GOVERNMENT COLLEGE OF ENGINEERING

SALEM - 636 011

(An Autonomous Institution Affiliated to

Anna University, Chennai)

REGULATIONS 2022

CURRICULAM AND SYLLABUS

(For Candidates admitted from 2022 - 2023 onwards)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(FULL TIME PROGRAMME)

Rough Draft

VISION

We envision our students has excellent engineers not only in the field of science and technology, but also in good citizenship and discipline our commitment lies in producing comprehensive knowledge seekers and human individuals, capable of building a strong and developed nation.

MISSION

- To achieve the vision we should have diligent faculty who use effective teaching methodologies.
- To impart updated technical education and knowledge.
- To groom our young students to become professionally and morally sound engineers.
- To reach global standards in production and value based living through an honest and scientific approach

Programme Educational Objective (PEO)

- Graduates will have the fundamental knowledge and ability to expertise in Computer Science and Engineering.
- Graduates will continue to learn and adapt latest technologies to solve real life problems.
- Graduates will have exhaustive subject knowledge and communicate the same to the peer group.
- Graduates will be ethically and socially responsible solution providers and entrepreneurs in Computer Science and other engineering disciplines.
- Graduates will pursue research and higher education.

Programme Outcomes (PO)

- **PO1**: Apply the knowledge of Mathematics, Physical Science, Computer Science, and Computer Engineering to solve engineering problems in the modeling and design of computer-based systems.
- **PO2**: Ability to identify, formulate, and analyze complex real-life problems in order to provide meaningful solutions by applying knowledge acquired in computer science and engineering
- **PO3**: Design, develop, test, and debug the software with excellent programming, analytical, logical, and problem-solving skills.
- **PO4**: Ability to investigate problems in multidisciplinary fields and specialized domains.
- **PO5**: Create, select, and apply appropriate techniques, skills, and modern computing tools to integrate IT-based solutions into the user environment effectively.
- **PO6**: Acquire the knowledge of sustainable development to assess society, healthcare, safety, legal, and cultural issues in the professional engineering practice.
- **PO7**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge that is needed for sustainable development.
- **PO8**: Impart ethical principles and commitment to professional ethics & responsibilities in the engineering practice.
- **PO9**: Function effectively as an individual and as a member or leader in diverse teams in multidisciplinary settings.
- **PO10**: Communicate effectively on engineering activities with the engineering community and society.
- **PO11**: Apply the knowledge and understanding of engineering management principles to manage projects in interdisciplinary environments.

- **PO12**: Ability to excel in competitive examinations and develop confidence for lifelong learning to cope with the rapidly evolving disciplines of Computer Science

Programme Specific Outcomes (PSO)

- Develop efficient computerized solutions to real world problems through the application of principles in Data structures, Analysis of algorithms, Software Engineering and Object oriented analysis and Design.
- Apply the knowledge in Data mining and Big data analytics to infer, predict or prescribe data centric business solutions.

GOVERNMENT COLLEGE OF ENGINEERING, SALEM – 636 011.

B.E – Computer Science and Engineering (FULL TIME)

S. No.	Course Code	Course Title	Cat.	Hours / Week				Max. Marks		
				L	T	P	C	CA	FE	Total
SEMESTER I										
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 and 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 Tamil / தமிழர் மரபு	HS MC	1	0	0	0	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				**21.5**			**800**
SEMESTER II										
S. No.	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**				**Max. Marks**		
				L	**T**	**P**	**C**	**CA**	**FE**	**Total**
THEORY										
1	22MA202	Linear Algebra and Linear Programming Problem	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	4	0	0	4	40	60	100
5	22ME101	Engineering Graphics & Design	ES	1	0	4	3	40	60	100
6	22MCIN01	Engineering Sprints	EEC	0	0	2	1	100	-	100
7	22MC201	Tamils and Technology/ தமிழரும் தொழில்நுட்பமும்	HS MC	1	0	0	0	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				**23.5**			**1100**

SEMESTER III										
S. No.	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**				**Max. Marks**		
				L	**T**	**P**	**C**	**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	EEC	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**			**800**

SEMESTER IV										
S. No.	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**				**Max. Marks**		
				L	**T**	**P**	**C**	**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	EEC	0	0	2	1	100	-	100
7	22CYMC01	Environmental Science	MC	3	-	-	NC	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**

SEMESTER V										
S. No.	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**				**Max. Marks**		
				L	**T**	**P**	**C**	**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		Open Elective I	OE	3	0	0	3	40	60	100
6	22MCIN04	Ideation Sprints	EEC	0	0	2	1	100	-	100
7	22MC301	Indian Constitution	MC	2			NC	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**				**Max. Marks**		
				L	**T**	**P**	**C**	**CA**	**FE**	**Total**
THEORY										
1		Professional Elective I	PE	3	0	0	3	40	60	100
2		Professional Elective II	PE	3	0	0	3	40	60	100
3		Professional Elective III	PE	3	0	0	3	40	60	100
4		Open Elective I	OE	3	0	0	3	40	60	100
5		Open Elective II	OE	3	0	0	3	40	60	100
6		Open Elective III	OE	3	0	0	3	40	60	100
PRACTICAL										
7	22CS601	Mini Project	EEC	0	0	6	3	60	40	100
TOTAL							**21**			**700**

***NCC credit course level II 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 VI (Protosem Stream)										
S. No.	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**				**Max. Marks**		
				L	**T**	**P**	**C**	**CA**	**FE**	**Total**
THEORY										
1	22PSPE01	Computational Hardware	PE	2	0	2	3	100	-	100
2	22PSPE02	Coding for Innovators	PE	2	0	2	3	100	-	100
3	22PSPE03	Industrial Automation	PE	2	0	2	3	100	-	100
4	22PSOE01	Applied Design Thinking	OE	2	0	2	3	100	-	100
5	22PSOE02	Startup Fundamentals	OE	2	0	2	3	100	-	100
6	22PSOE03	Industrial Design &Rapid Prototyping Techniques	OE	2	0	2	3	100	-	100
PRACTICAL										
7	22PSEE01	Robotics/ML/ML/Ops	EEC	2	0	2	3	100	-	100
TOTAL							**21**			**700**
SEMESTER VII										
S. No	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**				**Max. Marks**		
				L	**T**	**P**	**C**	**CA**	**FE**	**Total**
THEORY										
1	22CS701	Cryptography and Network Security	PC	3	0	0	3	40	60	100
2	22CS702	Python Programming	PC	3	0	0	3	40	60	100
3	22CS703	Machine Learning	PC	3	0	0	3	40	60	100
3	22CS704	Mobile Computing	PC	3	0	0	3	40	60	100
4	22MG701	Principles of Management	HS	3	0	0	3	40	60	100
		Professional Elective IV	PE	3	0	0	3	40	60	100
PRACTICAL										
5	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**				**Max. Marks**		
				L	**T**	**P**	**C**	**CA**	**FE**	**Total**
THEORY										
1		Professional Elective V	PE	3	0	0	3	40	60	100
		Professional Elective VI	PE	3	0	0	3	40	60	100
PRACTICAL										
2	22CS801	Project Work	EEC	0	0	12	6	80	120	200
TOTAL							**12**			**400**

***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**

List of Professional Electives I

Subject Code	Subject Name	Category						Contact Periods		
		Cat.	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE101	Software Project Management	PE	3	3	0	0	3	40	60	100
22CSPE102	Artificial Intelligence	PE	3	3	0	0	3	40	60	100
22CSPE103	Web Technology	PE	3	3	0	0	3	40	60	100
22CSPE104	Agile Technology	PE	3	3	0	0	3	40	60	100
22CSPE105	Data Mining and Warehousing	PE	3	3	0	0	3	40	60	100
22CSPE106	Computer Hardware and Troubleshooting	PE	3	3	0	0	3	40	60	100

List of Professional Electives II

Subject Code	Subject Name	Category						Contact Periods		
		Cat.	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE201	Software Quality and Testing	PE	3	3	0	0	3	40	60	100
22CSPE202	Blockchain Technologies	PE	3	3	0	0	3	40	60	100
22CSPE203	Parallel Computing Architecture and Programming	PE	3	3	0	0	3	40	60	100
22CSPE204	Computer Graphics and Multimedia	PE	3	3	0	0	3	40	60	100
22CSPE205	Object Oriented Analysis and Design	PE	3	3	0	0	3	40	60	100
22CSPE206	Cyber Forensics	PE	3	3	0	0	3	40	60	100

List of Professional Electives III

Subject Code	Subject Name	Category						Contact Periods		
		Cat.	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE301	Service Oriented Architecture	PE	3	3	0	0	3	40	60	100
22CSPE302	Cloud Computing	PE	3	3	0	0	3	40	60	100
22CSPE303	Open-Source Technologies	PE	3	3	0	0	3	40	60	100
22CSPE304	Big Data Analytics	PE	3	3	0	0	3	40	60	100
22CSPE305	User Interface Design	PE	3	3	0	0	3	40	60	100
22CSPE306	E-Commerce	PE	3	3	0	0	3	40	60	100

List of Professional Electives IV										
Subject Code	**Subject Name**	**Category**						**Contact Periods**		
		Cat.	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE401	Wireless Sensor Networks	PE	3	3	0	0	3	40	60	100
22CSPE402	Mobile Application Development	PE	3	3	0	0	3	40	60	100
22CSPE403	Data Visualization Technique	PE	3	3	0	0	3	40	60	100
22CSPE404	Predictive Data Analytics	PE	3	3	0	0	3	40	60	100
22CSPE405	Game Theory and its Applications	PE	3	3	0	0	3	40	60	100
22CSPE406	Business Intelligence and its Application	PE	3	3	0	0	3	40	60	100

List of Professional Electives V										
Subject Code	**Subject Name**	**Category**						**Contact Periods**		
		Category	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE501	Information Security	PE	3	3	0	0	3	40	60	100
22CSPE502	Data Science	PE	3	3	0	0	3	40	60	100
22CSPE503	Deep Learning	PE	3	3	0	0	3	40	60	100
22CSPE504	Social Network Analysis	PE	3	3	0	0	3	40	60	100
22CSPE505	Natural Language Processing	PE	3	3	0	0	3	40	60	100
22CSPE506	Ethical Hacking	PE	3	3	0	0	3	40	60	100

List of Open Electives offered to other departments										
Subject Code	**Subject Name**	**Category**						**Contact Periods**		
		Category	Contact Periods	Lecture	Tutorial/Demo*	Practical	Credit	CA	FE	Total
22CSOE01	Object Oriented Programming using C++	OE	3	3	0	0	3	40	60	100
22CSOE02	Operating Systems	OE	3	3	0	0	3	40	60	100
22CSOE03	Computer Networks	OE	3	3	0	0	3	40	60	100

22CSOE04	Python Programming	OE	3	3	0	0	3	40	60	100
22CSOE05	Java Programming	OE	3	3	0	0	3	40	60	100
22CSOE06	Computer Organization and Architecture	OE	3	3	0	0	3	40	60	100
22CSOE07	Data Structures using C++	OE	3	3	0	0	3	40	60	100
22CSOE08	Cloud Computing	OE	3	3	0	0	3	40	60	100
22CSOE09	Artificial Intelligence and Machine Learning	OE	3	3	0	0	3	40	60	100

Computer Science and Engineering Scheme of Instruction

Course work	**Credits recommended by AICTE**	**Credit % for AICTE recommendation**	**Credits**	**Credit %**
Humanities and Social Sciences (HS)	12	7.54	12	7.4
Basic Sciences (BS)	24	15.09	27	16.6
Engineering Science (ES)	29	18.23	23	14.19
Program Core (PC)	49	30.81	57	35.18
Program Electives (PE)	15	9.43	15	9.37
Open Electives (OE)	9	5.66	9	5.6
Empl. Enhancement Courses (EEC)	15	9.43	13	8.02
Naan Mudhalvan Scheme	6	3.77	6	3.75
Mandatory Courses(MC) (Zero Credit)	0	0	0	0
Total	**159**	**100**	**162**	**100**

HS	Humanities and Social Sciences
BS	Basic Sciences
ES	Engineering Sciences
PC	Program Core
PE	Program Elective
OE	Open Electives
EEC	Employability Enhancement Courses
MC	Mandatory Courses

COMPUTER SCIENCE AND ENGINEERING- FULL TIME

REGULATION 2022 – SYLLABUS

SEMESTER-I

<table>
<tr><td>22MC101</td><td colspan="2">INDUCTION PROGRAM</td><td colspan="2">Semester</td><td>I</td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>MC</td><td colspan="2">Credit</td><td>0</td></tr>
<tr><td colspan="2" rowspan="2"></td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="7">INDUCTION PROGRAM (MANDATORY) - 3 WEEKS DURATION</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td colspan="7">Total = 21 Days</td></tr>
</table>

22EN101	COMMUNICATIVE ENGLISH	Semester	I

PREREQUISTIES	CATEGORY	HS	Credit		3
Basic language skills listening, speaking, reading and writing	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, writing and 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 | **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 | **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 | **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 | **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 | **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	L2: Understanding
CO2	:	use language effectively at technical and professional contexts	L3: Applying
CO3	:	apply the academic and functional writing skills in formal and informal communicative contexts	L3: Applying
CO4	:	interpret pictorial representation of statistical data and charts	L3: Applying

COURSE ARTICULATION MATRIX

COs /POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	0	0	0	1	0	0	0	0	1	3	0	1	0	0	1
CO2	0	0	0	1	0	0	0	0	1	3	0	2	0	0	2
CO3	0	0	0	2	0	0	0	0	1	3	0	1	0	0	1
CO4	0	0	0	3	0	0	0	0	1	3	0	1	0	0	1
Avg	0	0	0	1.75	0	0	0	0	1	3	0	1.25	0	0	1.25

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

22MA101	MATRICES, CALCULUS AND ORDINARY DIFFERENTIAL EQUATION B.E. (Common to all Branches Except EEE)	Semester			I
PREREQUISITES	**Category**	**BS**	**Credit**		**4**
Basic 12th 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 (45+15) = 60 Periods

Text Books:

1	Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2015.
2	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 3rd Edition, Narosa Publications, New Delhi, 2007.

Reference Books:

1	James Stewart, "Essential Calculus", 2nd edition, Cengage Learning, New Delhi, 2014.
2	P. Kandasamy, K. Thilagavathy and K. Gunavathy," Engineering Mathematics (For I year B.E., B. Tech)", 9th 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", 9th Edition, John Wiley & Sons, 2007.
5	Siva Ramakrishna Das.P, Ruknmangadachari.E. "Engineering Mathematics", 2nd 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	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	**3**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
CO2	**3**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
CO3	**3**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
CO4	**3**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
CO5	**3**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
Avg	**3**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22PH101	ENGINEERING PHYSICS	Semester			I
PREREQUISITES	**Category**	**BS**	**Credit**		**4**
Basic knowledge in sound, light and heat	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**1**	**0**	**4**

Course Learning Objectives

1	To understand Principles of ultrasonic production , its applications and acoustics of buildings
2	To understand Principle,working and industrial applications of LASER and optical fiber
3	To gain knowledge in mode of transmission of heat by conduction mechanism with experimental illustrations
4	To obtain knowledge in basic concepts of quantum physics and matter waves
5	To acquire knowledge in basics of crystal structure ,types of crystal , its defects and crystal growth techniques

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, spontaneous emission and stimulated emission –Population inversion – Pumping methods – Types of laser- Nd–YAG, CO_2 laser – 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 – Schrodinger'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 (45+15) = 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, New Delhi, 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	OrazioSvelto, David C. Hanna, 'Principles of Lasers', Springer Science & Business Media, LLC, 2010.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the principle to produce ultrasonic waves and acoustics of buildings.	Understand
CO2	Understand the principle and applications of laser & optical fiber.	Understand
CO3	Analyze various modes involved in heat transmission.	Analyze
CO4	Gain knowledge in the basic concept of quantum physics.	Remember
CO5	Recognize Crystal structure, crystal defects and crystal growth techniques.	Evaluate

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**1**	**0**
CO2	**2**	**3**	**1**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**1**	**0**
CO3	**3**	**2**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**
CO4	**3**	**2**	**1**	**1**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
CO5	**2**	**2**	**1**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**
Avg	**2.6**	**2.2**	**1**	**1**	**1.4**	**0.4**	**0.2**	**0**	**0**	**0**	**0**	**1.4**	**1.2**	**0.6**	**0.2**
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 (45+15) = 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	Remembrance
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**3**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**1**	**1**
CO2	**3**	**2**	**0**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**1**	**1**
CO3	**3**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**1**
CO4	**2**	**1**	**0**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**
CO5	**3**	**2**	**0**	**3**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**
Avg	**2.8**	**1.8**	**0**	**1.8**	**0**	**1.2**	**0**	**0**	**0**	**0**	**0**	**0**	**2.2**	**1.4**	**1.2**
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	L1 and L2
CO2	Use general problem-solving techniques to develop solutions to problems	L3
CO3	Apply the concepts of C programming to develop solutions by writing C programs	L3 and L4

COURSE ARTICULATION MATRIX

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

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

22MC102	தமிழர்மரபு	Semester			I
PREREQUISITES	Category	HSMC	Credit		0
Basics of Tamil	Hours/Week	L	T	P	TH
		1	0	0	1

அலகு I	மொழி மற்றும் இலக்கியம்	3	0	0	3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச்சார்பற்றதன்மை – சங்கஇலக்கியத்தில்பகிர்தல்அறம் – திருக்குறளில்மேலாண்மைக்கருத்துக்கள் – தமிழ்க்காப்பியங்கள், தமிழகத்தில்சமணபௌத்தசமயங்களின்தாக்கம்– பக்திஇலக்கியம், ஆழ்வார்கள்மற்றும்நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில்நவீனஇலக்கியத்தின்வளர்ச்சி – தமிழ்இலக்கியவளர்ச்சியில்பாரதியார்மற்றும்பாரதிதாசன்ஆகியோரின்பங்களிப்பு.

அலகு II	மரபு – பாறைஓவியங்கள்முதல்நவீன ஓவியங்கள் வரைசிற்பக்கலை	3	0	0	3

நடுகல்முதல்நவீனசிற்பங்கள்வரை – ஐம்பொன்சிலைகள் – பழங்குடியினர்மற்றும்தயாரிக்கும்கைவினைப்பொருட்கள், பொம்மைகள் – தேர்செய்யும்கலை – சுடுமண்சிற்பங்கள் – நாட்டுப்புறத்தெய்வங்கள்- குமரிமுனையில்திருவள்ளுவர்சிலை- இசைக்கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின்சமூகபொருளாதாரவாழ்வில்கோவில்களின்பங்கு.

அலகு III	நாட்டுப்புறக்கலைகள்மற்றும்வீரவிளையாட்டுகள்	3	0	0	3

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

அலகு IV	தமிழர்களின்திணைக்கோட்பாடுகள்	3	0	0	3

தமிழகத்தின்தாவரங்களும், விலங்குகளும் – தொல்காப்பியம்மற்றும்சங்கஇலக்கியத்தில்அகம்மற்றும்புறக்கோட்பாடுகள் – தமிழர்கள்போற்றியஅறக்கோட்பாடு – சங்ககாலத்தில்தமிழகத்தில்எழுத்தறிவும், கல்வியும் – சங்ககாலநகரங்களும்துறைமுகங்களும் – சங்ககாலத்தில்ஏற்றுமதிமற்றும்இறக்குமதி – கடல்கடந்தநாடுகளில்சோழர்களின்வெற்றி.

அலகு V	இந்தியதேசியஇயக்கம்மற்றும்இந்தியபண்பாட்டிற்குத் தமிழர்களின்பங்களிப்பு	3	0	0	3

இந்தியவிடுதலைப்போரில்தமிழர்களின்பங்கு – இந்தியாவின்பிறப்பகுதிகளில்தமிழ்ப்பண்பாட்டின்தாக்கம் – சுயமரியாதைஇயக்கம் – இந்தியமருத்துவத்தில், சித்தமருத்துவத்தின்பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப்புத்தகங்களின்அச்சுவரலாறு.

Total= 15 Periods

Text Books / Reference Books:

1. தமிழகவரலாறு – மக்களும்பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு :தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்.
2. கணினித்தமிழ் – முனைவர்இல.சுந்தரம்.(விகடன்பிரசுரம்)
3. கீழடி – வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம்(தொல்லியல்துறைவெளியீடு)
4. பொருநை – ஆற்றங்கரைநாகரிகம்(தொல்லியல்துறைவெளியீடு)

22MC102	HERITAGE OF TAMILS	Semester			I
PREREQUISITES	Category	BS	Credit		1
Basics of Tamil	Hours/Week	L	T	P	TH
		1	0	0	1

Unit I	LANGUAGE AND LITERATURE	3	0	0	3

3 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.

Unit II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3	0	0	3

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.

Unit III	FOLK AND MARTIAL ARTS	3	0	0	3

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Unit IV	THINAI CONCEPT OF TAMILS	3	0	0	3

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.

Unit V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3	0	0	3

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.

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)

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

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										3			1	
CO2	2	3											1	
CO3	2	3	3									3	2	
CO4	1	1	1									3	3	
Avg	**1.6**	**2.3**	**2**							**3**		**3**	**1.7**	

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

22ME102	WORKSHOP MANUFACTURING PRACTICES	SEMESTER I

PRE-REQUISITE	Category	ES	Credit		2
	Hours/Week	L	T	P	TH
		0	0	4	4

Course 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 = 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" manual 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 the course, the students will be able to:		Bloom's Taxonomy Mapped
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	Fabrication of components using welding, lathe and drilling machine.	Analyze
CO4	Make the model using sheet metal works.	Analyze

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
CO2	0	3	0	2	1	0	0	0	0	0	0	0	0	0	2
CO3	0	3	0	2	1	0	0	0	0	0	0	0	0	0	2
CO4	0	3	0	2	1	0	0	0	0	0	0	0	0	0	2
CO5	0	3	0	2	1	0	0	0	0	0	0	0	0	0	2
Avg	**0**	**2.4**	**0**	**1.6**	**0.8**	**0.6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1.6**

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

SEMESTER-II

22MA202	LINEAR ALGEBRA AND LINEAR PROGRAMMING PROBLEM	SEMESTER	II

PREREQUISTIES	CATEGORY	BS	Credit		4
Basic 12th level knowledge of Matrices and Determinants, Vectors and graphical drawing.	Hours/Week	L	T	P	TH
		3	1	0	4

Course Objectives:

1.	To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
2.	To understand the concepts of vector space, linear transformations and diagonalization.
3.	To apply the concept of inner product spaces in orthogonalization.
4.	To acquire knowledge to find the solution of LPP using graphical and simplex methods.
5.	To solve the transportation and assignment models of LPP.

UNIT I	VECTOR SPACES	9	3	0	12

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT II	LINEAR TRANSFORMATION AND DIAGONALIZATION	9	3	0	12

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigenvalues and eigenvectors - Diagonalizability.

UNIT III	INNER PRODUCT SPACES	9	3	0	12

Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

UNIT IV	INTRODUCTION TO LINEAR PROGRAMMING	9	3	0	12

Linear programming – formulation, solution by graphical and simplex methods (Primal- Penalty, Two Phase), Special cases- Dual Simplex method- Principles ofDuality.

UNIT V	LINEAR PROGRAMMING EXTENSIONS	9	3	0	12

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.

Total (45L+15T) = 60 Periods

Text Books:

1.	Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Cengage Learning, New Delhi, 2014.
2.	Taha, H.A., "Operations Research – An Introduction", 10th Edition, Pearson Education Edition, Asia, New Delhi,2019.

Reference Books:

1.	D.Poole, "Linear Algebra, A Modern introduction", 4th Edition, Brooks, 2014.
2.	V.Krishnamurthy, V.P. Mainra and J.L. Arora, "An Introduction to Linear Algebra", East-West press, Reprint 2005.

3.	R. Paneer Selvam, "Operations Research", 2nd Edition, Prentice Hall of India, 2002.
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.	L3: Applying
CO2	:	Apply the concept of linear transformations in diagonalizability.	L3: Applying
CO3	:	Illustrate the concept of inner product spaces in orthogonalization	L2: Understanding
CO4	:	Solve LPP by using Graphical and Simplex methods.	L3: Applying
CO5	:	Obtain the solution of Transportation and Assignment models.	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	1	1	0	0	0	0	0	0	0	0	2	0	0
CO2	3	2	1	1	0	0	0	0	0	0	0	0	2	0	0
CO3	3	2	1	1	0	0	0	0	0	0	0	0	2	0	0
CO4	3	2	1	2	0	0	0	0	0	0	0	0	2	0	0
CO5	3	2	1	2	0	0	0	0	0	0	0	0	2	0	0
Avg	**3**	**2**	**1**	**1.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**

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

22HS201	UNIVERSAL HUMAN VALUES	SEMESTER	II
PRE-REQUISITE:	Category	HS	Credit 3

	Hours/Week	L	T	P	TH
		2	1	0	3

Course Objectives:

1.	Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2.	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
3.	Strengthening of self-reflection.
4.	Development of commitment and courage to act.

UNIT I		6	3	0	9

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.

UNIT II		6	3	0	9

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.

UNIT III		6	3	0	9

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.

UNIT IV		6	3	0	9

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.

UNIT V		6	3	0	9

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.

Total (30L + 15T) = 45 Periods

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**	**PSO3**
CO1	0	0	1	0	0	1	0	2	0	1	0	3	2	0	1
CO2	0	0	1	0	0	3	0	1	0	1	0	3	1	0	1
CO3	0	0	1	0	0	2	0	1	0	1	0	3	1	0	2
CO4	0	0	2	0	0	1	0	1	0	1	0	3	1	0	1
Avg	**0**	**0**	**1.25**	**0**	**0**	**1.75**	**0**	**1.25**	**0**	**1**	**0**	**3**	**1.25**	**0**	**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:		**Bloom's Taxonomy Mapped**
Upon completion of this course, the students will be able to:		
CO1	Apply Boolean laws to derive simplified Boolean function and implement the circuit with logic components.	L2 and L3
CO2	Reproduce the existing design of combinational or sequential circuits of a computing device and scale them in size	L1 and L2
CO3	Analyze and design simple combinational or sequential circuits	L3 and L4

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	Semester			II
PREREQUISITES	Category	ES	Credit		4
	Hours/Week	L	T	P	TH
		4	0	0	4

Course Learning Objectives

1	To understand and analyze basic electric circuits.
2	To study the working principle of electrical machines and transformers.
3	To study basics of electronic devices and operational amplifiers.
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 Kirchoff'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, 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 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 (45+15) = 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**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	1	1	0	0	0	0	0	0	0	0	1	1	**0**	0	0
CO2	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0
CO3	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
CO4	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
CO5	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Avg	**1**	**0.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22ME101	ENGINEERING GRAPHICS AND DESIGN	Semester			II
PREREQUISITES	**Category**	**ES**	**Credit**		**3**
Students should know about the basics of drawings. Students should be able to construct geometric shapes	**Hours/Week**	**L**	**T**	**P**	**TH**
		1	**0**	**4**	**5**

Course Learning Objectives

1	To impart knowledge on graphical skills for communications of concepts, ideas and design of engineering products and to provide exposure to design.
2	To expose them to existing national standards related to technical drawings.
3	To understand the basics of points, lines, planes and solids.
4	To understand the basics of the surface of an object.
5	To expose them to isometric and perspective views of simple solids.

Unit I	**PROJECTION OF POINTS, LINES AND PLANE SURFACES**	**3**	**0**	**12**	**15**

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.

Unit II	**PROJECTION OF SOLIDS**	**3**	**0**	**12**	**15**

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.

Unit III	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**	**3**	**0**	**12**	**15**

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.

Unit IV	**ORTHOGRAPHIC AND ISOMETRIC PROJECTION**	**3**	**0**	**12**	**15**

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.

Unit V	**PERSPECTIVE PROJECTION**	**3**	**0**	**12**	**15**

Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

Total (15+60) = 75 Periods

Text Books:

1	Bhatt, N.D.,Panchal V M and Pramod R. Ingle, “Engineering Drawing”, Charotar Publishing House, 53rd Editio 2014.
2	Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

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	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	1	0	0	0	0	0	0	0	0	0	0	3	1	0
CO2	3	1	0	0	0	0	0	0	0	0	0	0	3	1	0
CO3	3	1	0	0	0	0	0	0	0	0	0	0	3	1	0
CO4	3	1	0	0	0	0	0	0	0	0	0	0	3	1	0
CO5	3	1	0	0	0	0	0	0	0	0	0	0	3	1	0
Avg	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**1**	**0**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

22MCIN01	ENGINEERING SPRINTS	Semester			II
PREREQUISITES	Category	EEC	Credit		1
	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:	
CO1	Apply street fight engineering concepts
CO2	Construct Flowchart & block diagrams for algorithms
CO3	Apply the idea Hexagon Tool to understand basic electronics for building basic hardware
CO4	Examine real-world problems with a system view

22MC201	TAMILS AND TECHNOLOGY	Semester			II
PREREQUISITES	Category	HS MC	Credit		0
	Hours/Week	L	T	P	TH
		1	0	0	1

Course Learning Objectives

1	
2	
3	

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)

22NC201	NCC COURSE-I (Only for NCC Students)	Semester			II
PREREQUISITES	**Category**	**NC**	**Credit**		**3**
NIL	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To maintain the unity and disciplines to the students

Unit I	**NCC GENERAL & NATIONAL INTEGRATION AND AWARENESS**	**9**	**0**	**0**	**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.

Unit II	**PERSONALITY DEVELOPMENT & LEADERSHIP DEVELOPMENT**	**9**	**0**	**0**	**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.

Unit III	**DISASTER MANAGEMENT AND HEALTH & HYGIENE**	**9**	**0**	**0**	**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.

Unit IV	**PRINCIPLES OF FLIGHT & GENERAL SERVICE KNOWLEDGE**	**9**	**0**	**0**	**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.

Unit V	**NAVIGATION, AEROENGINES, AIRCOMPAIGNS & AIRMANSHIP**	**9**	**0**	**0**	**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.

Total = 45 Periods

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

PRE-REQUISITE	CATEGORY	HS	Credit		1
	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	**0**	**0**	**9**	**9**
Reading – Reading a short story – learning pronunciation, intonation, and splitting of sentences to form meaningful units. Speaking – Narrating a story without any help of handouts.				
UNIT II	**0**	**0**	**9**	**9**
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	**0**	**0**	**9**	**9**
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	**0**	**0**	**9**	**9**
Reading – Reading dialogue scripts – learning expression, tone, stress and co-operative reading. Speaking –Proposing welcome address, vote of thanks and organizing events.				
UNIT V	**0**	**0**	**9**	**9**
Reading – Reading technical descriptions of gadgets – learning the different parts of devices. Speaking – Describing a process – everyday technical activities like taking printouts, purchasing equipment for a company, booking a hall for meetings etc.,				

Total (0T+45P) = 45 Periods

Text Books:

1.	Norman Whitby. Business Benchmark – Pre-Intermediate to Intermediate, Students book, Cambridge University Press, 2014.

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-References:	
1.	https://www.talkenglish.com/
2.	https://www.readingrockets.org/

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

COURSE ARTICULATION MATRIX

CO/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	0	0	0	1	0	0	0	0	2	3	0	1	0	0	1
CO2	0	0	0	1	0	0	0	0	2	3	0	1	0	0	1
CO3	0	0	0	2	0	0	0	0	2	3	0	1	0	0	1
CO4	0	0	0	2	0	0	0	0	2	3	0	1	0	0	3
Avg	**0**	**0**	**0**	**1.5**	**0**	**0**	**0**	**0**	**2**	**3**	**0**	**1**	**0**	**0**	**1.5**

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

22PH103	PHYSICS LABORATORY	SEMESTER	II

PRE-REQUISITE	CATEGORY	BS	Credit		1.5
There are no prerequisites for this course	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.	Applying
CO2	Calculate the important parameters and to arrive at the final result based on the experimental measurements.	Analyzing

COURSE ARTICULATION MATRIX															
CO/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	0	3	3	0	0	0	3	1	0	2	1	1	1
CO2	3	2	0	2	1	0	0	0	2	0	0	1	1	1	1
Avg	**3**	**2**	**0**	**2.5**	**2**	**0**	**0**	**0**	**2.5**	**1**	**0**	**1.5**	**1**	**1**	**1**
3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)															

22CY102	CHEMISTRY LABORATORY	SEMESTER	II

PRE-REQUISITE	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.	Understanding
CO2	To calculate the composition of brass quantitatively and the molecular weight of polymers.	Applying
CO3	To understand the principle and applications of conductometric and pH titrations, spectrometer, and potentiometric titrations.	Understanding

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	1	1	0	3	0	0	0	0	0	0	0	0	2	0	0
CO2	1	2	0	3	0	0	0	0	0	0	0	0	2	0	0
CO3	2	2	0	3	0	0	0	0	0	0	0	0	2	0	0
Avg	**1.3**	**1.7**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**

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

22EE102	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	SEMESTER	II

PRE-REQUISITE	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 losses in single phase Transformer.
5. Demonstration of cut-out sections of machines: induction machine (squirrel cage rotor), and single-phase induction motor.
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	PSO3
CO1	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0
CO2	1	1	0	0	0	0	0	0	0	0	1	1	0	0	0
CO3	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
CO4	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
CO5	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Avg	**1**	**0.4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**

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

SEMESTER-III

22MA303	PROBABILITY AND NUMERICAL METHODS	Semester			III
PREREQUISITES	Category	BS	Credit		4
	Hours/Week	L	T	P	TH
		3	1	0	4

Course Learning Objectives

1	To obtain the knowledge of standard distribution.
2	To understand the statistical averages and fitting of curve.
3	To gain the knowledge of significance test for large and small samples.
4	To obtain the knowledge about numerical solution of equations.
5	To acquire knowledge of numerical interpolation, differentiation and integration.

UNIT I	STANDARD DISTRIBUTION	9	3	0	12

Binomial, Poisson, Exponential, Gamma and Normal Distributions and their properties - Chebyshev's inequality. Joint distributions – Marginal and Conditional distributions – Correlation, Regression and rank correlation.

UNIT II	BASIC STATISTICS	9	3	0	12

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.

UNIT III	TEST OF HYPOTHESIS	9	3	0	12

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.

UNIT IV	SOLUTION OF EQUATIONS	9	3	0	12

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.

UNIT V	NUMERICAL SOLUTION FOR ORDINARY DIFFERENTIAL EQUATIONS	9	3	0	12

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.

Total (45+15) = 60 Periods

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",8thedition, 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.	L2
CO2	Learn about statistical averages and fitting the curves by Least Square Method.	L2
CO3	Use the Large and small sample tests.	L3
CO4	Solve equations by using numerical techniques.	L3
CO5	Acquire the techniques of interpolation, Numerical differentiation and integration.	L2

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 AND ARCHITECTURE	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, Memory Operations, 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, Booth Algorithm, 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, 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	Explain the working principle and operation of computer hardware components and its various functional units and Apply the operations of arithmetic unit to perform specific task	L2 and L3
CO2	Analyze the different types of control and compare them, Illustrate concept of pipelining and organize the various memory components including Cache memory and Virtual memory	L3, L4 and L5
CO3	Explain the different ways of communication with I/O devices and standard I/O interfaces	L3

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	
CO2	2	2									1	3		2
CO3	2	2									3	3		2
Avg	**2.3**	**2.3**									**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 Alternative Architectural 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 and Sons, 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 and Prof.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.	L1 and L2
CO2	Design and develop software systems	L5
CO3	Differentiate and Apply the various testing techniques for project management	L3 and L4

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
CO 2	3	3	3		2						2	3	3	
CO 3	3	3	3		2						2	3	3	
Avg	**3**	**3**	**3**		**2**						**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 - 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 - 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.	L1, L2, L3
CO2	Apply the different linear and non-linear data structures to solve real world problems.	L1, L2, L3 and L4
CO3	Critically analyze the various sorting, searching and hashing techniques.	L1, L2, L3 and L4

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

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.	L1, L2, L3
CO2	Apply the different linear and non-linear data structures to solve real world problems.	L1, L2, L3 and L4
CO3	Critically analyze the various sorting, searching and hashing techniques.	L1, L2, L3 and L4

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

PRE-REQUISITE:	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**	**PSO 3**
CO1	0	3	0	0	0	2	1	0	2	0	0	0	0	0	2
CO2	0	3	0	2	0	0	0	0	2	0	0	0	0	0	2
CO3	0	0	3	2	0	0	0	0	2	0	0	0	0	0	2
CO4	2	0	3	0	0	0	0	1	2	0	0	0	0	0	2
CO5	0	0	0	0	0	0	0	0	2	3	0	0	0	0	2
Avg	**0.4**	**1.2**	**1.2**	**0.8**	**0**	**0.4**	**0.2**	**0.2**	**2**	**0.6**	**0**	**0**	**0**	**0**	**2**

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

22NC301	NCC COURSE-II (Only for NCC Students)		SEMESTER III			
PRE-REQUISITE:		**Category**	**NC**	**Credit**		**0**
		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.	Remember and 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.	Remember and Understand

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	0	0	0	0	0	0	0	0	0	0	3	1	1
CO2	3	3	2	3	0	0	0	0	0	0	0	0	3	2	1
CO3	3	2	3	1	0	2	0	0	0	0	0	0	3	2	1
CO4	3	2	2	2	0	0	0	0	0	0	0	0	3	2	1
CO5	3	0	0	0	0	1	0	0	0	0	0	0	3	3	1
Avg	**3**	**1.6**	**1.4**	**1.2**	**0**	**0.6**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2**	**1**

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

22CS305	OPERATING SYSTEMS LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	PC	Credit		2
Problem Solving and 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	L2 and L3
CO2	Implement various commands using Shell Programming	L2 and L3
CO3	Apply various functionalities of operating system to solve problems.	L2 and L3

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
Problem Solving and 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	Decide a suitable data structure and algorithm to solve a real world problem.	L2 and L3
CO2	Understand various linear and non-linear data structures such as stacks, queues, trees, graphs, etc. to solve various computing problems.	L2 and L3
CO3	Demonstrate understanding of various sorting techniques and searching techniques.	L2 and L3

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)														

SEMESTER- IV

22MA401	DISCRETE MATHEMATICS	SEMESTER	IV
PREREQUISTIES	**CATEGORY**	**BS**	**Credit** 4

	L	T	P	TH
Hours/Week	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.	L2
CO2	Have an understanding in identifying structures on many levels.	L2
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.	L3
CO4	Be exposed to concepts and properties of algebraic structures such as groups, rings and fields.	L3
CO5	Familiar with Lattices and Boolean algebra.	L2

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)

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 problem.

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.	L4
CO2	Apply appropriate design technique for a problem.	L3
CO3	Modify existing algorithms to improve efficiency.	L2 and L3

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	L4 and L6
CO2	Establish equivalence among computational models of equivalent capacities.	L2 and L3
CO3	Recall the procedures involved in the construction of computational models.	L1

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
Problem Solving and C Programming	Hours/Week	L	T	P	TH
		3	0	0	3

Course 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 steam 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	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.	L1 and L2
CO2	Apply Object Oriented Programming concepts for problem solving.	L3
CO3	Design solutions to real world problems using Object Oriented Concepts.	L1,L2, L3 and L4

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 assembler directives – 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.	L2
CO2	Design Memory Interfacing circuits.	L1
CO3	Design and interface I/O circuits.	L1
CO4	Design and implement 8051 microcontroller based systems.	L3

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

PRE-REQUISITE:	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	Applying
CO2	Apply system thinking concepts in reverse engineering	Applying
CO3	Apply user research techniques to meet the UX needs of a customer and design a visual prototype	Applying
CO4	Develop prototyping models using the tools from mechanical prototyping models	Applying
CO5	Develop prototyping models using the tools from electrical and software prototyping methods	Applying

COURSE ARTICULATION MATRIX

CO/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	0	1	0	0	0	0	0	2	0	0	0	0	0	2
CO2	2	3	0	0	0	0	0	0	2	0	0	0	0	0	2
CO3	3	0	1	0	0	0	0	1	2	0	0	0	0	0	2
CO4	0	0	3	2	3	0	0	0	2	0	0	0	0	0	2
CO5	2	0	2	0	1	0	0	0	2	0	0	0	0	0	2
Avg	**2**	**0.6**	**1.4**	**0.4**	**0.8**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**

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

2CYMC01	ENVIRONMENTAL SCIENCE	SEMESTER IV

PREREQUISTIES	CATEGORY	MC	Credit		0
Basic Science	Hours/Week	L	T	P	TH
		3	0	0	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) Revised 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-Hall 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.	L2: Understanding & L4: Analyzing
CO2	**:**	Predict the methods to conserve energy and ways to make optimal use of the energy for the future.	L3: Applying

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO1 1**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	0	1	3	0	0	3	1	1	0	0	0	1	2	0	1
CO2	0	1	3	0	0	3	1	1	0	0	0	1	2	0	1
Avg	**0**	**1**	**3**	**0**	**0**	**3**	**1**	**1**	**0**	**0**	**0**	**1**	**2**	**0**	**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
Problem Solving and 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	L2, L3, L4 and L5
CO2	Build Generic Programming	L2 and L3
CO3	Develop program for handling exceptions	L2, L3, L4 and L5

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)

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
5.	Be familiar with MASM

EXPERIMENTS

8086 Programs using kits and MASM

1.	Basic arithmetic and Logical operations
2.	Move a data block without overlap
3.	Code conversion, decimal arithmetic and Matrix operations.
4.	Floating point operations, string manipulations, sorting and searching
5.	Password checking ,Print RAM size and system date
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.	Printer status
12.	Serial interface and Parallel interface
13.	A/D and D/A interface and Waveform Generation

8051 Experiments using kits and MASM

7.	Basic arithmetic and Logical operations
8.	Square and Cube program, Find 2's complement of a number
9.	Unpacked BCD to ASCII

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

LAB EQUIPMENT FOR SOFTWARE(A BATCH OF 30 STUDENTS):	
4.	Intel Desktop Systems with MASM–30 nos
5.	8086 Assembler 8051 Cross Assembler

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	L1
CO2	Interface different I/O switch processor	L3
CO3	Generate waveforms using Microprocessors	L3
CO4	Execute Programs in 8051	L3
CO5	Explain the difference between simulator and Emulator	L2

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)

SEMESTER V

22CS501	DATABASE MANAGEMENT SYSTEMS				SEMESTER V
PREREQUISITES		Category	PC	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 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 Publications, 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 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	L2 & L3
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	L2 & L6
CO3	Describe and analyze the general idea of data storage, indexing techniques and query processing and Develop a simple database for applications	L4& L6

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
CO 2	3	3	3			3						3	3	3
CO 3	3				3	3				3	3	3	3	3
Avg	**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	L3
CO2	Build the standalone applications and applet applications	L6
CO3	Develop simple chart application and Database Connectivity	L6

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3												
CO 2	3	3	3		3				3		3	3	3	2
CO 3	3	3	3	3	3				3		3	3	3	2
Avg	**3**	**3**	**3**	**3**	**3**				**3**		**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
NIL		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.	L1 and L2
CO2	Apply the various functionalities of OSI layers in real time applications	L2 and L3
CO3	Analyze the various network issues in different layers and provide suitable solutions.	L2, L3 and L4

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**

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.	L1 and L2
CO2	Compute the information to perform the task of a compiler phase.	L3 and L4
CO3	Recall the principles and algorithms involved in compiler construction.	L1

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)

22MC301	INDIAN CONSTITUTION	SEMESTER V

PREREQUISITES	CATEGORY	MC	Credit		0
	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 (6 L) = 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	L2
CO2	explain the key concepts of Indian Political System	L2
CO3	describe the role of constitution in a democratic society.	L1
CO4	present the structure and functions of the Central and State Governments, the Legislature and the Judiciary	L2

22CS505	DATABASE MANAGEMENT SYSTEMS LABORATORY	SEMESTER V			
REREQUISITES	**CATEGORY**	**PC**	**Credit**		**2**
C++, Java	**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)= 60 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Build tables, construct relationships among them and retrieve data with simple and complex queries.	L6
CO2	Build various constraints, triggers and indexes on the tables.	L6
CO3	Design and implement a database and to integrate into a simple application.	L6

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
CO 2			3				3				3		3	3
CO 3			3				3				3		3	3
Avg			**3**				**3**				**3**		**3**	**3**

3 / 2 /1 - indicates strength of correlation (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:		**Bloom's Taxonomy Mapped**
After the successful completion of the practical session, the students will be able to		
CO1	Implement object oriented programming concepts and java features	L2 and L3
CO2	Develop Java standalone applications and applet applications	L6
CO3	Build simple chat applications and database connectivity applications	L6

COURSE ARTICULATION MATRIX

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

	CATEGORY	HS	T	P	2
	Hours/Week	L	T	P	TH
		0	0	4	4

PREREQUISITES

1. Basic knowledge in reading skill and writing skill
2. Basic ability in listening skill and speaking skill

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 (60)= 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	L3: Applying
CO2	develop adequate soft skills and career skills required for the workplace	L6: Creating
CO3	make effective presentations on given topics	L6: Creating
CO4	apply their verbal ability and reasoning ability in campus interviews	L3: Applying

COURSE ARTICULATION MATRIX

COs /POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	0	0	0	1	0	0	0	0	2	3	0	1	0	0	1
CO2	0	0	0	2	0	0	0	0	2	3	0	1	0	0	2
CO3	0	0	0	2	0	0	0	0	1	3	0	1	0	0	1
CO4	0	0	0	1	0	0	0	0	2	3	0	1	0	0	2
Avg	0	0	0	1.5	0	0	0	0	1.75	3	0	1	0	0	1.5

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

SEMESTER VII

22CS701	CRYPTOGRAPHY AND NETWORK SECURITY	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 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. (Unit - V)

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	L2
CO2	Apply various cryptographic operations of Symmetric key and Asymmetric key Cryptography Algorithms	L3
CO3	Apply various Authentication schemes to simulate different applications.	L2 & L3
CO4	Understand the concept of Network security applications and System security standards.	L2 & L3

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	SEMESTER VII			
PREREQUISITES	**CATEGORY**	**PC**	**Credit**		**3**
Object Oriented Programming	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course 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 FUNCTIONS**	**9**	**0**	**0**	**9**

Conditionals and loops-if statement-else statement – elif-Conditional Expressions-while statement-for statement – break-continue –pass- Functions-Calling functions-Creating functions-Passing Functions-Formal Arguments-Variable length arguments- Variable scope – Recursion- Map, Filter, Reduce and List Comprehensions.

UNIT III	**PYTHON EXCEPTIONS, MODULES , PACKAGES AND FILES**	**9**	**0**	**0**	**9**

Errors and Exceptions – Introduction-Detecting and handling Exceptions- Raising Exceptions – Assertions-Standard Exceptions – Modules – Packages - Files and Input/ Output.

UNIT IV	**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.

UNIT V	**GRAPHICAL USER INTERFACES (GUI) AND DATABASES**	**9**	**0**	**0**	**9**

GUI: Using Module tkinter - Building a Basic GUI-Customizing the Visual Style-Object –Oriented GUIs. Databases: Creating and populating-Retrieving Data-Updating and Deleting –Using NULL for Missing Data-Using Joins to Combine Tables-Keys and constraints.

Total (45 L) =45 Periods

Text Books:

1.	Wesley J.Chun-"Core Python Programming" –Prentice Hall, Third Edition, 2012.
2.	Paul Gries, Jennifer Campbell, Jason Montojo , "Practical Programming, An Introduction to Computer Science Using Python 3.6", The Pragmatic Bookshelf, Third Edition,2017.

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 the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	To understand the basic concepts of python programming.	L1 and L2
CO2	To design simple programs using python programming concepts.	L3
CO3	To apply python programming concepts in the real world application.	L1,L2, L3 and L4

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)

22CS703	MACHINE LEARNING	SEMESTER VII

PREREQUISITES	CATEGORY	PC	Credit		C
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.

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recall or apply the machine learning fundamentals	L1, L3
CO2	Reproduce or apply the learning techniques	L2, L3

COURSE ARTICULATIONMATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1												1	2
CO2		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	L1, L2
CO2	Identify solution for each functionality at each layer	L2, L3
CO3	Develop a mobile application.	L5

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

	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 basic management functions and planning techniques; also have same basic knowledge on international aspect of management.	L1, L2
CO2	Interpret the managerial functions like organizing, staffing and directing with motivational theories.	L1, L2
CO3	Understand analytical, developmental, technical skills, communication and controlling techniques to managing organizations.	L1, L2

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
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		L	T	P	TH
	PC	0	0	4	2

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	L3
CO2	Choose appropriate criteria to report machine learning model performance	L3

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	3	3
CO2	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)

SEMESTER VIII

<table>
<tr><td>22CS801</td><td colspan="2">PROJECT WORK</td><td colspan="4">SEMESTER VIII</td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>CATEGORY</td><td>EEC</td><td colspan="2">Credit</td><td>6</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>0</td><td>0</td><td>12</td><td>6</td></tr>
<tr><td colspan="7">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.</td></tr>
</table>

List of Professional Electives I

Subject Code	Subject Name	Category						Contact Periods		
		Cat.	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE101	Software Project Management	PE	3	3	0	0	3	40	60	100
22CSPE102	Artificial Intelligence	PE	3	3	0	0	3	40	60	100
22CSPE103	Web Technology	PE	3	3	0	0	3	40	60	100
22CSPE104	Agile Technology	PE	3	3	0	0	3	40	60	100
22CSPE105	Data Mining and Warehousing	PE	3	3	0	0	3	40	60	100
22CSPE106	Computer Hardware and Troubleshooting	PE	3	3	0	0	3	40	60	100

List of Professional Electives II

Subject Code	Subject Name	Category						Contact Periods		
		Cat.	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE201	Software Quality and Testing	PE	3	3	0	0	3	40	60	100
22CSPE202	Blockchain Technologies	PE	3	3	0	0	3	40	60	100
22CSPE203	Parallel Computing Architecture and Programming	PE	3	3	0	0	3	40	60	100
22CSPE204	Computer Graphics and Multimedia	PE	3	3	0	0	3	40	60	100
22CSPE205	Object Oriented Analysis and Design	PE	3	3	0	0	3	40	60	100
22CSPE206	Cyber Forensics	PE	3	3	0	0	3	40	60	100

List of Professional Electives III

Subject Code	Subject Name	Category						Contact Periods		
		Cat.	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE301	Service Oriented Architecture	PE	3	3	0	0	3	40	60	100
22CSPE302	Cloud Computing	PE	3	3	0	0	3	40	60	100
22CSPE303	Open-Source Technologies	PE	3	3	0	0	3	40	60	100
22CSPE304	Big Data Analytics	PE	3	3	0	0	3	40	60	100
22CSPE305	User Interface Design	PE	3	3	0	0	3	40	60	100
22CSPE306	E-Commerce	PE	3	3	0	0	3	40	60	100

List of Professional Electives IV

Subject Code	Subject Name	Category						Contact Periods		
		Cat.	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE401	Wireless Sensor Networks	PE	3	3	0	0	3	40	60	100
22CSPE402	Mobile Application Development	PE	3	3	0	0	3	40	60	100
22CSPE403	Data Visualization Technique	PE	3	3	0	0	3	40	60	100
22CSPE404	Predictive Data Analytics	PE	3	3	0	0	3	40	60	100
22CSPE405	Game Theory and its Applications	PE	3	3	0	0	3	40	60	100
22CSPE406	Business Intelligence and its Application	PE	3	3	0	0	3	40	60	100

List of Professional Electives V

Subject Code	Subject Name	Category						Contact Periods		
		Category	Contact Periods	L	T	P	C	CA	FE	Total
22CSPE501	Information Security	PE	3	3	0	0	3	40	60	100
22CSPE502	Data Science	PE	3	3	0	0	3	40	60	100
22CSPE503	Deep Learning	PE	3	3	0	0	3	40	60	100
22CSPE504	Social Network Analysis	PE	3	3	0	0	3	40	60	100
22CSPE505	Natural Language Processing	PE	3	3	0	0	3	40	60	100
22CSPE506	Ethical Hacking	PE	3	3	0	0	3	40	60	100

22CSPE101	SOFTWARE PROJECT MANAGEMENT	SEMESTER VI

PREREQUISITES	CATEGORY	PE	Credit		3
Software Engineering	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To understand the Software Project Planning and Evaluation techniques.
2.	To plan and manage projects at each stage of the software development life cycle (SDLC).
3.	To manage software projects and control software deliverables.
4.	To develop skills to manage the various phases involved in project management and people management.
5.	To deliver successful software projects that support organization‘s strategic goals.

UNIT I	PROJECT EVALUATION AND PROJECT PLANNING	9	0	0	9

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT II	PROJECT LIFE CYCLE AND EFFORT ESTIMATION	9	0	0	9

Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.

UNIT III	ACTIVITY PLANNING AND RISK MANAGEMENT	9	0	0	9

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.

UNIT IV	PROJECT MANAGEMENT AND CONTROL	9	0	0	9

Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.

UNIT V	STAFFING IN SOFTWARE PROJECTS	9	0	0	9

Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.

Total (45 L)=45 Periods

Text Books:

1.	Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

Reference Books:

1.	Robert K. Wysocki ―Effective Software Project Management‖ – Wiley Publication, 2011.
2.	Walker Royce: ―Software Project Management‖- Addison-Wesley, 1998.
3.	Gopalaswamy Ramesh, ―Managing Global Software Projects‖ – McGraw Hill Education (India), Fourteenth Reprint 2013.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand Project Management principles while developing software	L1 and L2
CO2	Gain extensive knowledge about the basic project management concepts, framework and the process models.	L2
CO3	Analyze the risks involved in various project activities.	L4

COURSE ARTICULATION MATRIX

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

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

22CSPE102	ARTIFICIAL INTELLIGENCE	SEMESTER VI

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	Recall the fundamentals of Artificial Intelligence	L2
CO2	Apply the problem-solving strategies in Artificial Intelligence	L3
CO3	Design and demonstrate the behavior of a simple agent	L6

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	SEMESTER VI

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, PearsonEducation, Copyright 2010.

Course Outcomes:		**Bloom’s Taxonomy Mapped**
Upon completion of this course, the students will be able to:		
CO1	Understand about client- server communication and protocols used during communication.	L2
CO2	Design of interactive Web pages using scripting languages.	L2,L3 and L4
CO3	Implement the Servlet and Server side programs(JSP)	L3
CO4	Develop web pages using XML / XSLT.	L3 and L4

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	SEMESTER VI

PREREQUISITES	CATEGOR	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	L1 and L2
CO2	Understand how Agile Project Development is actually implemented	L1 and L2
CO3	Demonstrate the concepts of Scrum and Extreme Programming	L1, L2 and L3
CO4	Understand the concepts of Unified Process and EVE	L1 , L2 and L3

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	SEMESTER VI

PREREQUISITES	CATEGORY	PE	Credit	3
Database Management Systems	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.

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, Third 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	Discuss the fundamentals of data mining and preprocessing and Explain the basic concept of data warehousing and multidimensional model	L1 & L2
CO2	Develop association rule mining and classification algorithms. And Apply different clustering and outlier detection techniques.	L3 & L6
CO3	Create further interest in research and design of new Data Mining techniques and concepts	L3 & L4

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	3	2	2	3						3		3	
CO 2	3	3	3	2	2	3						3		3	
CO 3	3	3	3	2	2	3						3		3	
Avg	**3**	**3**	**3**	**2**	**2**	**3**						**3**		**3**	

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

22CSPE106	COMPUTER HARDWARE AND TROUBLESHOOTING	SEMESTER 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	L1 and L2
CO2	Familiar with hardware and technology of computer	L2
CO3	Apply the knowledge for installation and maintenance of computer	L2 and L3
CO4	Understand the issues in troubleshooting	L2,L3 and L4

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1			1								1		1		
CO 2			1		1						1		1		
CO 3			1	1	1	2					2		1		
CO 4			1	2	1						2		1		
Avg			**1**	**1.5**	**1**	**2**					**1.5**		**1**		

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

22CSPE201	SOFTWARE QUALITY AND TESTING	SEMESTER VI

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	L1, L2 & L3
CO2	Understand the concepts of metrics, and models in software quality assurance	L1 & L2
CO3	Develop the procedures and workbenches for various testing process.	L5 & L6
CO4	Apply various testing process to the software systems.	L1,L2 &L3

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	SEMESTER VI

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

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	L1 and L2
CO2	Illustrate decentralization and practical aspects of cryptography	L1 and L2
CO3	Present bitcoin technology, alternative coins and smart contracts	L1 and L2
CO4	Develop a distributed application using Ethereum	L3
CO5	Deploy an application using Hyperledger	L3

COURSE ARTICULATION MATRIX

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

PREREQUISITES	CATEGORY	PE	Credit		3
Computer Architecture, Programming language	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 Floyd‟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	L1 & L2
CO2	develop the parallel models and parallel algorithms for various problems	L3,L4, L5 & L6
CO3	analyses the performance of parallel algorithms	L4

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	SEMESTER VI

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 graphics and apply two-dimensional transformation	L2, L3
CO2	Design and apply three-dimensional graphics and transformations.	L2, L3
CO3	Design various software programs used in the creation and implementation of multi-media (interactive, motion/animation, presentation, etc.).	L2, L3
CO4	Design hypermedia messaging and distributed multimedia systems.	L3

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
CO4	2	3	2	2	3	2	-	-	-	2	2	2	1	2
Avg	**2.5**	**3**	**2.5**	**1**	**3**	**1**	**-**	**-**	**-**	**2**	**1**	**2**	**2**	**1.5**

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

22CSPE205	OBJECT ORIENTED ANALYSIS AND DESIGN	SEMESTER VI

PREREQUISTIES	CATEGORY	PE	Credit		
		L	T	P	TH
NIL	Hours/Week	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	L3
CO2	Express software design with UML diagrams	L1 & L2
CO3	Understand the various testing methodologies for OO software	L1 & L2

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)

22CSPE206	CYBER FORENSICS	SEMESTER 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	L2
CO2	Apply different computer forensic tools to a given scenario	L3
CO3	Analyze and validate forensics data	L2, L4
CO4	Implement real-world hacking techniques to test system security	L2, L3

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**	**1**	**2**	**3**	**2.7**

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

22CSPE301	SERVICE ORIENTED ARCHITECTURE	SEMESTER VI

PREREQUISTIES	CATEGORY	PE	Credit		3
		L	T	P	TH
NIL	Hours/Week	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	L2
CO2	Understand service orientation, benefits of SOA	L2
CO3	Understand web services and WS standards	L2
CO4	Use web services extensions to develop solutions	L5
CO5	Understand and apply service modeling, service oriented analysis and design for application development	L2

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO2**	**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	CLOUD COMPUTING	SEMESTER 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	Explain the main concepts and architecture of Parallel computing, Distributed Computing and Cloud Computing.	L2
CO2	Analyze the concept of Virtualization, Cloud Architecture and Storage.	L4
CO3	Analyze the Cloud Platforms in Industry and Software Environments.	L2, L4
CO4	Identify the security issues in scientific and real time applications.	L2,L3

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**	**-**	**-**	**-**	**-**	**-**	**1.5**	**-**	**3**	**3**

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

22CSPE303	OPEN-SOURCE TECHNOLOGIES	SEMESTER VI

PREREQUISITES	CATEGORY	PE	Credit		C
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	L2
CO2	Apply the procedure to develop open-source software	L3

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)

22CSPE304	BIG DATA ANALYTICS	SEMESTER VI

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	L2
CO2	Use Hadoop ecosystem to process big data.	L3

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)

22CSPE305	USER INTERFACE DESIGN	SEMESTER VI

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	L1 & L2
CO2	Explain the characteristics and components of windows ,the various controls for the windows and various problems in windows design with color, text, graphics and To study the testing methods.	L4 ,L5
CO3	Illustrate various testing tools of interface designs.	L3 and L4

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	
CO 2	3		3		3					3	3	3	3	
CO 3	3		3		3					3	3	3	3	
Avg	**3**		**3**		**3**					**3**	**3**	**3**	**3**	

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

22CSPE306	E-COMMERCE	SEMESTER VI

PREREQUISTIES	CATEGORY	PE	Credit		C
		L	T	P	TH
NIL	Hours/Week	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	L2
CO2	Analyze the impact of E-commerce on business models and strategies	L4
CO3	Discuss legal issues and privacy in E-Commerce	L1
CO4	Describe Internet trading relationships including Business to Consumer, Business-to-Business, Intra-organizational	L3
CO5	Understand the business standards	L2

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**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	SEMESTER VII			
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.	L1and L2
CO2	Demonstrate various routing protocols for gathering information in Wireless sensor networks.	L1and L2
CO3	Illustrate different schemes for energy management in wireless sensor networks.	L2 and L3
CO4	Summarize various challenges, attacks and countermeasures for attacks in wireless sensor networks.	L2 and L3
CO5	Describe and install various operating systems used in wireless sensor networks.	L2 and L3

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1		1	1							1	1		1	
CO 2		1	1							2	1		1	2
CO 3		2	1							1	1		2	
CO 4		2	1							1	1		2	
CO 5		1	1							1	1		1	
Avg		**1.4**	**1**							**1.2**	**1**		**1.4**	**2**

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

22CSPE402	MOBILE APPLICATION DEVELOPMENT				SEMESTER VII
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	L1
CO2	Critique mobile applications on their design pros and cons	L4
CO3	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces	L5
CO4	Program mobile applications for the Android operating system that use basic and advanced phone features	L3
CO5	Deploy applications to the Android marketplace for distribution	L5

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)

22CSPE403	DATA VISUALIZATION TECHNIQUE	SEMESTER VII

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	L1, L2 and L3
CO2	Apply visualization techniques for various data analysis tasks – numerical data	L3
CO3	Apply visualization techniques for the applications using unstructured data	L3
CO4	Make use of different visualization techniques for the given problems	L3
CO5	Design information dashboard for Sales and marketing analysis	L6

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)

22CSPE404	PREDICTIVE DATA ANALYTICS	SEMESTER VII

PREREQUISTIES	CATEGORY	PE	Credit		3
		L	T	P	TH
NIL	Hours\Week	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	Explore the processing steps of predictive analysis for solving real time problems	L3
CO2	Make use of data for modeling project	L3
CO3	Utilize various descriptive modeling algorithms	L3
CO4	Implement different types of predictive modeling algorithms	L3
CO5	Apply predictive analytics concepts to real world applications	L3

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										3	1
CO2	1	1	1										3	1
CO3	1	1	1										3	1
CO4	1	1	1										3	1
CO5	1	1	1										3	1
Avg	1	1	1										3	1

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

2CSPE405	GAME THEORY AND ITS APPLICATIONS	SEMESTER VII

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	L1 & L2
CO2	Solve the real time games and present its optimized solution	L5 & L6
CO3	Apply the concept of games theory to identify the certainty of games.	L3

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)

22CSPE406	BUSINESS INTELLIGENCE AND ITS APPLICATION	SEMESTER VII

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 modelling, measurement technologies and process.

UNIT I	INTRODUCTION TO BUSINESS INTELLIGENCE	9	0	0	9

Business Enterprise Organizations, Functions & core business processes, Baldrige Business Framework, Key purpose 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	L2
CO2	Illustrate various operations of OLAP on Multidimensional data.	L3 and L4
CO3	Familiarize with ETL in the context of data warehousing.	L2
CO4	Design a data model at conceptual and logical levels.	L3 and L4

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)

22CSPE501	INFORMATION SECURITY	SEMESTER VIII

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	9	0	0	9

History of Information Security, What is Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Balancing Information Security and Access, The System Development Life Cycle, The Security System Development Life Cycle.

UNIT II	NEED FOR SECURITY	9	0	0	9

Business Needs First, Threats, Attacks; Legal, Ethical and Professional Issues in Information Security- Law and Ethics in Information Security, Code of Ethics and Professional Organizations.

UNIT III	RISK MANAGEMENT	9	0	0	9

An Overview of Risk Management-Risk Identification, Risk Assessment, Risk Control Strategies.

UNIT IV	PLANNING FOR SECURITY	9	0	0	9

Information Security Policy, Standards and Practices, The Information Security Blueprint, NIST Models, Design of Security Architecture, Continuity Strategies.

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, Vikas Publishing House, New Delhi, 2003.

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.

COURSEOUTCOMES: 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.	L1 and L2
CO2	Identify the common threats and security challenges.	L3
CO3	Analyze the possible security attacks in complex real time systems and their effective countermeasures.	L4

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	SEMESTER VIII

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	L1,L2 and L3
CO2	Utilize machine learning techniques for solving problems with large data	L3
CO3	Experiment with Hadoop and Spark framework for data science applications	L3
CO4	Apply the data science process to solve real world problem by using NoSQL database and Graph database	L3
CO5	Make use of text analytics techniques for building solutions for text mining problem	L3

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	DEEP LEARNING	SEMESTER VIII

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

Text Books:

1.	Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

Reference Books:

1.	Neural Networks: A Systematic Introduction, Raúl Rojas, 1996
2.	Pattern Recognition and Machine Learning, Christopher Bishop, 2007

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	L1 & L2
CO2	Explain the concept behind Recurrent Neural Networks and Identify the Generative Deep learning models	L4
CO3	Recognize the tangible applications of Deep learning.	L3 and L6

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	2	3						3		3	
CO 2	3	3	3	2	2	3						3		3	
CO 3	3	3	3	2	2	3						3		3	
Avg	**3**	**3**	**3**	**2**	**2**	**3**						**3**		**3**	

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

22CSPE504	SOCIAL NETWORK ANALYSIS	SEMESTER VIII

PREREQUISITES	CATEGORY	PE	Credit		3
Graph Theory	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.	L3 and L6
CO2	Represent knowledge using ontology.	L2
CO3	Predict human behaviour in social web and related communities.	L4
CO4	Visualize social networks.	L3

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	2				2	2	2	2	3	2
CO 2	3	3	3	3	2				2	2	2	2	3	2
CO 3	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)

22CSPE505	NATURAL LANGUAGE PROCESSING		SEMESTER VIII			
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	L2
CO2	Have a basic understanding of a variety of NLP tools	L2
CO3	Understand approaches to discourse, generation, dialogue and summarization within NLP	L2
CO4	Understand current methods for statistical approaches to machine translation	L2
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	L2

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**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)

List of Open Electives offered to other departments										
Subject Code	**Subject Name**	**Category**						**Contact Periods**		
		Category	Contact Periods	Lecture	Tutorial/Demo*	Practical	Credit	CA	FE	Total
22CSOE01	Object Oriented Programming using C++	OE	3	3	0	0	3	40	60	100
22CSOE02	Operating Systems	OE	3	3	0	0	3	40	60	100
22CSOE03	Computer Networks	OE	3	3	0	0	3	40	60	100
22CSOE04	Python Programming	OE	3	3	0	0	3	40	60	100
22CSOE05	Java Programming	OE	3	3	0	0	3	40	60	100
22CSOE06	Computer Organization and Architecture	OE	3	3	0	0	3	40	60	100
22CSOE07	Data Structures using C++	OE	3	3	0	0	3	40	60	100
22CSOE08	Cloud Computing	OE	3	3	0	0	3	40	60	100
22CSOE09	Artificial Intelligence and Machine Learning	OE	3	3	0	0	3	40	60	100

22CSOE01	OBJECT ORIENTED PROGRAMMING USING C++	SEMESTER VI			
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 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	**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:		**Bloom’s Taxonomy Mapped**
Upon completion of this course, the students will be able to:		
CO1	Familiarize the object oriented programming concepts, Generic Programming and handling exceptions.	L1 and L2
CO2	Apply Object Oriented Programming concepts for problem solving.	L3
CO3	Design solutions to real world problems using Object Oriented Concepts.	L1,L2, L3 and L4

22CSOE02	OPERATING SYSTEMS	SEMESTER VI

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	L1 and L2
CO2	Apply various services and concepts of operating system to real time applications	L2 and L3
CO3	Analyze the issues related to operating system and provide suitable solutions.	L2, L3 and L4

22CSOE03	COMPUTER NETWORKS	SEMESTER VI

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.	L1 and L2
CO2	Apply the various functionalities of OSI layers in real time applications	L2 and L3
CO3	Analyze the various network issues in different layers and provide suitable solutions.	L2, L3 and L4

22CSOE04	PYTHON PROGRAMMING				SEMESTER VI	
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.	L1 and L2
CO2	To design simple programs using python programming concepts.	L3
CO3	To apply python programming concepts in the real world application.	L1,L2, L3 and L4

22CSOE05	JAVA PROGRAMMING	SEMESTER VI

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	L1 and L2
CO2	Build the simple standalone applications and web applications	L3 , L4 and L6
CO3	Develop simple application using files and Database	L3, L4 and L6

22CSOE06	COMPUTER ORGANIZATION ANDARCHITECTURE	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	Describe in the working principle and operation of computer hardware components and its various functional units and Apply the operations of arithmetic and logic unit to perform specific task	L2 & L3
CO2	Analyze the different types of control and compare them, Illustrate concept of pipelining and Evaluate performance of various memory systems	L4 , L3 and L5
CO3	Summarize the different ways of communicating with I/O devices and standard I/O interfaces	L2

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 oriented programming, particularly in C++
2	To use object oriented programming to implement data structures
3	To introduce linear, non-linear data structures and their applications

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	Explain the concepts of Object oriented programming	L1 and L2
CO2	Write simple applications using C++.	L3
CO3	Discuss the different methods of organizing large amount of data.	L1,L2, L3 and L4

22CSOE08	CLOUD COMPUTING	SEMESTER VI

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, 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 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.	L2
CO2	Analyze the concept of Virtualization, Cloud Architecture and Storage.	L4
CO3	Analyze the Cloud Platforms in Industry and Software Environments.	L2 & L4
CO4	Identify the security issues in scientific and real time applications.	L2 & L3

22CSOE09	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	SEMESTER VI

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
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

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)

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	L1
CO2	Represent a problem using first order and predicate logic	L2
CO3	Differentiate between supervised, unsupervised, semi-supervised machine learning approaches	L4
CO4	Discuss the decision tree algorithm and identity and overcome the problem of over fitting	L2 & L3

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROFESSIONAL ELECTIVE COURSES: VERTICALS

(2022 Regulation)

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

22CSH101	EXPLORATORY DATA ANALYSIS		Semester			
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.	L2
CO2	Implement the data visualization using Matplotlib.	L6
CO3	Perform univariate data exploration and analysis.	L3
CO4	Apply bivariate data exploration and analysis.	L3
CO5	Use Data exploration and visualization techniques for multivariate and time series data	L3

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		Semester			
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.	L2
CO2	Implement machine-learning and data-mining algorithms in recommender systems data sets.	L6
CO3	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.	L6
CO4	Design and implement a simple recommender system.	L6
CO5	Learn about advanced topics of recommender systems	L1
CO6	Learn about advanced topics of recommender systems applications	L1

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**	**0.83**	**1.16**	**1**	**-**	**-**	**-**	**0.83**	**-**	**-**	**1**	**2**	**2**

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

22CSH103	NEURAL NETWORKS AND DEEP LEARNING	Semester			
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 (45+15) = 60 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.	L3
CO2	Understand the basics of associative memory and unsupervised learning networks.	L2
CO3	Apply CNN and its variants for suitable applications.	L3
CO4	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.	L4
CO5	Apply autoencoders and generative models for suitable applications.	L3

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**	**2.4**	**0.4**	**0**	**0**	**1.6**	**0.6**	**0.8**	**1**	**1.8**	**2**

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

22CSH104	TEXT AND SPEECH ANALYSIS		Semester			
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 (45+15) = 60 Periods

Text Books:

1	Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Langua Processing, 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	L2
CO2	Apply deep learning techniques for NLP tasks, language modelling and machine translation	L3
CO3	Explain coreference and coherence for text processing	L2
CO4	Build question-answering systems, chatbots and dialogue systems.	L6
CO5	Apply deep learning models for building speech recognition and text-to-speech systems	L3

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	Semester	
PREREQUISITES	Category	PE	Credit 3

	L	T	P	TH
Hours/Week	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 (45+15) = 60 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.	L2
CO2	Identify the business processes for extracting Business Intelligence	L3
CO3	Apply predictive analytics for business fore-casting	L3
CO4	Apply analytics for supply chain and logistics management	L3
CO5	Use analytics for marketing and sales.	L3

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	Semester	

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.	L2
CO2	Explain the techniques used for image pre-processing.	L2
CO3	Develop various object detection techniques.	L6
CO4	Understand the various face recognition mechanisms.	L2
CO5	Elaborate on deep learning-based video analytics.	L4

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		Semester			
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	To understand basic knowledge, theories and methods in image processing and computer vision.	L2
CO2	To implement basic and some advanced image processing techniques in OpenCV.	L3
CO3	To apply 2D a feature-based based image alignment, segmentation and motion estimations.	L3
CO4	To apply 3D image reconstruction techniques	L3
CO5	To design and develop innovative image processing and computer vision applications.	L6

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**	**0.4**	**0.25**	**-**	**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		Semester			
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. .	L1
CO2	Explain NoSQL big data management	L2
CO3	Install, configure, and run Hadoop and HDFS.	L3
CO4	Perform map-reduce analytics using Hadoop	L3
CO5	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.	L3

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	Semester	

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 .	L6
CO2	Implement a front-end web application using Angular.	L3
CO3	Will be able to create modules to organise the server	L6
CO4	Build RESTful APIs with Node, Express and MongoDB with confidence.	L6
CO5	Will learn to Store complex, relational data in MongoDB using Mongoose .	L2

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		Semester			
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
	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. .	L6
CO2	Develop hybrid applications with basic event handling.	L6
CO3	Implement cross-platform applications with location and data storage capabilities.	L3
CO4	Implement cross platform applications with basic GUI and event handling.	L3
CO5	Develop web applications with cloud database access.	L6

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	Semester	

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	L2
CO2	Describe the concepts of SOA	L1
CO3	Apply the Web services, some of the prevailing standards and technologies of Web Services	L3
CO4	Design approaches for providing security for XML documents as well as messages exchanged among Web Services	L6
CO5	Explain the concepts about Big data and SOA with its Business case analysis	L4

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		Semester			
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 (45+15) = 60 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	L6
CO2	Evaluate UX design of any product or application	L5
CO3	Demonstrate UX Skills in product development	L1
CO4	Implement Sketching principles	L3
CO5	Create Wireframe and Prototype	L6

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		Semester			
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	L2
CO2	Design Test planning and different activities involved in test planning	L6
CO3	Design effective test cases that can uncover critical defects in the application	L6
CO4	Carry out advanced types of testing	L2
CO5	Automate the software testing using Selenium and TestNG	L3

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	Semester	

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	L2
CO2	Be acquainted with the process for secure development and deployment of web applications	L2
CO3	Acquire the skill to design and develop Secure Web Applications that use Secure APIs	L2
CO4	Be able to get the importance of carrying out vulnerability assessment and penetration testing	L2
CO5	Acquire the skill to think like a hacker and to use hackers tool sets	L2

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**	**-**	**-**	**-**	**-**	**-**	**-**	**0.6**	**2**	**2**

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

22CSH207	DEVOPS		Semester			
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 (45+15) = 60 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.	L2
CO2	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.	L3
CO3	Ability to Perform Automated Continuous Deployment	L3
CO4	Ability to do configuration management using Ansible	L3
CO5	Understand to leverage Cloud-based DevOps tools using Azure DevOps	L2

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	Semester			
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
	R. Kent Dybvig, "The Scheme programming language", Fourth Edition, Prentice Hall, 2011.
	Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Pearson, 1997.
	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	L1
CO2	Explain data, data types, and basic statements of programming languages	L2
CO3	Design and implement subprogram constructs	L3
CO4	Apply object-oriented, concurrency, and event handling programming constructs and Develop programs in Scheme, ML, and Prolog	L3
CO5	Understand and adopt new programming languages	L2

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		Semester			
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.	L2
CO2	Apply the concept of virtualization and its types	L3
CO3	Experiment with virtualization of hardware resources and Docker	L3
CO4	Develop and deploy services on the cloud and set up a cloud environment.	L6
CO5	Explain security challenges in the cloud environment	L4

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	Semester	
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	L4
CO2	Apply the Virtualization for real-world applications	L3
CO3	Install & Configure the different VM platforms	L3
CO4	Experiment with the VM with various software	L3

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	Semester	
PREREQUISITES	Category	PE	Credit 3

	L	T	P	TH
Hours/Week	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.	L1
CO2	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services	L2
CO3	Solve the real world problems using Cloud services and technologies	L3
CO4	Understand the pricing model of cloud.	L2
CO5	Understand the Cloud service Governance and value	L2

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		Semester			
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	L6
CO2	Apply the OLAP Technology	L3
CO3	Analyse the partitioning strategy	L4
CO4	Critically analyze the differentiation of various schema for given problem	L4
CO5	Frame roles of process manager & system manager	L2

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**	**1**	**-**	**-**	**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	L1
CO2	Illustrate the usage of advanced intelligent storage systems and RAID	L3
CO3	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization	L4
CO4	Examine the different role in providing disaster recovery and remote replication technologies	L4
CO5	Infer the security needs and security measures to be employed in information storage management	L2

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		Semester			
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	L1
CO2	Identify the functions of the data plane and control plane	L3
CO3	Design and develop network applications using SDN	L6
CO4	Orchestrate network services using NFV	L4
CO5	Explain various use cases of SDN and NFV	L4

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)

22CSH307	STREAM PROCESSING	Semester	

PREREQUISITES	Category	PE	Credit		3
	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	Introduce Data Processing terminology, definition & concepts
2	Define different types of Data Processing
3	Explain the concepts of Real-time Data processing
4	Select appropriate structures for designing and running real-time data services in a business environment
5	Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

UNIT I	FOUNDATIONS OF DATA SYSTEMS	9	0	0	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

UNIT II	REAL-TIME DATA PROCESSING	9	0	0	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

UNIT III	DATA MODELS AND QUERY LANGUAGES	9	0	0	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

UNIT IV	EVENT PROCESSING WITH APACHE KAFKA	9	0	0	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

UNIT V	REAL-TIME PROCESSING USING SPARK STREAMING	9	0	0	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

Total (45 L) =45 Periods

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
	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.	L2
CO2	Describe and apply current research trends in data-stream processing.	L1
CO3	Analyze the suitability of stream mining algorithms for data stream systems.	L4
CO4	Program and build stream processing systems, services and applications.	L6
CO5	Solve problems in real-world applications that process data streams.	L3

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	Semester			
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.	L2
CO2	Explain the security challenges in the cloud.	L2
CO3	Define cloud policy and Identity and Access Management.	L1
CO4	Understand various risks and audit and monitoring mechanisms in the cloud.	L2
CO5	Define the various architectural and design considerations for security in the cloud.	L1

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)

22CSH401	CYBER PHYSICAL SYSTEMS	Semester	
PREREQUISITES	Category	PE	Credit 3

	L	T	P	TH
Hours/Week	3	0	0	3

Course Learning Objectives

1	To provide introduction to Microcontroller and Embedded Systems.
2	To equip students with essential tools for Embedded systems.
3	To foster understanding through real-world applications related to embedded systems
4	To know logics towards solving a unknown problem
5	To Familiarize cyber physical systems applications.

UNIT I	INTRODUCTION	9	0	0	9

Cyber-Physical System, Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

UNIT II	CPS PLATFORM COMPONENTS	9	0	0	9

CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN,Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model.

UNIT III	SYNCHRONOUS AND ASYNCHRONOUS MODEL	9	0	0	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..

UNIT IV	SECURITY OF CYBER-PHYSICAL SYSTEMS	9	0	0	9

Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Countermeasures, Advanced Techniques in CPS Securities.

UNIT V	CPS APPLICATION	9	0	0	9

Health care and Medical Cyber-Physical Systems, Smart grid and Energy Cyber Physical Systems, WSN based Cyber-Physical Systems, Smart Cities

Total (45 L) =45 Periods

Text Books:

1	E. A. Lee and S. A. Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”, 2011.
2	R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.

Reference Books:

1	Raj Rajkumar, Dionisio de Niz and Mark Klein, “Cyber-Physical Systems”, Addison- Wesley, 2017
2	Rajeev Alur, “Principles of Cyber-Physical Systems”, MIT Press, 2015
3	Fei Hu, “Cyber-Physical Systems”, CRC Press 2013

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.	L1
CO2	Present solution to automated systems to make life easier.	L2
CO3	Apply concepts of embedded systems and microcontroller to enhance existing systems	L1
CO4	Ability to develop concepts, logics towards solving a unknown problem in research and industry..	L2
CO5	Describe cyber physical systems applications	L1

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	Semester	
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	To express knowledge on basics of computer based vulnerabilities.	L1
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods	L2
CO3	To demonstrate the enumeration and vulnerability analysis methods.	L1
CO4	To gain knowledge on hacking options available in Web and wireless applications.	L2
CO5	To acquire knowledge on the options for network protection	L1
	To use tools to perform ethical hacking to expose the vulnerabilities	L3

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	Semester	

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 (45+15) = 60 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: 58450-389.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Have knowledge on digital forensics..	L1
CO2	Know about digital crime and investigations	L1
CO3	Be forensic ready.	L1
CO4	Investigate, identify and extract digital evidence from iOS devices	L4
CO5	Investigate, identify and extract digital evidence from Android devices	L4

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		Semester			
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	L5
CO2	Address Privacy and Security issues in Social Networking	L1
CO3	Explain the data extraction and mining of social networks	L2
CO4	Discuss the prediction of human behavior in social communities	L1
CO5	Describe the applications of social networks	L1

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		Semester			
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.	L2
CO2	Determine the concepts of symmetric encryption and authentication.	L1
CO3	Identify the use of public key encryption, digital signatures, and key establishment.	L3
CO4	Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.	L2
CO5	Express the use of Message Authentication Codes	L2

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	Semester	

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	L3
CO2	Apply security principles in software development	L3
CO3	Evaluate the extent of risks. .	L5
CO4	Involve selection of testing techniques related to software security in the testing phase of software development. .	L2
CO5	Use tools for securing software.	L3

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)

2CSH407	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	Semester	

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	L2
CO2	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.	L3
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.	L2
CO4	Apply hyper ledger Fabric and Ethereum platform to implement the Block chain Application.	L3

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		Semester			
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 (45+15) = 60 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	L2
CO2	Apply a number of different computer forensic tools for various crime and incident scenes	L3
CO3	Choose appropriate technique to validate forensics data	L2
CO4	Identify the vulnerabilities in a given network infrastructure and the role of ethical hacking	L3
CO5	Apply intrusion techniques to detect intrusion.	L3

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)

22CSM01	PROGRAMMING IN C++	Semester			
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.
5	

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.	L6
CO2	Familiarize and build the template functions and classes	L1
CO3	Disseminate and apply exception handling mechanisms.	L3
CO4	Depict and exploit steam classes.	L2

22CSM02	ADVANCED DATA STRUCTURES AND ALGORITHMS	Semester			
PREREQUISITES	Category	O E	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-H 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	L3
CO2	Apply the different Non-Linear Data Structures to solve problems	L3
CO3	Analyze and implement graph data structures to solve various computing problems.	L4
CO4	Critically analyze the various sorting and searching algorithms	L4

22CSM03	COMPUTER ORGANIZATION AND DESIGN		Semester			
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, Memory Operations, 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, Booth Algorithm, 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, 5 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 this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the working principle and implementation of computer hardware components and its various functional units	L2
CO2	Apply the operations of arithmetic unit to perform specific task	L3
CO3	Analyze the different types of control and the concept of pipelining	L4
CO4	Illustrate various memory components including Cache memory and Virtual memory	L3
CO5	Explain the different ways of communication with I/O devices and standard I/O interfaces	L2

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 & Son 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	L3
CO2	Apply various CPU scheduling algorithms to solve problems	L3
CO3	Analyze the needs and applications of process synchronization and deadlocks	L4
CO4	Apply the concepts of memory management including virtual memory and page replacement to the issues that occur in real time applications	L3
CO5	Solve issues related to file system implementation and disk management	L3

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	L2
CO2	Apply the error detection and correction methods and also identify the different network technologies	L3
CO3	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and routing technologies	L4
CO4	Illustrate the transport layer principles and reliable data transfer using protocols	L3
CO5	Analyze the application layer protocols and also the use of network security	L4

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

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. .	L5
CO2	Create own Python Modules, packages, functions and Exceptions. .	L6
CO3	Illustrate Object oriented Programming features and Regular Expressions.	L3
CO4	Create own Web programs, GUI and database programs.	L6

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, Ta 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 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.	L2
CO2	Design a database using ER diagrams and map ER into Relations and normalize the relations.	L6
CO3	Develop a simple database for applications	L6

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 (45+15) = 60 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.	L2
CO2	Analyze the concept of Virtualization	L4
CO3	Identify the approaches of SLA and programming model in Cloud	L3
CO4	Analyze the Cloud Platforms in Industry and Software Environments.	L4
CO5	Identify the security issues in scientific and real time applications.	L3