Massachusetts, 2006.
4	Raj Kamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013

E-References:

1	https://lecturenotes.in/subject/225/embedded-system-es
2	https://nptel.ac.in/courses/108102045/19
3	https://www.coursera.org/learn/introduction-embedded-systems.

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Course Outcomes: Upon completion of this course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Outline the concepts of embedded systems	Understanding
CO2	Understand the concept of memory management system and interrupts.	Understanding
CO3	Know the importance of interfaces.	Understanding
CO4	Understand real time operating system concepts.	Understanding
CO5	To realize the applications of validation and debugging.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	3	3	1	3	-	-	-	-	-	-	3	3	3	-	2
CO2	3	3	2	3	-	-	-	-	-	-	3	3	3	-	2
CO3	3	3	3	3	-	-	-	-	-	-	3	3	3	-	2
CO4	3	3	2	3	-	-	-	-	-	-	2	3	3	-	2
CO5	3	3	2	3	-	-	-	-	-	-	3	3	3	-	2
Avg	3	3	2	3	-	-	-	-	-	-	2.8	3	3	-	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

22EEM01	LINEAR AND DIGITAL ELECTRONICS CIRCUITS		SEMESTER			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Electron Devices and Circuits		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1. To impart knowledge on the characteristics& applications of Operation Amplifier, functional diagram and applications of linear ICs.
2. To simplify the switching functions
3. To design the combinational logic circuits and sequential logic circuits

Unit I	OPERATIONAL AMPLIFIERS	9	0	0	9

Operational amplifiers - Equivalent circuit, voltage transfer curve - Open loop Op-amp configurations –Voltage series, Voltage shunt feedback amplifiers configurations, closed loop differential amplifiers for single and differential outputs.
Output offset voltage, minimizing output offset voltage due to input bias current and input offset current, factors affecting off set parameters, CMRR - Open loop and closed loop frequency response of op-amps, circuit stability, slew rate and its effects in applications.

Unit II	APPLICATION OF OPERATIONAL AMPLIFIER AND LINEAR ICS	9	0	0	9

DC & AC amplifiers- Summing, Scaling and Averaging amplifiers-Instrumentation amplifier- Voltage to Current converter for floating and grounded loads - Current to voltage converter - Integrator, Differentiator. Voltage comparators - Zero Crossing Detector - Schmitt trigger with voltage limiter- Precision Rectifier Circuits-Peak Detector-Sample and Hold circuit, Active Filters - Frequency response characteristics of major active filters, first and higher order low pass and high pass filters, all pass filters.
Functional block diagram and Applications of Linear ICs: IC 555 Timer -IC 566 Voltage controlled oscillator- IC 565 Phase-locked loops - IC LM317 voltage regulators.

Unit III	COMBINATIONAL LOGIC CIRCUITS	9	0	0	9

Representation of logic functions: SOP and POS forms - Simplification of switching functions: K-maps method and QuineMcCluskey (Tabulation) method.
Design:Adders -Subtractors– 2 bit Magnitude Comparator-Multiplexer- Demultiplexer- Encoder - Priority Encoder - Decoder – Code Converters. Implementation of combinational logic circuits using multiplexers and Decoder.

Unit IV	SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	9	0	0	9

Flip-flops: SR, D, JK and T- Conversion of flip-flops; Classification of sequential circuits: Moore and Mealy models - Analysis and design of synchronous sequential circuits - Design of synchronous counters- Universal shift register.

Unit V	ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	9	0	0	9

Fundamental mode and pulse mode circuits , Analysis procedure of asynchronous circuits with /without using of SR latches- primitive state / flow table – Reduction of state and flow table - state assignment –Design Procedure of asynchronous circuits with /without using of SR latches-Problems in asynchronous sequential circuits: cycles -Races –Hazards.

Total (45L+0T) = 45 Periods

Text Books:

1. Ramakant A Gayakward, “Op-Amps and Linear Integrated Circuits”, Fourth Edition, Pearson Education, 2003.
2. Donald.E.Neaman, “Electronic Circuit, Analysis and Design”, Tata McGraw Hill Publishing Company Limited, Second Edition, 2002.
3. D.Roy Chowdhury and Shail B. Jain, “Linear Integrated Circuits”, Fourth Edition, New Age International (P) Ltd Publishers, 2014.
4. M. Morris Mano, “Digital Design” , Third Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2010 .
5. S. Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, Third Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 201

Reference Books:	
1.	Jacob Millman, Christos C.Halkias, “Integrated Electronics - Analog and Digital circuits system”, Tata McGraw Hill 2003.
2.	R.P.Jain, “Modern Digital Electronics”, Third Edition, Tata McGraw–Hill Publishing company limited, New Delhi, 2011.
3.	Thomas L. Floyd, “Digital Fundamentals”, Pearson Education, Inc, New Delhi, 2015
4.	Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, Fifth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Understand the Op-amp characteristics	L2: Understanding
CO2	:	Understand the applications of Op-amp and other linear ICs.	L2: Understanding
CO3	:	Apply K-map and Tadulation methods to simplify the switching functions	L3: Applying
CO4	:	Design and implement of combinational logic circuits	L6: Creating
CO5	:	Analyse and design of synchronous & asynchronous sequential logic circuits	L4: Analyzing

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1											2		
CO2	3	2	1	1									3		
CO3	3	2		2	2								3	3	
CO4	3	2	3	1	2							2	3	3	1
CO5	3	2	3	1	2							2	3	3	1
Avg.	**2.8**	**1.8**	**2.3**	**1.25**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.8**	**3**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22EEM02	MICROPROCESSOR AND MICROCONTROLLER		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
C Programming		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To study the architecture of μP8085 and μC 8051.
2.	To study the Interrupt structure of 8085 and 8051.
3.	To do simple applications development with programming 8085 and 8051.

UNIT I	**8085 8 BIT MICROPROCESSOR**	**9**	**0**	**0**	**9**

Fundamentals of microprocessors – Architecture of 8085 – Groups of Instructions - Addressing modes – Basic timing diagram – Organization and addressing of Memory and I/O systems –Interrupt structure – Stack and sub-routines - Simple 8085 based system design and programming.

UNIT II	**8051 8 BIT MICROCONTROLLER**	**9**	**0**	**0**	**9**

Fundamentals of microcontrollers – Architecture of 8051 – Groups of Instructions - Addressing modes – Organization of Memory systems – I/O Ports – Timers/Counters – Serial Port - Interrupt structure – Simple programming concepts using Assemblers and Compliers.

UNIT III	**INTERFACING WITH 8051 MICROCONTROLLER**	**9**	**0**	**0**	**9**

Need and requirements of interfacing – Interfacing – LED, 7 segment and LCD Displays – Tactile switches, Matrix keyboard – Parallel ADC – DAC – Interfacing of Current, Voltage, RTD and Hall Sensors.

UNIT IV	**EXTERNAL COMMUNICATION INTERFACE**	**9**	**0**	**0**	**9**

Synchronous and Asynchronous Communication. RS232, RS 485, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

UNIT V	**APPLICATIONS OF MICROCONTROLLERS**	**9**	**0**	**0**	**9**

Simple programming exercises- key board and display interface –Control of servo motor stepper motor control- Application to automation systems.

Total (45L+0T)= 45 Periods

Text Books:

1.	R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
2.	K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.
3.	Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

Reference Books:

1.	R. Kamal, "Embedded System", McGraw Hill Education, 2009.
2.	D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.

E-References;

1.	www.onlinecourses.nptel.ac.in/noc18_ee41
2.	www.class-central.com
3.	www.mooc-list.com

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand basics of microprocessor and microcontroller	L2: Understanding
CO2	:	Understand the architecture of Microprocessor and Microcontroller	L1: Remembering
CO3	:	Apply the digital concepts to measure and control simple electrical systems	L3: Applying
CO4	:	Design and interface communications between digital systems	L2: Understanding
CO5	:	Design a microcontroller based electrical control system.	L5: Evaluating

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	1								1	1	1	
CO2	2	1	1	1								1	1	1	
CO3	2	3	2	3	2							1	1	1	2
CO4	2	3	3	3	2							2	2	2	2
CO5	2	3	3	3	2							2	2	2	2
Avg.	**2**	**2.2**	**2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.4**	**1.4**	**1.4**	**2**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22EEM03	CONTROL SYSTEMS			SEMESTER			
PREREQUISTIES		CATEGORY		PE	Credit		3
Electrical Machines and Electric circuit analysis		Hours/Week		L	T	P	TH
				1	1	0	3

Course Objectives:

1.	To understand the methods of representation of physical systems and getting their transfer function models.
2.	To provide adequate knowledge in the time response of systems and steady state error analysis.
3.	To give basic knowledge in obtaining the open loop and closed loop frequency response of systems.
4.	To understand the concept of stability of control system and methods of stability analysis.
5.	To study the designing compensators for a feedback control system.

UNIT I	MODELLING OF LINEAR TIME INVARIANT SYSTEMS	6	9	0	9

Basic elements in control systems – Open and closed loop systems – Feedback control system characteristics - Mathematical model and Electrical analogy of mechanical systems – Transfer function Representation– Synchro – AC and DC servo-motors – Block diagram reduction techniques – Signal flow graphs.

UNIT II	TIME RESPONSE ANALYSIS	6	3	0	9

Standard test signals – Time response of first order and second order systems –time domain specifications - Steady-state errors and error constants – Type and order of control systems – Effect of adding poles and zeros to transfer functions – Response with P, PI, PD and PID controllers.

UNIT III	FREQUENCY RESPONSE ANALYSIS	6	3	0	9

Correlation between time and frequency response: Second order systems – Frequency domain specifications - Polar plots – Bode plots – Computation of Gain Margin and Phase Margin — Constant M and N-circles – Nichols chart.

UNIT IV	STABILITY OF CONTROL SYSTEM	6	3	0	9

BIBO stability – Necessary conditions for stability – Routh-Hurwitz stability criterion – Root locus concepts – Rules for the construction of Root loci – Nyquist stability criterion – Assessment of relative stability using Nyquist criterion.

UNIT V	COMPENSATOR AND CONTROLLER DESIGN	6	3	0	9

Need for compensation – Types of compensators – Electric network realization and frequency characteristics of basic compensators: Lag, lead and lag-lead compensators – Design of compensators using root locus and Bode plot techniques-PID controller: Design using reaction curve and Ziegler - Nichols technique.

Total (30L+15T) = 45 Periods

Text Books:

1.	A. Anand Kumar, "Control Systems", PHI Learning Pvt. Ltd., New Delhi, 2nd Edition, 2017.
2.	I.J. Nagrath, and M. Gopal, "Control Systems Engineering", New Age International Publishers, Delhi, 7th Edition, 2021.

Reference Books:

1.	K. Ogata, "Modern Control Engineering", Pearson Education, New Delhi, 5th Edition, 2021.
2.	M. Gopal, "Control Systems: Principles and Design", TMH, New Delhi, 4th Edition, 2018.

E-Reference

1.	https://nptel.ac.in/courses/107106081
2.	https://nptel.ac.in/courses/108106098

Course Outcomes: Upon completion of this course, the students will be able to:	**Bloom's Taxonomy Mapped**

CO1	:	Develop the transfer function models of any electrical and electro-mechanical systems.	L2: Understanding
CO2	:	Obtain the time responses of the systems and construct root locus plot.	L3: Applying
CO3	:	Analyze the frequency response of the system	L3: Applying
CO4	:	Analyze the absolute / relative stability of a control system.	L4: Analyzing
CO5	:	Design the compensators and PID controller of a feedback control system.	L3: Applying

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	2	2							1	3	2	1
CO2	3	3	3	2	2							1	3	2	1
CO3	3	3	3	2	2							1	3	2	1
CO4	3	3	3	2	2							1	3	2	1
CO5	3	3	3	2	2							1	3	2	1
Avg	**3**	**3**	**2.8**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**2**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22EEM04	MEASUREMENTS AND INSTRUMENTATION		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
Electric Circuit Analysis		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To educate the fundamental concepts and characteristics of measurement System
2.	To introduce the fundamentals of electrical and electronic instruments for measurement of Electrical and Non-electrical quantities
3.	To familiarize Oscilloscope and the bridge circuits for electrical parameters measurement

UNIT I	INTRODUCTION	9	0	0	9

Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement. Measurement of voltage and current - permanent magnet moving coil and moving iron type meters

UNIT II	MEASUREMENT OF POWER , ENERGY AND FREQUENCY	9	0	0	9

Measurement of power - single and three phase- electrodynamometer type watt meters – Construction, operation – torque equation for deflection – errors. Measurement of energy-Single phase induction type energy meters, Instrument transformers – Current and Potential transformers, Power factor meters- Single phase electrodynamometer type power factor meter, frequency meter-Electrical resonance type frequency meter

UNIT III	DC AND AC BRIDGES	9	0	0	9

Balance equations - Wheatstone bridge – Kelvin double Bridge –Maxwell's inductance capacitance bridge – Hay's bridge – Anderson's bridge – Schering bridge and De Sauty's bridge

UNIT IV	POTENTIOMETERS, OSCILLOSCOPES AND DIGITAL INSTRUMENTS	9	0	0	9

DC Potentiometer- Crompton's Potentiometer, AC potentiometer– Drysdale polar potentiometer- Gall Tinsley co-ordinate type potentiometer, Cathode Ray Oscilloscope and Digital storage Oscilloscope-Construction, operation and Applications, Digital multi-meters, Digital voltmeters.

UNIT V	MEASUREMENT OF NON-ELECTRICAL QUANTITIES	9	0	0	9

Classification of transducers –Position transducers, Piezo-electric transducers and Hall effect transducers. Measurement of pressure, temperature and displacement– Introduction to Smart Sensors

Total (45L+0T)= 45 Periods

Text Books:

1.	A.K. Sawhney, 'A Course in Electrical & Electronics Measurement & Instrumentation', Dhanpat Rai and Co, 2015
2.	E.O. Doebelin, 'Measurements Systems- Application and Design', Tata McGraw Hill publishing company, 2015.

Reference Books:

1.	D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt. Ltd, 2010.
2.	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, 2015.
3.	Martin Reissland, ' Electrical Measurements', New Age International(P) Ltd., Delhi, 2011.

E-Reference:

1	https://archive.nptel.ac.in/courses/108/105/108105153/

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Recall the fundamentals of measurement system in electrical engineering.	L1: Remembering
CO2	:	Describe the working principle of different measuring instruments	L2: Understanding
CO3	:	Choose appropriate instrument for measuring the electrical parameters	L3: Applying
CO4	:	Employ the digital instruments in real time measurements.	L3: Applying
CO5	:	Select an appropriate transducer for measurement of non-electrical quantities	L4: Analysing

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	2	2	3				1		2		2	2	1	1
CO2	1	3			3					2		1	2	1	
CO3	1	1		2	1	1	2		1				1	2	1
CO4	1	1		1	1		2	2	1		2	2	1	3	1
CO5	2	2	3	1	2	2	1			1	3		1	2	
Avg	**1.4**	**1.8**	**2.5**	**1.75**	**1.75**	**1.5**	**1.67**	**1.5**	**1**	**1.67**	**2.5**	**1.67**	**1.4**	**1.8**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

22EEM05	ELECTRICAL MACHINES		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To impart knowledge on construction, working and performance of DC generators and motors.
2.	To deliberate the construction, working and performance of single phase and three phase transformers.
3.	To impart knowledge on construction, working and performance of synchronous generators and motors.
4.	To impart knowledge on construction, principle of operation and performance of single and three-phase induction motors.

UNIT I	DC GENERATORS	9	0	0	9

Principle of operation, constructional details, types - EMF equation, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, Open circuit and load characteristics of different types of DC Generators. Parallel operation of DC Generators, applications of DC Generators.

UNIT II	DC MOTORS	9	0	0	9

Principle of operation, significance of back emf, torque equation and power developed by armature, load characteristics of shunt, series and compound type motors, starting methods, speed control methods - losses and efficiency calculation, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne's test, Hopkinson's test, Retardation test, Separation of core losses - applications of DC motors.

UNIT III	TRANSFORMER	9	0	0	9

Single phase transformer: Construction and principle of operation, working of practical transformer - equivalent circuit, voltage regulation, losses and efficiency- testing : polarity test, open circuit and short circuit tests, back-to back test, all day efficiency, parallel operation, applications.
Autotransformer: Construction and working, saving of copper - applications, **Three phase transformer**: construction, types of connections and their comparative features.

UNIT IV	SYNCHRONOUS GENERATOR AND MOTOR	9	0	0	9

Synchronous Generator: Constructional and working details – Types of rotors – EMF equation – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus - Synchronizing and parallel operation – Synchronizing torque - Voltage regulation – EMF, MMF and ZPF method – steady state power angle characteristics – Two reaction theory – slip test.

Synchronous Motor: Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power Developed -Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT V	THREE PHASE AND SINGLE PHASE INDUCTION MOTOR	9	0	0	9

Three phase induction motor: Constructional details – Types of rotors –- Principle of operation – Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Starters: DOL, Autotransformer and Star delta starters – Speed control methods: Voltage control, Frequency control and pole changing – V/f control – Slip power recovery Scheme.

Single phase induction motor: Constructional details – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – split phase, Capacitor-start, capacitor start and capacitor run Induction motor.

Total (45L+0T)= 45 Periods

Text Books:

1.	I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 5th Edition, 2017.

2.	P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.
3.	B.L.Theraja and A.K.Theraja," A text book of Electrical Technology - Volume-II", S.Chand & Company Ltd., New Delhi, 23rd Edition, 2009.
Reference Books:	
1.	B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.
2.	Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, First edition, 2010.
3.	A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education, 2017.
4.	Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Explain the construction and working principle of DC machines, and Interpret various characteristics of DC machines.	L2: Understanding
CO2	:	Compute various performance parameters of the machine, by conducting suitable tests.	L5: Evaluating
CO3	:	Describe the working principle of transformer, auto transformer, three phase transformer connection, and determine the efficiency and regulation.	L3: Applying
CO4	:	Understand the construction and working principle of Synchronous Machines.	L3: Applying
CO5	:	Understand the construction and working principle, speed control of three phase and single phase induction motor.	L5: Evaluating

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	1	1	1			1				1	3	2	1
CO2	3	3	1	1	1			1				1	3	2	1
CO3	3	3	1	1	1			1				1	3	2	1
CO4	3	3	1	1	1			1				1	3	2	1
CO5	3	3	1	1	1			1				1	3	2	1
Avg.	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**2**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22EEM06	ELECTRICAL DRIVES AND CONTROL		SEMESTER			
PREREQUISTIES		CATEGORY	PE	Credit		3
DC Machines and Transformers, Synchronous and Induction Machines, and Power Electronics		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To know about the operation analyse of chopper fed DC drive, both qualitatively and quantitatively.
2.	To understand the operation and performance of AC motor drives.

UNIT I	DC MOTOR CHARACTERISTICS & CHOPPER FED DC DRIVES	9	0	0	9

Review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed. Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper.

UNIT II	MULTI-QUADRANT & CLOSED-LOOP CONTROL OF DC DRIVE	9	0	0	9

Review of Four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, current controller specification and design, speed controller specification and design.

UNIT III	INDUCTION MOTOR CHARACTERISTICS	9	0	0	9

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency. Review of three-phase voltage source inverter, generation of three-phase PWM signals, constant V/f control of induction motor

UNIT IV	CONTROL OF SLIP RING INDUCTION MOTOR	9	0	0	9

Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery. .

UNIT V	CONTROL OF SRM AND BLDC MOTOR DRIVES.	9	0	0	9

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine - Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlledd Brushless dc motor drive

Total (45L+0T)= 45 Periods

Text Books:

1.	G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2.	R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall,2010
3.	Bose B K, "Modern Power Electronics and AC Drives", Pearson Education New Delhi, 2010.

Reference Books:

1.	G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2012.
2.	W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

E-Reference

1	https://www.iith.ac.in/~ketan/drives.htmL

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand the characteristics of dc motors and induction motors.	L2: Understanding
CO2	:	Summarize the operation of chopper fed DC drives.	L4: Analyzing
CO3	:	Understand the principles of speed-control of dc motors and induction motors.	L2: Understanding
CO4	:	Identify suitable power electronic converters used for dc motor and induction motor speed control.	L3: Applying
CO5	:	Analyze the SRM and BLDC motor drive control	L4: Analyzing

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	1	3			1	1					1	3	2	
CO2	3	3	1	3		1	1					1	3	2	
CO3	3	3	3	3	1	1	1					1	3	2	
CO4	1	3	3	2	1	1	1					1	3	2	
CO5	3	3	3	3	1	1	1					1	3	2	
Avg.	**2.6**	**2.6**	**2.6**	**2.75**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**3**	**2**	**-**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22EEM07	ELECTRIC VEHICLES AND CONTROL		SEMESTER				
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**	
Electrical drives and control		**Hours/Week**	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives:

1.	To provide knowledge on electric vehicle architecture and its configurations
2.	To impart knowledge on vehicle control, use of energy storage systems and energy management in Electric Vehicle

UNIT I	**ELECTRIC VEHICLES**	**9**	**0**	**0**	**9**

Configurations of Electric Vehicles (EV), Performance of Electric Vehicles, Tractive Effort in Normal Driving and Energy Consumption, Hybrid Electric Vehicles (HEV): Classification, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains

UNIT II	**PLUG-IN HYBRID ELECTRICVEHICLES (PHEV) AND FUEL CELL ELECTRIC VEHICLES**	**9**	**0**	**0**	**9**

Functions and Benefits of PHEV, Components of PHEVs, Operating Principles of Plug-in Hybrid Vehicle, Control Strategy of PHEV, Fuel Cell: Operation and Types, Fuel Cell Electric Vehicle: Configuration and Control Strategy

UNIT III	**ELECTRIC PROPULSION SYSTEMS**	**9**	**0**	**0**	**9**

Typical electric propulsion system, Classification of electric motor drives for EV and HEV, Multiquadrant Control of Chopper-Fed DC Motor Drives, Vector Control of Induction Motor drives, Permanent Magnetic Brush-Less DC Motor Drives, Switched Reluctance Motor Drives for Electric Vehicles

UNIT IV	**ENERGY STORAGE SYSTEM**	**9**	**0**	**0**	**9**

Status of Battery Systems for Automotive Applications, Battery Technologies: Nickel–Metal Hydride (Ni–MH) Battery, Lithium–Polymer (Li–P) Battery, Lithium-Ion (Li-Ion) Battery, Ultracapacitors: Features, operation and performance, Ultrahigh-Speed Flywheels, Hybridization of Energy Storages

UNIT V	**ENERGY MANAGEMENT SYSTEM**	**9**	**0**	**0**	**9**

Energy Management System(EMS) in Electric Vehicle, Rule-based control strategy: Deterministic rule-based control, Fuzzy logic-based control, and Neural network-based control. Optimization based control strategy: Dynamic Programming, Metaheuristic optimization methods and Model predictive control, Semi-active type Hybrid Energy Storage System-based EMS, Fully-active type Hybrid Energy Storage System-based EMS

Total (45L+0T)= 45 Periods

Text Books:

1.	Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, Taylor & Francis Group, Second Edition ,2011.
2.	Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, AliEmadi,, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles” CRC Press, 2016

Reference Books:

1.	Ali Emadi, Mehrdad Ehsani, John M.Miller ,“Vehicular Electric Power Systems”, Ali Emadi, Mehrdad Ehsani, John M.Miller, Special Indian Edition, Marcel dekker, Inc 2010

E-Reference:

1	https://archive.nptel.ac.in/courses/108/106/108106170/

Course Outcomes: Upon completion of the course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Recall the fundamentals of electric vehicle and its mechanics	L1: Remembering
CO2	:	Explain the architecture of different forms of hybrid electric vehicles.	L2: Understanding

CO3	:	Illustrate the four-quadrant operation of DC drive, induction motor drive and SRM drive for Electric Vehicles.	L4: Analyzing
CO4	:	Select an appropriate energy storage system for Electric vehicle	L4: Analyzing
CO5	:	Use the suitable energy management control strategy for hybrid electric vehicle	L3: Applying

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1		1	3	1		1					1	1	2	1
CO2	1	2	3	1			2					2	1	2	
CO3	1	1			2		3						1	1	1
CO4	3	1	2	1	2		1					2	1	2	1
CO5	1	2	1	2	1							1	1	2	1
Avg	**1.4**	**1.5**	**1.75**	**1.75**	**1.5**	**-**	**1.75**	**-**	**-**	**-**	**-**	**1.5**	**1**	**1.8**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22EEM08	ELECTRICAL ENERGY CONSERVATION AND AUDITING			SEMESTER			
PREREQUISITES			**CATEGORY**	**PE**	**Credit**		**3**
Power Generation, Transmission and Distribution System			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To get knowledge about basics of energy and energy scenario of India.
2.	To familiarise the energy conservation methods.
3.	To acquire knowledge on energy auditing, energy efficiency and modern energy efficient devices.

UNIT I	ENERGY SCENARIO	9	0	0	9

Commercial and non-commercial energy -Primary energy resources - Commercial energy production - Final energy consumption - Energy needs of growing economy - Long term energy scenario - Energy pricing - Energy sector reforms - Energy and environment - Energy security - Energy conservation and its importance - Restructuring of the energy supply sector - Energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT II	BASICS OF ENERGY	9	0	0	9

Electricity tariff - Load management and maximum demand control - Thermal Basics-fuels - Thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT III	ENERGY MANAGEMENT AND AUDIT	9	0	0	9

Definition - Energy audit – Need and types of energy audit. Energy management (audit) approach understanding energy costs - Bench marking - Energy performance - Matching energy use to requirement - Maximizing system efficiencies - Optimizing the input energy requirements, fuel and energy substitution - Energy audit instruments. Material and energy balance: Facility as an energy system - Methods for preparing process flow, material and energy balance diagrams.

UNIT IV	ENERGY EFFICIENCY	9	0	0	9

Electrical system: Electricity billing - Electrical load management and maximum demand control -Power factor improvement and its benefit - Selection and location of capacitors - Performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types - Losses in induction motors - Motor efficiency - Factors affecting motor performance - Rewinding and motor replacement issues - Energy saving opportunities with energy efficient motors.

UNIT V	ENERGY EFFICIENT TECHNOLOGIES	9	0	0	9

Maximum demand controllers - Automatic power factor controllers - Energy efficient motors –Soft starters with energy saver - Variable speed drives - Energy efficient transformers - Electronic ballast - Occupancy sensors - Energy efficient lighting controls - Energy saving potential of each technology.

Total (45 L+ 0 T) = 45 Periods

Text Books:

1.	Sonal Desai, “Handbook of Energy Audit”, McGraw Hill, 2015.
2,	Tripathy, S. C, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
3.	Hossam A Gabbar, “Energy Conservation in Infrastructure Systems”, Wiley-IEEE Press, New Jersey, 2018

Reference Books:

1.	General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency, New Delhi, 2015.
2,	Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency, New Delhi, 2015.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the present energy scenario and future energy strategy.	L1: Understanding
CO2	Recognize the various forms of energy.	L1: Understanding
CO3	Interpret energy management methods and energy auditing.	L3: Applying
CO4	Familiar in energy efficiency of electrical systems.	L4: Analysing
CO5	Familiar with the advanced energy efficient technologies.	L4: Analysing

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1	2	3	2	2		3					1	2	2	1
CO2	1	2	2	2	2		3					1	2	2	1
CO3	2	2	2	3	2		3					1	1	3	1
CO4	2	3	2	2	3		3					1	3	3	1
CO5	2	2	3	1	2		3					1	3	2	1
Avg	**1.6**	**2.2**	**2.4**	**2**	**2.2**	**-**	**3**	**-**	**-**	**-**	**-**	**1**	**2.2**	**2.4**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

<table>
<tr><td>22EEM09</td><td colspan="3">SMPS AND UPS</td><td colspan="3">SEMESTER</td><td></td></tr>
<tr><td colspan="3">PREREQUISITES</td><td>CATEGORY</td><td>PE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="3" rowspan="2">Power Electronics</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
<tr><td>1.</td><td colspan="7">To impart knowledge about modern power electronic converters and their applications in power utility.</td></tr>
<tr><td>2.</td><td colspan="7">To impart knowledge about Resonant converters and UPS.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>UNIT I</td><td colspan="3">DC-DC CONVERTERS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Introduction to SMPS – Non-isolated DC-DC converters: Cuk, SEPIC topologies, Z-source converter – Zeta converter - Analysis and state space modeling –- Concept of volt-second and charge balance – High gain input-parallel output-series DC-DC converter.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>UNIT II</td><td colspan="3">SWITCHED MODE POWER CONVERTERS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Isolated DC-DC converters: Analysis and state space modelling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters- control circuits and PWM techniques – Bidirectional DC-DC converters.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>UNIT III</td><td colspan="3">RESONANT CONVERTERS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>UNIT IV</td><td colspan="3">DC-AC CONVERTERS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Introduction – Multilevel concept – Types of multilevel inverters – Diode-clamped MLI – Flying capacitors MLI – Cascaded MLI – Cascaded MLI – Applications – Switching device currents – DC link capacitor voltage balancing – Features of MLI – Comparisons of MLI.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>UNIT V</td><td colspan="3">POWER CONDITIONERS, UPS, AND FILTERS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for power electronic applications – Selection of capacitors.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8" align="right">Total (45L+0T)= 45 Periods</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Text Books:</td></tr>
<tr><td>1.</td><td colspan="7">Simon Ang, Alejandro Oliva,” Power-Switching Converters”, Third Edition, CRC Press, 2010.</td></tr>
<tr><td>2.</td><td colspan="7">M.H. Rashid – Power Electronics handbook, Elsevier Publication, 2001.</td></tr>
<tr><td colspan="8">Reference Books:</td></tr>
<tr><td>1.</td><td colspan="7">Ned Mohan, Tore.M.Undeland, William.P.Robbins, “Power Electronics Converters, Applications and Design”, 3rd Edition, John Wiley and Sons, 2006.</td></tr>
<tr><td>2.</td><td colspan="7">M.H. Rashid, “Power Electronics circuits, devices and applications”, 3rd Edition, PHI, New Delhi, 2007.</td></tr>
<tr><td colspan="8">E-References:</td></tr>
<tr><td>1.</td><td colspan="7">NPTEL Course: Power Electronics, IIT-B.</td></tr>
<tr><td>2.</td><td colspan="7">www.cdeep.iitb.ac.in. (Electrical Engineering)</td></tr>
</table>

Course Outcomes: Upon completion of this course, the students will be able to:			Bloom's Taxonomy Mapped
CO1	:	Analyze the state space model for DC – DC converters.	L4: Analyzing
CO2	:	Acquire knowledge on switched mode power converters.	L2: Understanding
CO3	:	Outline the PWM techniques for DC-AC converters.	L1: Remembering
CO4	:	Discuss about modern power electronic converters and its applications in electric power utility.	L2: Understanding
CO5	:	Identify the filters and UPS.	L2: Understanding

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1	2	2			1					2	2	2	1
CO2	1	1	3	2			1					2	3	3	2
CO3	2	2	2	3			1					1	2	2	1
CO4	2	1	1	2			1					2	2	3	2
CO5	1	1	2	1			1					1	2	2	1
Avg.	**1.6**	**1.2**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1.6**	**2.2**	**2.4**	**1.4**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22EEM10	UTILIZATION OF ELECTRICAL ENERGY			SEMESTER			
PREREQUISITES			**CATEGORY**	**PE**	**Credit**		**3**
Electrical Machines, Power System, and Power Electronics			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To understand the economics of power generation, tariff and energy conservation methods.
2.	To impart knowledge on principle and design of illumination systems.
3.	To analyze the performance and different methods of electric heating and electric welding.
4.	To impart knowledge on electric traction systems and their performance.
5.	To understand electric drives for various industrial applications.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Economics of generation – definitions – load duration curve – number and size of generator units – Cost of electrical energy – tariff –– availability based Tariff- (ABT) – Battery Energy storage system (BESS)- Frequency based energy measurement - need for electrical energy conservation – methods.- Introduction to energy audit

UNIT II	**ILLUMINATION**	**9**	**0**	**0**	**9**

Introduction-nature of radiation – definition – laws of illumination – luminous efficacy-photometry – lighting calculations – design of illumination systems for residential, commercial, street lighting and sports ground– types of lamps –incandescent lamp- mercury vapour –fluorescent lamp-energy efficiency lamps – types of lighting schemes – requirements of good lighting

UNIT III	**HEATING AND WELDING**	**9**	**0**	**0**	**9**

Introduction- classification of methods of heating – requirements of a good heating material – design of heating element – temperature control of resistance furnace – electric arc furnace –induction heating – dielectric heating – electric welding – resistance welding – electric arc welding-electrical properties of arc-applications of electric arc welding.

UNIT IV	**ELECTRIC TRACTION**	**9**	**0**	**0**	**9**

Introduction – requirements of an ideal traction system – supply systems – train movement -mechanism of train movement – traction motors and control –speed control of three phase induction motor- multiple unit control – braking – recent trends in electric traction.

UNIT V	**DRIVES AND THEIR INDUSTRIAL APPLICATIONS**	**9**	**0**	**0**	**9**

Electric drive –advantages of electric drive-individual drive and group drive –factors affecting selection of motor – types of loads – steady state –transient characteristics –size of motor– load equalization – industrial applications – modern methods of speed control of D.C drives-dynamic braking using thyristors-regenerative braking using thyristors.

Total (45L+0T)= 45 Periods

Text Books:

1.	C.L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt.Ltd, 2003.
2.	Eric Openshaw Taylor, “Utilisation of Electric Energy”, English Universities Press Limited, 1937
3.	J.B. Gupta, “Utilization of Electric Power and Electric Traction”, S.K.Kataria and Sons, 2002.

Reference Books:

1.	G.C.Garg, S.K.Gridhar&S.M.Dhir, “A Course in Utilization of Electrical Energy”, Khanna Publishers, Delhi, 2003.
2.	H. Partab, “Art and Science of Utilization of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.

E-References:

1.	www.onlinecourses.nptel.ac.in
2.	www.class-central.com
3.	www.mooc-list.com

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand the economics of power generation, tariff and energy conservation methods.	L2: Understanding
CO2	:	Interpret the concept behind illumination and design a suitable illumination system for a specific application.	L3: Applying
CO3	:	Design and choose an appropriate heating method for specific application and gain knowledge about electric welding system.	L4: Analyzing
CO4	:	Explain the concepts and recent trends of traction system.	L4: Analyzing
CO5	:	Discuss the concepts of electric drives and their characteristics.	L2: Understanding

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	1	1	1	1	2	1	2	2	1	1	1	2	2	3
CO2	2	3	2	3	1	1	2	1	1			1	3	3	2
CO3	3	3	1	3	1	1	2	1					2	2	3
CO4	1	2	2	3	3	1	2	1					2	3	2
CO5	3	1	1	2	1	1	2	1		1		1	2	2	3
CO6	1	3	3	3	3	1	2	2				1	3	3	2
Avg	**2.17**	**2.17**	**1.67**	**2.5**	**1.67**	**1.17**	**1.83**	**1.33**	**1.5**	**1**	**1**	**1**	**2.33**	**2.5**	**2.5**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22MEM01	**ENGINEERING THERMODYNAMICS** *(Use of standard thermodynamic tables, Mollier diagram are permitted)*				
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:	
1.	To impart the knowledge on concepts of zeroth and first law of thermodynamics.
2.	To make the learners to understand the third law of thermodynamics and analyze the various work and heat interactions in closed and open systems.
3.	To teach properties of pure substance.
4.	To impart knowledge on the concepts of steam power cycle.
5.	To derive thermodynamic relations for ideal and real gases.

UNIT I	**BASIC CONCEPT AND FIRST LAW**	**9**	**0**	**0**	**9**

Role of Thermodynamics in Engineering and Science - Applications of Thermodynamics. Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems, Property, state, path and processes, quasi-static process, Thermodynamic equilibrium, Displacement work, P-V diagram. Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics – application to closed and open systems, steady flow processes with reference to various thermal equipment.

UNIT II	**SECOND LAW AND ENTROPY**	**9**	**0**	**0**	**9**

Heat engine – Refrigerator – Heat Pump, Second law of thermodynamics – Kelvin's and Clausius statements- Equivalence of these statements their corollaries. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle. Clausius inequality, Concept of entropy, principle of increase of entropy, T-s diagram, T-ds equations, Entropy.

UNIT III	**PROPERTIES OF PURE SUBSTANCES**	**9**	**0**	**0**	**9**

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT IV	**STEAM POWER CYCLE**	**9**	**0**	**0**	**9**

Basic Rankine cycle, T-s & h-s diagrams - Performance Improvement - Reheat cycle, regenerative cycle and their combination cycles.

UNIT V	**IDEAL AND REAL GASES AND THERMO DYNAMIC RELATIONS**	**9**	**0**	**0**	**9**

Properties of ideal and real gases, equation of state of ideal and real gases, Avogadro's law, Vander Waal's equation of states, Principle of corresponding states, reduced properties and compressibility chart. Exact differentials, Maxwell relations, Specific heat equations, Tds, relations, Clausius Clapeyron equations and Joule Thomson Coefficient.

Total (45L)= 45 Periods

Text Books:	
1.	Nag. P.K, "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2017.
2.	Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., Fundamentals of Thermodynamics, 6th ed., John Wiley, 2003.
3.	Arora C.P, "Thermodynamics", Tata McGraw Hill, New Delhi, 2003.
4.	Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987.

Reference Books:	
1.	Cengel, "Thermodynamics- An Engineering Approach", 3rd Edition, Tata McGraw Hill, 2015.
2.	Merala C, Pother, Craig W and Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGrawHill, New Delhi, 2004.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom Taxonomy Mapped**
CO1	Understand the concepts of zeroth, first and second law of thermodynamics.	Remember
CO2	Analyze the various work and heat interactions for different types of processes for closed and open systems	Evaluate
CO3	Evaluate the different properties of pure substances using steam tables and Mollier chart	Evaluate
CO4	Analyze the performance of steam power cycle.	Analyze
CO5	Derive thermodynamic relations for ideal and real gases.	Analyze

COURSE ARTICULATION MATRIX															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2			1					1	3	1	1
CO2	3	3	2	2			1					1	3	1	1
CO3	3	3	3	2		1	1					1	3	1	1
CO4	2	3	2	2		1	1					1	3	1	1
CO5	3	3	2	2		1						1	3	1	1
Avg	**2.8**	**3**	**2.2**	**2**		**1**	**1**					**1**	**3**	**1**	**1**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)															

22MEM02	FLUID MECHANICS AND MACHINERY					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
1.Engineering Physics 2.Engineering Chemistry 3.Engineering Mathematics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the basic concepts and properties of fluids.
2.	To analyze the kinematic and dynamic concepts of fluid flow.
3.	To understand the various incompressible fluid flow through pipes and between parallel plates.
4.	To apply the principles of fluid mechanics to design and operation of hydraulic turbines.
5.	To apply the principles of fluid mechanics to design and operation of hydraulic pumps.

UNIT I	**INTRODUCTION AND FLUID STATICS**	**9**	**0**	**0**	**9**

Basic concepts and units of measurement of physical quantities- Classification of fluids - Properties of fluids – density, relative density, vapour pressure, surface tension, Capillarity and viscosity. Fluid statics- hydrostatic pressure, buoyancy and Archimedes' principle.

UNIT II	**FLUID KINEMATICS AND DYNAMICS**	**9**	**0**	**0**	**9**

Classification of fluid flow - system and control volume - Lagrangian and Eulerian description for fluid flow - flow patterns-streamline, pathline, streakline and timeline. Velocity potential function and Stream function - continuity equation and its applications. Fluid dynamics - Bernoulli's equation and its applications. Dimensional analysis – Buckingham's theorem, dimensional homogeneity, similarity-laws and models.

UNIT III	**FLOW THROUGH PIPES AND PLATES**	**9**	**0**	**0**	**9**

Incompressible fluid flow-Laminar flow- Hagen-Poiseuille equation, shear stress, pressure gradient relationship - flow through pipes and flow between parallel plates. Turbulent flow – flow through pipes, friction factors in turbulent flow - total energy line, hydraulic gradient line, flow through pipes in series and parallel- Moody's friction factor chart. Power transmission-Boundary layer flows - Boundary layer thickness, momentum thickness, energy thickness-boundary layer separation.

UNIT IV	**HYDRAULIC TURBINES**	**9**	**0**	**0**	**9**

Hydraulic turbines classification-impulse and reaction turbines-Working Principle, work done-efficiency and performance curves for Pelton, Francis and Kaplan turbines (Only descriptive) - Comparison between impulse and reaction turbine-specific speed degree of reaction -draft tubes.

UNIT V	**HYDRAULIC PUMPS**	**9**	**0**	**0**	**9**

Classification of hydraulic pumps- Centrifugal pumps - working principle, specific speed, performance curves and priming(Only descriptive) - Reciprocating pumps - classification, working principle, indicator diagram, air vessels and performance curves. Cavitation in pumps (Only descriptive) - Working principles of gear and vane pumps.

Total (45L)= 45 Periods

Text Books:

1.	Bansal, R.K., "A Textbook of Fluid Mechanics and Hydraulic Machines, 9th Ed", Laxmi Publication Pvt Ltd, 2010.
2.	Rajput, R.K., "A Textbook of Fluid Mechanics and Hydraulic Mechanics", S.Chand and Company Ltd, 2011.
3.	Subramanya. K., "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Company Ltd, 2011.

Reference Books:

1.	White, "Fluid Mechanics, 8 Ed", McGraw Hill India, 2017.
2.	Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics 8 th Edition", Wiley, 2016.
3.	Yunuscengel, John. M.cimbala, "Fluid Mechanics Fundamentals and Applications", McGraw Hill, 2017.

4.	Som, S.K, Biswas.G and SumanChakraborty, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill India, 2011.
5.	Dr.P.N.Modi, Dr.S.M.Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard book house, 2018.
E-References:	
1.	NPTEL courses: http://nptel.iitm.ac.in/courses.php - web and video sources on fluid mechanics.

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Understand the basic concepts and properties of fluids.	Remember
CO2	Analyze the kinematic and dynamic concepts of fluid flow.	Analyze
CO3	Understand the various incompressible fluid flow through pipes and between parallel plates.	Understand
CO4	Apply the principles of fluid mechanics to design and operation of hydraulic turbines.	Apply
CO5	Apply the principles of fluid mechanics to design and operation of hydraulic pumps.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1				2				1		2	2	1
CO2	3	3	1		2								2	2	1
CO3	2	3	2	2	1								2	2	1
CO4	3	3	3	2	1	2	1						2	2	1
CO5	3	3	3	2	1	2	1						2	2	1
Avg	**2.8**	**2.6**	**2**	**2**	**1.25**	**2**	**1.3**				**1**		**2**	**2**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEM03	MANUFACTURING PROCESSES					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
1. Basic science, Engineering mathematics, Engineering Physics 2. Engineering Materials		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To make the students familiarize with various manufacturing processes and fabrication techniques of metals and design of casting.
2.	To develop design concepts of various manufacturing processes.
3.	Gain knowledge to select appropriate manufacturing processes for various parts.
4.	To develop an entrepreneur skill among the students.
5.	To evaluate and select plastic deformation processes for various parts.

UNIT I	**CASTING**	**9**	**0**	**0**	**9**

Concepts of Manufacturing Process -Sand casting -Patterns – Design of Pattern, mould and cores- gating and risering design, solidification time calculation - Moulding machines - Core making. Special moulding processes – CO2 moulding; shell moulding, investment moulding, pressure die casting, centrifugal casting, casting defects.

UNIT II	**WELDING**	**9**	**0**	**0**	**9**

Classification of welding processes. Principles of Oxy-acetylene gas welding. Metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, Soldering and Brazing, Adhesive Bonding.

UNIT III	**METAL FORMING**	**10**	**0**	**0**	**10**

Metallurgical aspects of metal forming, slip, twinning mechanics of plastic deformation, load estimation of bulk deformation processes, Hot working and cold working of metals, Forging processes – open, closed and impression die forging – forging operations. Rolling of metals– Types of Rolling mill – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types.

UNIT IV	**SHAPING OF PLASTICS**	**8**	**0**	**0**	**8**

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding.

UNIT V	**SHEET METAL FORMING AND POWDER METALLURGY**	**9**	**0**	**0**	**9**

Formability of Sheet Metal, load estimation of sheet metal processes - Shearing, Deep drawing, Bending operations- types of presses used, Super Plastic forming; Introduction to Powder Metallurgy– Principal steps involved – sintering and compacting techniques, Advantages, limitations and applications of powder metallurgy.

Total (45L) = 45 Periods

Text Books:

1.	HajraChoudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2.	NagendraParashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2007.

Reference Books:

1.	Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", 4/e, Pearson Education, Inc. 2007.
2.	Jain. R.K., and S.C. Gupta, "Production Technology", 16th Edition, Khanna Publishers, 2001.

3.	"H.M.T. "Production Technology – Handbook", Tata McGraw-Hill, 2000.
4.	Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2000.
5.	Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
E-References:	
1.	https://fdocuments.in/document/production-technology-55844cac00bfc.html?page=40

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Describe the operational features of various casting processes, design gate and riser and discover various defects in casting.	Understand
CO2	Explain various metal joining processes and compare them.	Understand
CO3	Summarize several types of metal forming processes and select suitable method for different applications.	Analyze
CO4	Analyze various manufacturing methods for plastics and their needs in industry.	Analyze
CO5	Describe various sheet metal forming processes, load estimation calculation and principles of powder metallurgy	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1						1			1	2	1
CO2	2	1	2	1		1			1	1			1	2	1
CO3	1	1	1	1						1			1	1	1
CO4	1	1	1		1					1			1	1	1
CO5		1							1	1			1		1
Avg	**1.5**	**1**	**1.5**	**1**	**1**	**1**			**1**	**1**			**1**	**1.5**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEM04	MATERIALS ENGINEERING					
PRE-REQUISITE:		CATEGORY	PE	Credit		3
1. Engineering Physics 2. Engineering Chemistry		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To impart concept on reactions, treatment, microstructure and mechanical behavior of engineering materials at different temperature.
2.	To learn basic principles in metallurgy and materials engineering.
3.	To identity and select suitable engineering materials based on their applications.

UNIT I	PHASE DIAGRAMS	9	0	0	9

Crystal structures, Phases, solid solution types, compounds, Hume- Rothery rules; Gibb’s phase rule; Binary isomorphous alloy systems – Eutectic, Eutectoid, Peritectic systems. Lever rule, Equilibrium and non-equilibrium cooling, Fe-C Equilibrium diagram - effects of alloying elements – Ferrite and Austenite Stabilizers, TTT and CCT diagrams.

UNIT II	HEAT TREATMENT	9	0	0	9

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbo-nitriding – Flame and Induction hardening. Heat treatment of non-ferrous alloys - precipitation hardening. Heat treatment of HSS tools, gears, springs and gauges.

UNIT III	FERROUS AND NON FERROUS METALS	9	0	0	9

Plain carbon steels – Tool steels - maraging steels – HSLA steels .Stainless steels- ferritic and Austenitic, martensitic, duplex and precipitation hardened stainless steels. Types of Cast Irons- Gray cast iron, white cast iron, malleable cast iron, S.G.Iron. Copper alloys – Brass, Bronze and Cupronickel, Aluminium alloys, Bearing alloys.

UNIT IV	MECHANICAL PROPERTIES AND TESTING	9	0	0	9

Mechanical properties of engineering materials - Mechanisms of plastic deformation, slip and twinning – Creep, Fatigue and Fracture - Types of fracture – Testing of materials - tension, compression and shear loads - fatigue and creep tests – hardness and its effects – testing for hardness (Brinell, Vickers and Rockwell) - Impact test - Izod and Charpy.

UNIT V	NON DESTRUCTIVE TESTING AND SURFACE ENGINEERING	9	0	0	9

Non Destructive Testing: Basic principles - Testing method - Radiographic testing, Ultrasonic testing, Magnetic Particle Inspection and Liquid Penetrant Inspections. Introduction to surface engineering - Definition, diffusion techniques, deposition methods, high and low energy beam methods, surface engineering charts, elastic contact mechanics.

Total (45L) = 45 Periods

Text Books:

1.	Kenneth G. Budinski and Michael K. Buinski, “Engineering Materials”, Prentice Hall of India Ltd, 2002.
2.	Raghavan, V, “Materials Science and Engineering”, Prentice Hall of India (P) Ltd., 1999.
3.	Aswani.K.G, “A Text Book of Material Science”, S.Chand and Co. Ltd., New Delhi, 2001.
4.	Khanna O.P., “A Text Book of Materials Science and Metallurgy”, DhanpatRai Sons, 2004.

Reference Books:

1.	William. D.Callsber, “Material Science and Engineering”, John Wiley and Sons, 1997.
2.	Sydney.H.Avner, “Introduction to Physical Metallurgy” Mc Graw Hill Book Company, 1994.

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Understand the formation of materials and their classification based on atomic structure.	Understand
CO2	Understand the principles of various heat treatment processes in fabrication industry.	Understand
CO3	Describe properties, applications and types of various ferrous and non-ferrous metals used in fabrication industry	Understand
CO4	Describe various types of failure and select methods for destructive testing	Understand
CO5	Select methods for non destructive testing	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	1	1						2	3	1
CO2	1		2	1	1	2	1						2	3	1
CO3		1	1	1	1		1						3	2	1
CO4		2	2	1	1	1	1						2	3	1
CO5		2	2	2	1		1						2	2	1
Avg	**1**	**1.5**	**1.8**	**1.4**	**1.0**	**1.3**	**1**						**2.2**	**2.6**	**1.0**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEM05	KINEMATICS OF MACHINERY						
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**	
1. Engineering graphics. 2.Engineering Mechanics		**Hours/Week**	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives:

1.	To understand the basic components and layout of linkages in the assembly of a system/ machine.
2.	To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
3.	To understand basics of cam profile and its displacement.
4.	To understand the basic concepts of toothed gearing and kinematics of gear trains.
5.	Illustrate the effects of friction drives in transmission system.

UNIT I	**BASICS OF MECHANISMS**	**9**	**0**	**0**	**9**

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider-crank chains Limit positions- Mechanical advantage - Transmission angle- Description of some common mechanisms- Quick return mechanism, straight-line generators.

UNIT II	**KINEMATIC ANALYSIS**	**9**	**0**	**0**	**9**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centres - kinematic analysis of simple mechanisms- slider-crank mechanism dynamics Coincident points- Coriolis component of acceleration introduction to linkage synthesis three Position graphical synthesis for motion and path generation.

UNIT III	**KINEMATICS OF CAM**	**9**	**0**	**0**	**9**

Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical method for cam profile design.

UNIT IV	**GEARS AND GEAR TRAINS**	**9**	**0**	**0**	**9**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference / undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

UNIT V	**FRICTION IN MACHINE ELEMENTS**	**9**	**0**	**0**	**9**

Surface contacts- sliding and rolling friction- friction drives- friction in screw threads – bearings and lubrication- friction Clutches- belt and rope drives.

Total (45L) = 45 Periods

Text Books:

1.	Rattan S.S, "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998.
2.	Ghosh, A and Mallick, A.K, "Theory of Mechanisms and Machines", East-West Pvt. Ltd., New Delhi, 1988.

Reference Books:

1.	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2.	Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
3.	Erdman AG and Sandor G N, "Mechanism Design, Analysis and Synthesis", Vol.I, PHI Inc., 1997.
4.	Ambekar A.G, "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007.
5.	John Hannah and Stephens R C, "Mechanisms of Machines", Viva Low Price Student Edition, New Delhi, 1999.

E-References:

1.	https://archive.nptel.ac.in/courses/112/104/112104121/

2.	https://nptel.ac.in/courses/112106270
3.	http://velhightech.com/Documents/ME8492 Kinematics of Machinery.pdf

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Demonstrate and understand the concepts of various mechanisms and pairs.	Apply
CO2	Analyze the velocity and acceleration of simple mechanisms.	Analyze
CO3	Construct the cam profile for various motion.	Create
CO4	Solve problems on gears and gear trains.	Evaluate
CO5	Evaluate the friction in transmission system	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1									3	1	
CO2	3	2	2	1									3	1	
CO3	3	2	2	1									3	1	
CO4	3	2	2	1									3	1	
CO5	3	2	2	1									3	1	
Avg	**3**	**2**	**2**	**1**									**3**	**1**	
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)															

22MEM06	HYDRAULICS AND PNEUMATICS						
PRE-REQUISITE:		CATEGORY	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To enable the students understand the basics of hydraulics and pneumatics
2.	Applying the working principles of hydraulic actuators and control components.
3.	Designing and develop hydraulic circuits and systems.
4.	Applying the working principles of pneumatic power system and its components.
5.	Solving problems and troubles in fluid power systems.

UNIT I	**FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS**	**9**	**0**	**0**	**9**

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque - Problems, Sources of Hydraulic power; Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems.

UNIT II	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**	**9**	**0**	**0**	**9**

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary actuators - Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories; Reservoirs, Pressure Switches – Filters – types and selection - Applications – Fluid Power ANSI Symbols – Problems.

UNIT III	**HYDRAULIC CIRCUITS AND SYSTEMS**	**9**	**0**	**0**	**9**

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double - Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail - Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits – Servo and Proportional valves – Applications - Mechanical, hydraulic servo systems.

UNIT IV	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	**9**	**0**	**0**	**9**

Properties of air – Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification - single cylinder and multi cylinder circuits - Cascade method – Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V	**DESIGN OF FLUID POWER CIRCUITS AND TROUBLESHOOTING**	**9**	**0**	**0**	**9**

Servo systems, Hydro mechanical servo systems, electro hydraulic servo systems and proportional Valves, Introduction to electro hydraulic pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits, failure and troubleshooting. Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low cost Automation – Hydraulic and Pneumatic power packs. Case studies: A simple sequence, synchronize circuits using hydraulic and pneumatics components.

Total (45L) = 45 Periods

Text Books:

1.	Manjumdar S.R, "Oil Hydraulics", Tata McGraw-Hill, December 2002.
2.	Anthony Esposito, "Fluid Power with Applications", Pearson Education 2013.

Reference Books:

1.	Andrew Parr, "Hydraulic and Pneumatics", Jaico Publications House, 2005.
2.	Bolton W. "Pneumatic and hydraulic system", Butterworth-Heinemann 1997
3.	Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 2010

4.	Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006
5.	Srinivasan.R. “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008.
E-References:	
1.	http://www.fluidpowerjournal.com
2.	http://14.139.160.15/courses/112102011/2
3.	https://www.nfpa.com/home.htm

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom’s Taxonomy Mapped**
CO1	Select the components as per the application	Evaluate
CO2	Apply the working principles of hydraulic actuators and control components.	Apply
CO3	Design and develop hydraulic circuits and systems.	Create
CO4	Apply the working principles of pneumatic power system and its components.	Apply
CO5	Solve problems and troubles in fluid power systems.	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1										1	1	1
CO2		2	2	1									1	1	1
CO3	1	2	3			1							1	2	1
CO4	1	1	3	2	2								2	1	1
CO5	1	1	2										1	1	1
Avg	**1.25**	**1.4**	**2.2**	**1.5**	**2**	**1**							**1.2**	**1.2**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEM07	DESIGN OF MACHINE ELEMENTS					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
1. Student should study engineering mechanics. 2. Student should study kinematic of machinery.		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	Understanding of background in mechanics of materials and design of machine components.
2.	An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
3.	An understanding the design of shafts and couplings.
4.	Familiarize the design of energy storing elements and engine components.
5.	An appreciation of the relationships between component level design and overall machine system design and performance

UNIT I	**STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS**	**9**	**0**	**0**	**9**

Introduction to the design process – Product development cycle- factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers– Direct, Bending and Torsional stress – Impact and shock loading – Calculation of principle stresses for various load combinations, eccentric loading – Factor of safety -theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations .

UNIT II	**DESIGN OF SHAFTS AND COUPLINGS**	**9**	**0**	**0**	**9**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways - Design of rigid and flexible couplings.

UNIT III	**DESIGN OF THREADED FASTENERS, RIVETED AND WELDED JOINTS**	**9**	**0**	**0**	**9**

Threaded fasteners - Design of bolted joints including eccentric loading – Design of riveted and welded joints for pressure vessels and structures- theory of bonded joints.

UNIT IV	**DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS**	**9**	**0**	**0**	**9**

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting rods and crank shafts.

UNIT V	**DESIGN OF BEARINGS**	**9**	**0**	**0**	**9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number - Selection of Rolling Contact bearings.

Total (45L) = 45 Periods

Text Books:

1.	Bhandari V.B, “Design of Machine Elements”, Tata McGraw Hill Book Co, 2020
2.	Md.Jalaludeen.S, “A text book of Machine Design”, Anuradha Publications, 2006

Reference Books:

1.	Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2.	Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3.	Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4.	PSG Tech, “Design Data Handbook”, M/s.DPV Printers, Coimbatore, 2009

E-References:

1.	https://nptel.ac.in/courses/112105124
2.	Design of Machine Elements - V. B. Bhandari - Google Books

3.	[A Textbook of Machine Design by R.S.Khurmi And J.K.Gupta [tortuka]_1490186411865.pdf | DocDroid]

COURSE OUTCOMES: On completion of the course the student will be able to		**Bloom's Taxonomy Mapped**
CO1	Understand the influence of steady and variable stresses in machine component design.	Understand
CO2	Apply the concepts of design to shafts, keys and couplings.	Apply
CO3	Familiarize the design of temporary and permanent joints.	Understand
CO4	Design the various energy storing elements and engine components.	Analyse
CO5	Familiarize the design of various types of bearings.	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2		1	1				1		3	2	1
CO2	2	2	1	2		1	1				1		3	2	1
CO3	2	2	1	2		1	1				1		3	2	1
CO4	2	2	1	2		1	1				1		3	2	1
CO5	2	2	1	2		1	1				1		3	2	1
Avg	**2.0**	**2.0**	**1.0**	**2.0**		**1.0**	**1.0**				**1.0**		**3.0**	**2.0**	**1.0**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEM08	HEAT AND MASS TRANSFER						
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**	
1.The laws and basic concepts of thermodynamics 2. The concept of energy transfers and their conversion principles		**Hours/Week**	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

COURSE OBJECTIVES

1.	Understanding the science behind conduction heat transfer and its applications.
2.	Differentiating the concepts of forced and natural convection heat transfer.
3.	Describing the laws and concepts of radiation heat transfer.
4.	Understanding phase change processes and analyzing heat exchangers.
5.	Studying the concept of mass transfer process and its modes.

UNIT-I	**CONDUCTION HEAT TRANSFER**	**9**	**0**	**0**	**9**

General Differential equation – Cartesian(derivation of General Differential Equation), Cylindrical (derivation of General Differential Equation) and Spherical Coordinates – One DimensionalSteady State Heat-Concepts of electrical analogy, Conduction — plane and Composite Systems – Conduction with Internal HeatGeneration., Critical thickness of insulation.

Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infiniteand Infinite Solids –Use of Heisler’s charts.

UNIT-II	**CONVECTION HEAT TRANSFER**	**9**	**0**	**0**	**9**

Conservation equations, boundary layer concept – Forced convection: external flow – flow over plates, cylinders, spheres and bank of tubes. Internal flow – entrance effects.

Free convection –flow over vertical plate, horizontal plate, inclined plate, cylinders and spheres.

UNIT-III	**BOILING, CONDENSATION AND HEAT EXCHANGERS**	**9**	**0**	**0**	**9**

Regimes of Pool boiling and Flow boiling, Nusselt’s theory of condensation- correlations in boiling and condensation. Heat Exchanger types - Overall Heat Transfer Co-efficient – Fouling Factors. LMTD and NTU methods.

UNIT-IV	**RADIATION HEAT TRANSFER**	**9**	**0**	**0**	**9**

Radiation laws - Black Body and Gray body Radiation - Shape Factor - Electrical Analogy -Radiation Shields.

UNIT-V	**MASS TRANSFER**	**9**	**0**	**0**	**9**

Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state Molecular Diffusion - Equimolal counter diffusion. Basic Convective Mass Transfer Problems.

Total(45L) = 45 Periods

TEXT BOOKS:

1	R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, 2017
2	Frank P. Incropera and David P. Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley & Sons, 7th Edition, 2014.

REFERENCE BOOKS:

1	Yunus A. Cengel, “Heat Transfer A Practical Approach” – Tata McGraw Hill, 5 th Edition - 2013
2	Holman, J.P., “Heat and Mass Transfer”, Tata McGraw Hill, 2017
3	Kothandaraman, C.P., “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 2012
4	Ozisik, M.N., “Heat Transfer”, McGraw Hill Book Co., 1994.

COURSE OUTCOMES: On completion of the course the student will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyze the mechanism of heat conduction under steady and transient conditions.	Apply
CO2	Develop solutions to problems involving convective heat transfer.	Create
CO3	Design a heat exchanger for any specific application.	Understand
CO4	Adopt the concept of radiation heat transfer in real time systems.	Understand
CO5	Develop solutions to problems involving combined heat and mass transfer.	Apply

COURSE ARTICULATION MATRIX															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2		1						3	3	1
CO2	3	3	3	3	2		1						3	3	1
CO3	3	3	3	3	2		1						3	3	1
CO4	3	3	3	3	2		1						3	2	1
CO5	2	2	2	2	1		1						3	1	
Avg	**2.8**	**2.8**	**2.8**	**2.8**	**1.8**		**1**						**3**	**2.4**	**1**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)															

22MEM09	METROLOGY AND QUALITY CONTROL					
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
		Horus/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

COURSE OBJECTIVES

1.	Explaining the importance of measurements in engineering and the factors affecting measurements and to compute measurement uncertainty
2.	Applying the applications of linear and angular measuring instruments
3.	Interpretation of various tolerance symbols.
4.	Applying the SQC methods in manufacturing.
5.	Applying the advances in measurements for quality control.

UNIT-I	**BASICS OF MEASUREMENT SYSTEM AND DEVICES**	**9**	**0**	**0**	**9**

Definition of metrology, accuracy, precision and sensitivity, Abbe‘s principle. Three stages of generalized measurement system - mechanical loading – static characteristics of instruments – factors considered in selection of instruments - commonly used terms, error analysis and classification - sources of error. Measurement uncertainty.

UNIT-II	**CALIBRATION OF INSTRUMENTS AND QUALITY STANDARDS**	**9**	**0**	**0**	**9**

Calibration of measuring instruments - principles of calibration, Calibration of Instruments - Vernier caliper, Micrometer, feeler gauges, dial indicator, surface plates, slip gauges, care of gauge blocks. General cares and rules in measurement, ISO 9000 quality standards. Comparators- mechanical, electrical, optical and pneumatic.

UNIT-III	**GEOMETRICAL MEASUREMENT AND MACHINE ELEMENTS**	**9**	**0**	**0**	**9**

Angular measurement - optical protractors, sine bar, roundness measurement, limit gauge, design of plug gauge, Taylor‘s principle, three basic types of limit gauges, Tomlinson surface meter, computer controlled CMM. ISO metric thread, measurement of major, minor and effective diameters. Gear terminology; spur gear measurement, checking of composite errors, base pitch measurement. Principle of interferometry, laser interferometer, Machine vision, Fundamental of GD&T. Inspection of straightness, flatness, roundness deviations.

UNIT-IV	**STATISTICAL QUALITY CONTROL**	**9**	**0**	**0**	**9**

Surface finish – terminology and measurements – Optical measuring instruments –Acceptance test for machines. Statistical Quality Control - Control charts - Sampling plans.

UNIT-V	**SIX SIGMA**	**9**	**0**	**0**	**9**

Six sigma: Define measure, analyse, improve and control phases. Analyze phase tools: CommonTools: Histogram, Box Plot, Control chart, Scatter chart, Cause and effect diagram, Pareto analysis, interrelations diagram. Special Tools: Regression Analysis, Hypothesis Testing, ANOVA Multi variate analysis.

Total(45L) = 45 Periods

TEXT BOOKS:

1	Gupta.I.C, ―A text book of Engineering Metrology, Dhanpat Rai publications, New Delhi, 2018
2	Beckwith.T.G, Roy D. Marangoni, John H. Lienhard, - Mechanical Measurements‖, Prentice Hall, 2006

REFERENCE BOOKS:

1	Jain.R.K, ―Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.
2	Holmen.J.P, ―Experimental Methods for Engineers‖, Tata McGraw Hill Publications Co Limited, 2017.
3	Grant, E.L., Statistical Quality Control, Mc Graw-Hill, 2004. 3. Doeblin E.O., Measurement Systems, Mc Graw-Hill, 2004.
4	Alan S Morris, ―Measurement and Instrumentation Principles, Butterworth, 2006.

5	De Feo J A and Barnard W W, ―Six Sigma: Break trough and BeyondG, Tata McGraw-Hill, New Delhi, 2005.
E-REFERENCES:	
1	https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_405_Book_2,_for_Unit_2B.pdf
2	https://www.nist.gov/system/files/documents/srm/NIST-SRM-RM-Articlefinal.pdf
3	https://www.researchgate.net/publication/319587859_Computer-Aided_Metrology-CAM

COURSE OUTCOMES: On completion of the course the student will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the importance of measurements in engineering and the factors affecting measurements and to compute measurement uncertainty.	Understand
CO2	Apply the working principle and the applications of linear and angular measuring instruments.	Apply
CO3	Interpret of various tolerance symbols.	Apply
CO4	Apply the SQC methods in manufacturing.	Apply
CO5	Apply the advances in measurements for quality control in manufacturing industries.	Apply

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1							2	1	2				2	1	
CO2							3	1	2				1	2	
CO3							2	1					2	1	
CO4				3			2		1				1	2	
CO5				2				3	1				2	1	
Avg				**2.5**			**2.25**	**1.5**	**1.5**				**1.6**	**1.4**	

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MEM10	DYNAMICS OF MACHINERY					
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Engineering Mechanics, Kinematics of Machinery, Strength of Materials		**Hours\Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

COURSE OBJECTIVES:	
1.	To impart students with the knowledge about motion, masses and forces in machines and the Principle of Virtual Work.
2.	To facilitate the students, to understand the concept of balancing of rotating and reciprocating masses.
3.	To teach concepts of free vibration analyses of one and two degree-of-freedom rigid body systems
4.	To teach concepts of forced vibrations analyses of rigid body systems and to give awareness to students on the phenomenon of vibration and its effects.
5.	To learn about the concept of various types of governors.

UNIT I	**FORCE ANALYSIS**	**9**	**0**	**0**	**9**
Static Force Analysis, Free Body Diagrams, Conditions of Two, Three and Four Force Members. Inertia Forces and D'Alembert's Principle – Inertia Force Analysis in Reciprocating Engines – Crank Shaft Torque. Flywheels – Turning Moment Diagrams and Fluctuation of Energy of reciprocating engine mechanisms, Coefficient of Fluctuation of Energy and Speed, Weight of Flywheel Required.					
UNIT II	**BALANCING**	**9**	**0**	**0**	**9**
Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines					
UNIT III	**FREE VIBRATION**	**9**	**0**	**0**	**9**
Basic Features of Vibratory Systems – Types – Single Degree of Freedom System – Transverse Vibration of Beams – Natural Frequency by Energy Method, Dunkerly's Method - Critical Speed - Damped Free Vibration of Single Degree Freedom System -Types of Damping – Free Vibration with Viscous Damping, Critically Damped System, Under Damped System. Torsional Systems: Natural Frequency of Two and Three Rotor Systems.					
UNIT IV	**FORCED VIBRATION**	**9**	**0**	**0**	**9**
Response to Periodic Force – Harmonic Force – Force caused by Unbalance – Support Motion - Logarithmic Decrement-Magnification Factor – Vibration Isolation and Transmissibility.					
UNIT V	**GOVERNORS**	**9**	**0**	**0**	**9**
Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors – Characteristics - Effect of friction - Controlling Force - other governor mechanisms.					
					Total (45L) = 45 Periods

TEXT BOOKS:	
1.	Design of Machinery, Fourth Edition, by R.L. Norton, McGraw Hill, 2007
2.	Mechanical Vibration, V.P.Singh, Dhanpatrai, Delhi
REFERENCE BOOKS:	
1.	Ballaney, P.L., "Theory of Machines and Mechanisms", Khanna Publishers, New Delhi, 2002.
2.	Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", TMH ND, 1998.
3.	Amithabha Ghosh, and Ashok Kumar Malik., "Theory of Mechanisms and Machines", 2nd Ed., Affiliated East and West Press Limited, 1998.
4.	Prof.Nakara, IIT-Delhi Reference Books
E-REFERENCES:	
1.	www.university.youth4work.com/IIT_Kharagpur_Indian-Institute-of-Technology/study/1653-dynamics-of-Machinery-ebook

2.	http://nptel.ac.in/courses/112104114/

COURSE OUTCOMES: On completion of the course the student will be able to		**Bloom's Taxonomy Mapped**
CO1	Apply basic principles of mechanisms in mechanical system.	Apply
CO2	Familiarize the static and dynamic analysis of simple mechanisms.	Understand
CO3	Analyze the mechanical systems subjected to free vibration.	Analyze
CO4	Analyze mechanical systems subjected to forced vibration.	Analyze
CO5	Analyze the various types of governors and its speed control mechanism.	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	1					1		3	2	1	2
CO2	2	2	3	2	1					1		3	2	1	2
CO3	2	2	3	2						1		3	2	1	2
CO4	2	2	3	2	1					1		3	2	1	2
CO5	1	2	3	2						1		3	2	1	1
Avg	**1.8**	**2.0**	**3.0**	**2.2**	**1**					**1.0**		**3.0**	**2.0**	**1.0**	**1.8**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

22MTM01	ADVANCED PHYSICAL METALLURGY			Semester			
PREREQUISITES		**Category**	**OE**	**Credit**		**3**	
Engineering physics		**Hours/Week**	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Learning Objectives

1	To impart knowledge on the crystal structure, diffusion, phase diagrams for various engineering materials.

Unit I	CRYSTAL STRUCTURES	9	0	0	9

Review of atomic bonds, Lattice, unit cell, crystal systems and Bravais lattices; Principal crystal structures – BCC, FCC, HCP and its characteristics; Miller indices for crystallographic planes and directions, interplanar spacing; Volume, planar and linear atomic density; Polymorphism and allotropy; CsCl, NaCl, Diamond structures; single crystal and polycrystalline and amorphous materials; isotropy and anisotropy; Simple problems in the above topics

Unit II	CRYSTALLINE IMPERFECTIONS	9	0	0	9

Types of point defects, effect of temperature on vacancy concentration, interstitial sites-octahedral and tetrahedral sites; Line defects – dislocations – Edge, screw and mixed dislocations, Burger's vector, slip and twinning; Planar defects – grain boundaries, tilt boundaries, small angle grain boundaries; ASTM grain size number, grain size determinations; Volume defects; Simple problems in the above topics.

Unit III	ATOMIC DIFFUSION IN SOLIDS AND SOLIDIFICATION OF METAL	9	0	0	9

Diffusion mechanisms, steady state diffusion and non-steady state diffusion-Fick's first law and second law; Kirkendall effect and Darken's equation; Factors affecting diffusion; Industrial applications of diffusion processes; Simple problems in the above topics; Basic principles of solidification of metals and alloys; Growth of crystals– Planar growth, dendritic growth, Solidification time, dendrite size; Cooling curves; Cast or Ingot structure, Solidification defects – Control of casting structure; Directional solidification – single crystal growth; Simple problems in the above topics.

Unit IV	PHASE DIAGRAMS	9	0	0	9

Phases, solid solution types, compounds, Hume- Rothery rules; Gibb's phase rule; Phase diagram determination; Binary isomorphous alloy systems – composition and amount of phases, development of microstructure – equilibrium and non-equilibrium cooling- Coring and its effects, homogenization; Binary eutectic system - composition and amount of phases, development of microstructure; Eutectoid, Peritectic and monotectic reaction, Phase diagrams with intermediate phases and compounds; Ternary phase diagrams. Simple problems in the above topics.

Unit V	IRON-CARBON PHASE DIAGRAM	9	0	0	9

Iron-carbon diagram, Phases in Fe-C system, Invariant reactions, Microstructure of slowly cooled steels, composition and amount of phases, Effect of Alloying elements on Fe-C system, Type, structure, properties and applications of Plain Carbon Steels and different types of Cast iron; IS Specification for Steels and Cast Irons, Simple problems in above topics.

Total (45+0) = 45 Hours

Text Books:

1	Donald R. Askeland,"The Science and Engineering of Materials", Thomson Learning, India Edition, 2007.
2	William D.Callister, "Materials Science and Engineering – An Introduction", 4th edition, JohnWiley & Sons, New York, USA, 1997.

Reference Books:

1	Avner S H."An Introduction to Physical Metallurgy", McGraw Hill Book Co, New York, USA, 1997.
2	Donald R Askeland," Essentials of Material Science and Engineering ", Thomson Learning, India Edition, 2007
3	Raghavan V., "Physical Metallurgy – Principles and Practice", Prentice Hall of India Ltd., New Delhi, 199.
4	William F.Smith, "Foundations of Materials Science and Engineering", Second Edition, McGraw-Hill Inc, New York, 1993.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Describe the basic crystal structure, orientation and their influence on macroscopic properties.	L2: Understanding
CO2	:	Discuss the role of imperfections in strengthening the materials.	L2: Understanding
CO3	:	Diagonise the diffusion mechanism in solidification of materials under different conditions.	L4:Analysing
CO4	:	Apply the concept of phase diagrams in equilibrium transformation of materials phases.	L3:Applying
CO5	:	Construct the Fe-Fe_3C phase diagram and discuss various properties of steel and cast iron.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1		1	
CO2	1	1				1	1						1			1
CO3	1	1	1	1		1							1	1		
CO4	1	1		1	1								1			
CO5	1	1		1									1			1
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22MTM02	THERMODYNAMICS AND KINETICS IN METALLURGY		Semester			
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
Engineering physics and Engineering chemistry		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To learn the basic principles and concepts of thermodynamics in the field of Metallurgy and materials; and to learn about equations and their applications.

Unit I	**FUNDAMENTAL CONCEPT AND INTERNAL ENERGY**	**9**	**0**	**0**	**9**

Introduction: System and surrounding, Classification of systems, Path and state properties, Thermodynamic processes, Thermodynamic equilibrium, Reversible and Irreversible processes. First law of thermodynamics: Heat and work, Internal energy, Heat capacity of materials, Cp-Cv relations, Nernst Equation, Enthalpy, Thermochemistry Hess's law, Kirchoff's law, Maximum flame temperature.

Unit II	**ENTROPY AND AUXILARY FUNCTIONS**	**9**	**0**	**0**	**9**

Second law of thermodynamics: Carnot cycle, Entropy - Statistical interpretation of entropy, Free energy, Combined statement of first and second laws, Thermodynamic functions - Maxwell's relations, Gibbs Helmholtz equation. Third and Zeroth laws of thermodynamics : Definition, concept and applications

Unit III	**THERMODYNAMIC POTENTIALS AND PHASE EQUILIBRIA**	**9**	**0**	**0**	**9**

Thermodynamic potentials: Fugacity, Activity and Equilibrium constant. Clausius - Clayperon equation, Troutons rule. Le Chatelier's principle, Vant Hoff's equation. Equilibria in phase diagrams: Phase rule, Phase stability, Thermodynamics of surfaces, interfaces and defects, P-G-T diagrams, Application of free energy - composition diagrams to the study of alloy systems.

Unit IV	**THERMODYNAMICS OF SOLUTIONS**	**9**	**0**	**0**	**9**

Gibbs - Duhem equation, Partial and integral molar quantities, chemical potential, Ideal solutions - Raoult's law, Real solutions, Activity coefficient, Henry's law, Alternative standard states, Sievert's law, Mixing functions and excess functions, Regular solutions, Applications of Gibbs - Duhem equation.

Unit V	**THERMODYNAMICS OF REACTIONS AND KINETICS**	**9**	**0**	**0**	**9**

Electro chemical process: Cells, Interconversion of free energy and electrical work, Determination of thermodynamic quantities using reversible cells, Solid electrolytic cells. Kinetics: First, Second and third order reactions, Arrhenius equation - activation energy, Determination of order of the reaction.

Total (45+0) = 45 Hours

Text Books:

1	Upadhyaya G S andDube R K., "Problems in Metallurgical Thermodynamics & Kinetics",Pergamon, 1977.
2	Ahindra Ghosh, Text book of Materials & MetallurgicalThermodynamics, Prentice Hall India, 2002
3	. David R Gaskell, "Introduction to the Thermodynamics of Materials", Fifth Edition, Taylor & Francis, 2008

Reference Books:	
1	David V Ragone, "Thermodynamics of Materials - Volume-1", John Wiley & Sons, Inc. 1995.
2	Dr S.K Dutta,Prof A.B.Lele – Metallurgical thermodynamics kinetics and numericals,S.Chand& co Ltd.,New Delhi 2011
3	Darken LS and Gurry R W,"Physical Chemistry of Metals", CBS publications and distributors, 2002.
4	Parker R H, "An introduction to chemical metallurgy", Pergamon press, New York, second edition, 1978.
5	Kapoor M.L., “Chemical and Metallurgical Thermodynamics Vol. I and II”, Nem Chand, 1st Ed., 1981

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Discuss the fundamental concepts of thermodynamics and internal energy	L2: Understanding
CO2	:	State the thermodynamics entropy and auxilary functions.	L2: Understanding
CO3	:	Identify the basic laws, chemical potential and phase equilibria.	L4:Analysing
CO4	:	Describe the thermodynamics of the solution and various important equations.	L2: Understanding
CO5	:	Apply to solve problems related to electrochemical processes and kinetics.	L3:Applying

<u>COURSE ARTICULATION MATRIX</u>

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1	1		
CO2	1	1	1										1		1	
CO3	1	1		1	1								1			
CO4	1			1	1								1		1	1
CO5	1	1				1	1						1		1	
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

22MTM03	MECHANICAL BEHAVIOUR OF MATERIALS			Semester			
PREREQUISITES			**OE**	**Credit**			**3**
Engineering physics		**Hours/Week**	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Learning Objectives

1	To know the fundamental concepts of deformation behaviour for structural engineering applications.

Unit	Title	L	T	P	TH
Unit I	**DISLOCATIONS AND PLASTIC DEFORMATION**	**9**	**0**	**0**	**9**

Strength of perfect crystal and need for dislocations; Characteristics of dislocations – Edge dislocation, Screw dislocation, Burger's vector, mixed dislocation, dislocation loops; Movement of dislocation – Pierls stress, Cross slip, Climb; Dislocations in FCC, HCP and BCC lattice; Stress fields and energies of dislocations, forces on and between dislocations; Dislocation density; Intersections of dislocations – Jogs and kinks; Dislocation multiplication; Dislocation pile-ups; Deformation by slip and twinning; Critical resolved shear stress; Deformation bands and kink bands.

Unit	Title	L	T	P	TH
Unit II	**STRENGTHENING MECHANISMS**	**9**	**0**	**0**	**9**

Strain hardening; Grain boundary strengthening; Solid solution strengthening - yield-point phenomenon, strain ageing; Precipitation hardening - Conditions for precipitation hardening, Ageing, Formation of precipitates, coarsening of precipitates, Mechanism of strengthening; Dispersion strengthening; Fiber strengthening; Martensite strengthening - examples for above strengthening mechanisms from ferrous and non-ferrous systems, Bauschinger effect; Preferred orientation; Sever plastic deformation.

Unit	Title	L	T	P	TH
Unit III	**FRACTURE AND FRACTURE MECHANICS**	**9**	**0**	**0**	**9**

Types of fracture – ductile and brittle fracture, Ductile to Brittle Transition Temperature (DBTT), Metallurgical factors affecting DBTT, determination of DBTT, Hydrogen embrittlement and other embrittlement, Theoretical cohesive strength of metals, Griffith's theory of brittle fracture, Orowan's modification. Fracture mechanics - introduction, modes of fracture, stress intensity factor, strain energy release rate, fracture toughness and determination of KIC, introduction to COD, J integral.

Unit	Title	L	T	P	TH
Unit IV	**FATIGUE BEHAVIOUR AND TESTS**	**9**	**0**	**0**	**9**

Fatigue: Stress cycles, S-N curves, effect of mean stress, factors affecting fatigue, structural changes accompanying fatigue, cumulative damage, HCF / LCF, thermo-mechanical fatigue, application of fracture mechanics to fatigue crack propagation, fatigue testing machines.

Unit	Title	L	T	P	TH
Unit V	**CREEP BEHAVIOUR AND TESTS**	**9**	**0**	**0**	**9**

Creep curve, stages in creep curve and explanation, structural changes during creep, creep mechanisms, metallurgical factors affecting creep, high temperature alloys, stress rupture testing, creep testing machines, parametetric methods of extrapolation. Deformation Mechanism Maps

Total (45+0) = 45 Hours

Text Books:

1	George. E. Dieter, "Mechanical Metallurgy", 3rd Edition, McGraw-Hill Publications, New York, SI Edition, 2004
2	Marc Andr'e Meyers, Krishan Kumar Chawla, "Mechanical Behavior of Materials", Cambridge University Press, UK, 2009.

Reference Books:	
1	Reed Hill, R.E., "Physical Metallurgy Principles", Affiliated East West Press, New Delhi, 1992.
2	Davis.H.E. Troxell G.E., Hauck.G.E.W. “The Testing of Engineering Materials”, McGraw-Hill, 1982.
3	Wulff et al Vol. III “Mechanical Behavior of Materials”, John Wiley and Sons, New York, USA, 1983.
4	Honeycombe R.W.K., “Plastic Deformation of Materials”, Edward Arnold Publishers, 1984

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Discuss the mechanical behaviour of materials.	L2: Understanding
CO2	:	Discuss the strengthening mechanisms of materials.	L2: Understanding
CO3	:	List the various types of fractures and their mechanisms, fracture mechanics and various theories describing fracture mechanics.	L2: Understanding
CO4	:	Discuss the fatigue behaviour and the mechanism of fatigue, SN curve and fatigue testing machines.	L2: Understanding
CO5	:	Describe the creep behaviour and mechanism, factors affecting creep and creep testing machines.	L2: Understanding

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1		1	1								1	1		
CO2	1	1		1	1								1	1		
CO3	1	1	1		1										1	1
CO4	1	1				1	1								1	1
CO5	1	1		1	1								1	1		
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22MTM04	RATE PROCESSES IN METALLURGY			Semester			
PREREQUISITES				**OE**	**Credit**		**3**
Engineering physics			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Learning Objectives

1	To learn the basic principles and concepts of kinetics in the domain of metallurgy and materials; to learn about equations and their applications; And to appreciate that metallurgical kinetics as a Knowledge base with abundant applications.

Unit I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Introduction: Role of kinetics, heterogeneous and homogeneous kinetics, Role of heat and mass transfer in metallurgical kinetics, rate expression, Effect of Temperature and concentration on reaction kinetics: effect of temperature (Arrhenius Equation), Effect of concentration (order of a reaction), significance and determination of activation energy.					
Unit II	**KINETICS OF SOLID-FLUID REACTION**	**9**	**0**	**0**	**9**
Kinetics of solid-fluid reaction: kinetic steps, rate controlling step, definition of various resistances in series, shrinking core model, chemical reaction as rate controlling step, Product layer diffusion as rate controlling step, Mass transfer through external fluid film as rate controlling step, heat transfer as the rate controlling step, Concentration boundary layer, definition and significance of heat and mass transfer coefficient, Theoretical models for mass transfer coefficients, Correlations for heat and mass transfer coefficients					
Unit III	**LIQUID-SOLID PHASE TRANSFORMATION**	**9**	**0**	**0**	**9**
Principles of Solidification in metals and alloys: thermodynamics involved, eutectic and peritectic Solidification, Homogeneous and heterogeneous nucleation, Mechanisms of growth. Rapid Solidification Processing.					
Unit IV	**SOLID STATE PHASE TRANSFORMATIONS**	**9**	**0**	**0**	**9**
Nucleation and growth Kinetics, homogeneous and heterogeneous transformation, Precipitation: Coherency, age hardening, particle Coarsening. Ostwald ripening, Order-disorder transformation, spinodal decomposition, massive transformations					
Unit V	**SOLID STATE PHASE TRANSFORMATIONS IN STEEL**	**9**	**0**	**0**	**9**
Reconstructive and displacive transformations; Pearlitic transformation: mechanism and kinetics: Johnson-Mehl equation, morphology of pearlite; Bainitic transformation: mechanism and kinetics; morphology of upper bainite and lower bainite; Martensitic transformation: Mechanism- diffusionless displacive nature; morphology of high carbon and low carbon martensite.					
					Total (45+0) = 45 Hours

Text Books:	
1.	Ahindra Ghosh and Sudipto Ghosh, A Text book of Metallurgical Kinetics, PHI learning Pvt. Ltd., New Delhi, 2014
2.	H.S. Ray, Kinetics of Metallurgical Reactions, International Science publisher, 1993.
3.	F. Habashi, Kinetics of Metallurgical Processes, Metallurgy Extractive Québec, 1999.
4.	Upadhyaya G S and Dube R K., "Problems in Metallurgical Thermodynamics & Kinetics", Pergamon, 1977.

Reference Books:	
1.	Phase transformations in metals and alloys- D.A. Potter and K.E. Easterling, CRC Press, 1992. 2. Transformations in Metals, P.G. Shewmon, Mc-Graw Hill, 1969.
2.	Introduction to Physical Metallurgy – S. N. Avner, Tata McGraw Hill, 1997.
3.	Physical Metallurgy Principles, R. E. Reed-Hill and R. Abbaschian, 3rd ed, PWS-Kent Publishing, 1992.
4.	Modern Physical Metallurgy, R. E. Smallman, Butterworths, 1963

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the thermodynamic aspects of phase changes.	L2: Understanding
CO2	:	Discuss the fundamentals of solid –fluid reactions.	L2: Understanding
CO3	:	Explain the eutectic and peritectic solidifications and rapid solidification processes.	L2: Understanding
CO4	:	Describe the fundamentals of solidification.	L1: Remembering
CO5	:	Apply the solid state phase transformations in steel.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1			1
CO2	1	1			1	1									1	1
CO3	1	1		1	1								1	1		
CO4	1	1		1	1									1		1
CO5	1		1			1	1								1	1
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

22MTM05	CORROSION AND SURFACE ENGINEERING			Semester			
PREREQUISITES				**OE**	**Credit**		**3**
Engineering chemistry		**Hours/Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**
Course Learning Objectives							
1	To understand the corrosion and surface engineering, with its application in engineering field.						
Unit I	**MECHANISMS AND TYPES OF CORROSION**			**9**	**0**	**0**	**9**
Principles of direct and Electro chemical Corrosion, Hydrogen evolution and Oxygen absorption mechanisms – Galvanic corrosion, Galvanic series-specific types of corrosion such as uniform, Pitting, Intergranular, Cavitations, Crevice Fretting, Erosion and Stress Corrosion, corrosion fatigue, hydrogen damage –Factors influencing corrosion							
Unit II	**TESTING AND PREVENTION OF CORROSION**			**9**	**0**	**0**	**9**
Corrosion testing techniques and procedures- Corrosion Testing ASTM Standards, Pitting Corrosion Test, Hydrogen Induced Cracking Test, Sulphide Stress Corrosion Cracking Test- Prevention of Corrosion-Design against corrosion –Modifications of corrosive environment –Inhibitors – Cathodic Protection –Special surfacing processes.							
Unit III	**CORROSION OF INDUSTRIAL COMPONENTS**			**9**	**0**	**0**	**9**
Corrosion in fossil fuel power plants, Automotive industry, Chemical processing industries, corrosion in petroleum production operations and refining, Corrosion of pipelines- wear of industrial components.							
Unit IV	**SURFACE ENGINEERING FOR WEAR AND CORROSION RESISTANCE**			**9**	**0**	**0**	**9**
Diffusion coatings –Electro and Electroless Plating –Hot dip coating –Hard facing-Metal spraying, Flame and Arc processes- Conversion coating –Selection of coating for wear and Corrosion resistance.							
Unit V	**THIN LAYER ENGINEERING PROCESSES**			**9**	**0**	**0**	**9**
Laser and Electron Beam hardening –Effect of process variables such as power and scan speed - Physical vapor deposition, Thermal evaporation, Arc vaporization, Sputtering, Ion plating - Chemical vapor deposition – Coating of tools, TiC, TiN, Al_2O_3 and Diamond coating-Properties and applications of thin coatings.							
							Total (45+0) = 45 Hours

Reference Books:	
1.	Fontana. G., Corrosion Engineering, McGraw Hill,1985.
2.	Kenneth G. Budinski, Surface Engineering for Wear Resistance, Prenticehall,1992.
3.	ASM Metals Hand Book –Vol. 5, Surface Engineering,1996.
4.	Denny A Jones, “Principles and prevention of corrosion”, 2ndedition, Prentice Hall, New Jersey,1995.
5.	ASM International, Surface Engineering for Corrosion and Wear Resistance,2005.
6.	Schweitzer. P.A., Corrosion Engineering Hand Book, 3rd Edition, Marcel Decker, 1996.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Name the different types of corrosion and their mechanism.	L2: Understanding
CO2	:	Estimate corrosion resistance by different tests.	L4:Analysing
CO3	:	Explain the corrosion behavior of different metals in different industries.	L2: Understanding
CO4	:	Classify the different forms of processing techniques of surface engineering materials.	L1: Remembering
CO5	:	Select the type of deposition and spraying technique.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1	1		
CO2	1	1		1		1							1	1		
CO3	1	1	1	1			1								1	1
CO4	1	1		1	1										1	1
CO5	1	1		1	1								1	1		
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

<table>
<tr><td>22MTM06</td><td colspan="2">MATERIALS CHARACTERIZATION</td><td colspan="3">Semester</td><td></td></tr>
<tr><td colspan="2">PREREQUISITES</td><td></td><td>OE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">Engineering physics</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To acquire knowledge on various characterizations, chemical and thermal analysis of metallurgical components using its analysis tools.</td></tr>
<tr><td>Unit I</td><td colspan="2">OPTICAL MICROSCOPY</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Metallographic specimen preparation. Macro-examination -applications. Metallurgical microscope - principle, construction and working, , Optic properties - magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources, lens aberrations and their remedial measures, Various illumination techniques-bright field , dark field, phase-contrast, polarized light illuminations, interference microscopy, high temperature microscopy; Quantitative metallography – Image analysis.</td></tr>
<tr><td>Unit II</td><td colspan="2">X-RAY DIFFRACTION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Characteristic X-ray spectrum, Bragg's Law, Diffraction methods - Laue method, rotating crystal method and powder method. Diffraction intensity – structure factor calculation. X-ray diffractometer -general features, filters and counters. Applications of X-ray diffraction in materials characterisation – Determination of crystallite size, crystal structure, precise lattice parameter, measurement of stress.</td></tr>
<tr><td>Unit III</td><td colspan="2">ELECTRON MICROSCOPY</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Electron beam - specimen interactions. Construction and operation of Transmission Electron Microscopy – Diffraction effects and image formation, various imaging modes, selected area diffraction, applications, specimen preparation techniques. Scanning electron microscopy – principle, equipment, various operating modes and applications, Electron probe microanalyser (EPMA)- principle, instrumentation, qualitative and quantitative analysis. Introduction to HRTEM, FESEM, EBSD.</td></tr>
<tr><td>Unit IV</td><td colspan="2">SPECTROSCOPIC TECHNIQUES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">X-ray spectroscopy – EDS and WDS. Principle, instrumentation, working and applications of Auger Electron spectroscopy, X-ray photoelectron spectroscopy and Secondary ion mass spectroscopy / ion microprobe. Optical emission spectroscopy, Atomic Absorption spectroscopy and X-ray fluorescence spectroscopy - principle, construction, working and applications. UV-Vis, FTIR and Raman spectroscopy.</td></tr>
<tr><td>Unit V</td><td colspan="2">THERMAL ANALYSIS AND ADVANCED CHARACTERIZATION TECHNIQUES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Thermal Analysis: Principles of differential thermal analysis, differential scanning calorimetry and thermo-graviometric analysis – Instrumentation and applications. Advanced characterization techniques: Scanning probe microscopy - STM and AFM - principle, instrumentation and applications. Field ion microscopy including atom probe - principles, instrumentation and applications.</td></tr>
<tr><td colspan="7" align="right">Total (45+0) = 45 Hours</td></tr>
</table>

Text Books:	
1.	Cullity, B.D., Elements of X Ray Diffraction, Addison-Wesley Publishing Company Inc, Philippines, 1978
2.	Brandon, D. and W.D. Kaplan, Microstructural Characterization of Materials, John Wiley & Sons Ltd, England, 2013.

3.	Leng, Y., Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia) Pte Ltd, Singapore, 2008
Reference Books:	
1.	ASM Handbook, Volume 10, Materials Characterization, ASM international, USA, 1986.
2.	Vander Voort, G.F., Metallography: Principle and practice, ASM International, 1999.
3.	Phillips V A, Modern Metallographic Techniques and their Applications, Wiley Eastern, 1971.
4.	Angelo, P. C., Materials Characterization, Reed Elsevier India Pvt Ltd, Haryana, 2013.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the principles of metallurgical microscope, optical properties and various illumination techniques.	L2: Understanding
CO2	:	Analyze the various diffraction methods, X-ray diffractometer and determination of crystal parameter.	L4:Analysing
CO3	:	Discuss the principles of TEM, SEM, EPMA.	L2: Understanding
CO4	:	Explain various spectroscopic techniques,	L2: Understanding
CO5	:	Discuss the chemical and thermal analysis using advanced methods.	L2: Understanding

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	`1		1	1								1		1	
CO2	1	1	1	1		1							1			1
CO3	1		1			1	1					1	1			1
CO4	1	1		1	1							1	1			1
CO5	1	1		1	1								1		1	
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0					1.0	1.0		1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

22MTM07	AUTOMOTIVE, AEROSPACE AND DEFENCE MATERIAL			Semester			
PREREQUISITES				**OE**	**Credit**		**3**
Engineering physics		**Hours/Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**
Course Learning Objectives							
1	To understand the properties and applications various materials suitable for automobile, aircraft and defnce industries and its components.						
Unit I	**MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS**			**9**	**0**	**0**	**9**
Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.							
Unit II	**MATERIALS FOR AUTOMOTIVE STRUCTURES**			**9**	**0**	**0**	**9**
Materials selection for bearings, leaf springs, chasis & frames, Bumper, shock absorbers, wind screens, panels, brake shoes, Disc, wheels, differentials , damping and antifriction fluids, Tyres and tubes. Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, anti-collision, Anti-fog, Head lamps.							
Unit III	**AEROSPACE METALS AND ALLOYS**			**9**	**0**	**0**	**9**
Types of corrosion – Effect of corrosion on mechanical properties – Stress corrosion cracking – Corrosion resistance materials used for space vehicles. Heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – Effect of alloying treatment, heat resistance alloys – tool and die steels, magnetic alloys, powder metallurgy- application of materials in Thermal protection systems of Aerospace vehicles – super alloys							
Unit IV	**CERAMICS AND COMPOSITES**			**9**	**0**	**0**	**9**
Introduction – physical metallurgy – modern ceramic materials – cermet - cutting tools – glass ceramic – production of semi-fabricated forms - Plastics and rubber – Carbon/Carbon composites, Fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design.							
Unit V	**NUCLEAR WASTE AND RADIATION PROTECTION, IRRADIATION EFEFCTS**			**9**	**0**	**0**	**9**
Introduction-unit of nuclear radiation-Types of waste –disposal –ICRP recommendations-radiation hazards and prevention –radiation dose units - Irradiation Examination of Fuels, Irradiation behaviour of metallic uranium – irradiation growth, thermal cycling, swelling, adjusted uranium, blistering in uranium rods. Irradiation effects in ceramic oxide and mixed oxide fuels, definition and units of burn up, main causes of fuel element failure in power reactors and remedies to avoid failures.							
							Total (45+0) = 45 Hours

Reference Books:	
1.	ASM Handbook, “Selection of Materials Vol. 1 and 2”, ASM Metals Park, Ohio. USA, 1991.
2.	Materials Science and Engineering, Willium D. Callister, Jr. John Wiley & Sons publications Or Callister’s Materials Science and Engineering Adapted By R. Balasubramaniam, Wiley India, Edition -2010.

3.	Material Science and Engineering, V. Raghavan, Prentice Hall of India, 4th Edition.
4.	Engineering Metallurgy Applied Physical Metallurgy, R. A. Higgins, 6th Edition
5.	Gladius Lewis, “Selection of Engineering Materials”, Prentice Hall Inc. New Jersey USA, 1995.
6.	Charles J A and Crane. F A. A., “Selection and Use of Engineering Materials”, 3rd Edition, Butterworths, London UK, 1996
7.	ASM Handbook. “Materials Selection and Design”, Vol. 20- ASM Metals Park Ohio.USA, 1997
8.	Cantor,“ Automotive Engineering: Lightweight, Functional, and Novel Materials”, Taylor & Francis Group, London, 2006

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Describe the materials selection criteria for engine and transmission systems.	L2: Understanding
CO2	:	Analyze the different materials used for automotive structures and Different electronic materials for automotive applications.	L4:Analysing
CO3	:	Explain various topics such as elements of aerospace materials and mechanical behaviour of materials,	L2: Understanding
CO4	:	Compare the ceramics and composites of aerospace materials	L4:Analysing
CO5	:	Examine the fuels for nuclear materials.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1	1		
CO2	1	1	1			1							1	1		
CO3	1			1	1								1		1	
CO4	1	1	1				1						1			1
CO5	1	1		1	1								1			1
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