CURRICULUM

B.E – COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

CURRICULUM

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

SEMESTER II										
S. No.	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**			**Credit**	**Max. Marks**		
				L	**T**	**P**		**CA**	**FE**	**Total**
THEORY										
1	22MA202	Linear Algebra and Linear Programming Problems	BS	3	1	0	4	40	60	100
2	22HS201	Universal Human Values	HS	2	1	0	3	40	60	100
3	22AL201	Digital Principles and Computer Organization	ES	3	0	0	3	40	60	100
4	22EE101	Basic Electrical and Electronics Engineering	ES	3	1	0	4	40	60	100
5	22ME101	Engineering Graphics and Design	ES	1	0	4	3	40	60	100
6	22MCIN01	Engineering Sprints	EE	0	0	2	1	100	-	100
7	22MC201	Tamils and Technology/ தமிழரும்தொழில்நுட்பமும்	HS MC	1	0	0	1	100	-	100
8	22NC201	NCC COURSE – I (Only for NCC Students)	NC	3	0	0	3*	40	60	100
PRACTICAL										
9	22EN102	Professional Skills Laboratory	HS	0	0	2	1	60	40	100
10	22PH103	Physics Laboratory	BS	0	0	3	1.5	60	40	100
11	22CY102	Chemistry Laboratory	BS	0	0	3	1.5	60	40	100
12	22EE102	Basic Electrical and Electronics Engineering Laboratory	ES	0	0	3	1.5	60	40	100
						TOTAL	**24.5**			**1100**

SEMESTER III										
S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22MA307	Probability, Statistics and Stochastic Processes	BS	3	1	0	4	40	60	100
2	22AL301	Artificial Intelligence	PC	3	0	0	3	40	60	100
3	22AL302	Python Programming for Problem Solving and Data Analysis	PC	3	0	0	3	40	60	100
4	22AL303	Data Structures and Algorithm Analysis	PC	3	0	0	3	40	60	100
5	22AL304	Operating Systems	PC	3	0	0	3	40	60	100
6	22MCIN02	Innovation Sprints	EE	0	0	2	1	100	-	100
7	22NC301	NCC Course – II (Only for NCC Students)	NC	3	0	0	3*	40	60	100
PRACTICAL										
8	22AL305	Operating Systems Laboratory	PC	0	0	4	2	60	40	100
9	22AL306	Data Structures and Algorithms Laboratory	PC	0	0	4	2	60	40	100
10.	22AL307	Python Programming and Frameworks Laboratory	PC	0	0	4	2	60	40	100
TOTAL							23			900

SEMESTER IV										
S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22MA401	Discrete Mathematics	BS	3	1	0	4	40	60	100
2	22AL401	Java Programming	PC	3	0	0	3	40	60	100
3	22AL402	Computer Networks	PC	3	0	0	3	40	60	100
4	22AL403	Foundations of Data Science	PC	3	0	0	3	40	60	100
5	22AL404	Machine Learning	PC	3	0	0	3	40	60	100
6	22MCIN03	Design Sprints	EE	0	0	2	1	100	-	100
7	22CYMC01	Environmental Science	MC	2	0	1	0	100	-	100
PRACTICAL										
8	22AL405	Data Science Laboratory	PC	0	0	4	2	60	40	100
9	22AL406	Artificial Intelligence and Machine Learning Laboratory	PC	0	0	4	2	60	40	100
10.	22AL407	Java Programming Laboratory	PC	0	0	4	2	60	40	100
TOTAL							23			1000

SEMESTER V										
S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22AL501	Software Engineering	PC	3	0	0	3	40	60	100

2	22AL502	Database Management Systems	PC	3	0	0	3	40	60	100
3	22AL503	Automata Theory and Compiler Design	PC	3	0	0	3	40	60	100
4	22AL504	Natural Language Processing	PC	3	0	0	3	40	60	100
5	22xxOExx	Open Elective I	OE	3	0	0	3	40	60	100
6	22MCIN04	Ideation Sprints	EE	0	0	2	1	100	-	100
7	22MC301	Indian Constitution	MC	2	0	0	0	100	-	100
PRACTICAL										
8	22AL505	Database Management Systems Laboratory	PC	0	0	4	2	60	40	100
9	22AL506	Natural Language Processing 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

S. No.	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22ALPExx	Professional Elective I	PE	3	0	0	3	40	60	100
2	22ALPExx	Professional Elective II	PE	3	0	0	3	40	60	100
3	22ALPExx	Professional Elective III	PE	3	0	0	3	40	60	100
4	22xxOExx	Open Elective II	OE	3	0	0	3	40	60	100
5	22xxOExx	Open Elective III	OE	3	0	0	3	40	60	100
6	22xxOExx	Open Elective IV	OE	3	0	0	3	40	60	100
PRACTICAL										
7	22AL601	Mini Project	EE	0	0	6	3	60	40	100
						TOTAL	**21**			**700**

SEMESTER VII

S. No	Course Code	Course Title	Cat.	Hours / Week			Credit	Max. Marks		
				L	T	P		CA	FE	Total
THEORY										
1	22AL701	Data Privacy and Security	PC	3	0	0	3	40	60	100
2	22AL702	Computer Vision	PC	3	0	0	3	40	60	100
3	22AL703	Deep Learning	PC	3	0	0	3	40	60	100
4	22MG701	Principles of Management	HS	3	0	0	3	40	60	100
5	22ALPExx	Professional Elective IV	PE	3	0	0	3	40	60	100
PRACTICAL										
6	22AL704	Data Privacy and Security Laboratory	PC	0	0	4	2	60	40	100
TOTAL							**17**			**600**

SEMESTER VIII										
S. No	**Course Code**	**Course Title**	**Cat.**	**Hours / Week**			**Credit**	**Max. Marks**		
				L	**T**	**P**		**CA**	**FE**	**Total**
THEORY										
1	22ALPExx	Professional Elective V	PE	3	0	0	3	40	60	100
2	22ALPExx	Professional Elective VI	PE	3	0	0	3	40	60	100
PRACTICAL										
3	22AL801	Project Work	EE	0	0	14	7	120	80	200
		TOTAL					**13**			**400**

Total Credits: 166

List of Professional Electives I										
S. No	Subject Code	Subject Name	Cat.	Hours/ Week			Credit	Max.Marks		
				L	T	P		CA	FE	Total
1	22ALPE101	Graph Theory	PE	3	0	0	3	40	60	100
2	22ALPE102	Software Project Management	PE	3	0	0	3	40	60	100
3	22ALPE103	Statistical Learning	PE	3	0	0	3	40	60	100
4	22ALPE104	Multimedia Analytics	PE	3	0	0	3	40	60	100
5	22ALPE105	Computer Graphics	PE	3	0	0	3	40	60	100
List of Professional Electives II										
6	22ALPE201	Software Testing Methodologies	PE	3	0	0	3	40	60	100
7	22ALPE202	Computational Neuro Science	PE	3	0	0	3	40	60	100
8	22ALPE203	Pattern Recognition	PE	3	0	0	3	40	60	100
9	22ALPE204	Digital Image Processing	PE	3	0	0	3	40	60	100
10	22ALPE205	Web Frameworks and Applications	PE	3	0	0	3	40	60	100
List of Professional Electives III										
11	22ALPE301	Reinforcement Learning	PE	3	0	0	3	40	60	100
12	22ALPE302	Mobile Application Development	PE	3	0	0	3	40	60	100
13	22ALPE303	Social Network Data Analytics	PE	3	0	0	3	40	60	100
14	22ALPE304	Game Theory and its Applications	PE	3	0	0	3	40	60	100
15	22ALPE305	Algorithms for Bioinformatics	PE	3	0	0	3	40	60	100
List of Professional Electives IV										
16	22ALPE401	Parallel and Distributed Computing	PE	3	0	0	3	40	60	100
17	22ALPE402	Quantum Computing	PE	3	0	0	3	40	60	100
18	22ALPE403	Evolutionary Computing Algorithms	PE	3	0	0	3	40	60	100
19	22ALPE404	Data Mining and Analytics	PE	3	0	0	3	40	60	100
20	22ALPE405	Block Chain Technologies	PE	3	0	0	3	40	60	100
List of Professional Electives V										
21	22ALPE501	Semantic Web Technology	PE	3	0	0	3	40	60	100
22	22ALPE502	Randomized Algorithms	PE	3	0	0	3	40	60	100
23	22ALPE503	Business Intelligence and its Applications	PE	3	0	0	3	40	60	100
24	22ALPE504	Augmented Reality and Virtual Reality	PE	3	0	0	3	40	60	100
25	22ALPE505	Large Scale Machine Learning	PE	3	0	0	3	40	60	100
List of Professional Electives VI										
26	22ALPE601	Research Methodologies	PE	3	0	0	3	40	60	100
27	22ALPE602	Information Retrieval	PE	3	0	0	3	40	60	100
28	22ALPE603	Agile Technology	PE	3	0	0	3	40	60	100
29	22ALPE604	Information Storage Management	PE	3	0	0	3	40	60	100
30	22ALPE605	Expert Systems	PE	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE COURSES - VERTICALS FOR HONOURS

Vertical I **Data Science**	**Vertical II** **Full Stack Development**	**Vertical III** **Cloud Computing and Data Center Technologies**	**Vertical IV** **Cyber Security and Data Privacy**
22ALH101 Exploratory Data Analysis	22ALH201 Full Stack Web Application Development	22ALH301 Cloud Computing	22ALH401 Cyber Physical Systems
22ALH102 Recommender Systems	22ALH202 App Development	22ALH302 Virtualization	22ALH402 Ethical Hacking
22ALH103 Neural Networks and Deep Learning	22ALH203 Service Oriented Architecture	22ALH303 Cloud Services Management	22ALH403 Digital and Mobile Forensics
22ALH104 Text and Speech Analysis	22ALH204 UI and UX Design	22ALH304 Data Warehousing	22ALH404 Social Network Security
22ALH105 Business Analytics	22ALH205 Software Testing and Automation	22ALH305 Storage Technologies	22ALH405 Modern Cryptography
22ALH106 Image and Video Analytics	22ALH206 Web Application Security	22ALH306 Software Defined Networks	22ALH406 Engineering Secure Software Systems
22ALH107 Data visualization	22ALH207 DevOps	22ALH307 Stream Processing	22ALH407 Cryptocurrency and Blockchain Technologies
22ALH108 Big Data Analytics	22ALH208 Principles of Programming Languages	22ALH308 Security and Privacy in Cloud	22ALH408 Cyber Security

Computer Science and Engineering (AI & ML) Scheme of Instruction

Categories	Credits recommended by AICTE	Credits recommended by Anna University	Credits Breakup for CSE (AI and ML) Students
Humanities and Social Sciences (HS)/ Humanities and Social Sciences Mandatory Courses (HSMC)	10	12	14
Basic Sciences (BS)	16	25	27
Engineering Science (ES)	8	18	18
Program Core (PC)	71	61	63
Program Electives (PE)	16	18	18
Open Electives (OE)	6	12	12
Empl. Enhancement Courses (EEC)	38	16	14
Mandatory Courses (MC) (Zero Credit)	0	0	0
Total	**165**	**162**	**166**

SYLLABUS

B.E COMPUTER SCIENCE AND ENGINEERING(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING) FULL TIME

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 (THEORY CUM PRACTICAL)	SEMESTER	I

PREREQUISITES	CATEGORY	HS	Credit		3
		L	T	P	TH
Basic language skills listening, speaking, reading and writing	Hours/week	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	COMPREHENSION	6	0	6	12

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

UNIT II	RECOMMENDATION	9	0	0	9

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

UNIT III	CONVERSATION	9	0	0	9

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

UNIT IV	REPORTING	9	0	0	9

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

UNIT V	INTERPRETATATION	9	0	0	9

Listening – An interview with career advisor and recruitment agent, Feedbacks, Meeting extracts. Speaking – Qualities required for employability, Improving employee productivity, presentation on problem-solving skills, teamwork, creativity and leadership quality. Reading - Reading brochures, telephone messages, social media messages relevant to technical contexts. Writing - Letter Writing – Formal Letters and Informal Letters - cover letter with resume, Mind maps, Charts - interpreting statistical data, charts, graphs and tables. Grammar - One word substitution, Abbreviations and acronyms in technical contexts and technical vocabulary, Idioms.
Total (30L + 30P)= 60 Periods

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

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

COURSE ARTICULATION MATRIX

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

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

22MA101	MATRICES, CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS B.E. (Common to all Branches Except EEE)		Semester		I
PREREQUISITES		**Category**	**BS**	**Credit**	**4**
Basic 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 (45L+15T) = 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	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O2**
CO1	3	2		2									2	
CO2	3	2		2									2	
CO3	3	2		2									2	
CO4	3	2		2									2	
CO5	3	2		2									2	
Avg	**3**	**2**		**2**									**2**	

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

22PH101	ENGINEERING PHYSICS	SEMESTER I

PREREQUISITES	CATEGORY	BS	Credit		4
Basic theoretical knowledge in Physics	Hours/Week	L	T	P	TH
		3	1	0	4

Course Objectives:

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

UNIT I	Ultrasonics and Acoustics	9	3	0	12

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

UNIT II	Laser And Fiber Optics	9	3	0	12

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

UNIT III	Thermal Physics	9	3	0	12

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

UNIT IV	Quantum Physics	9	3	0	12

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

UNIT V	CRYSTAL PHYSICS	9	3	0	12

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

Total (45L+15T) = 60 Periods

Text Books:

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

Reference Books:

1.	Gaur R.K. and Gupta S.L, 'Engineering Physics', Dhanpat Rai publishers, 2012.
2.	Arthur Beiser, 'Concepts of Modern Physics', Tata McGraw Hill Publishing Co. Ltd, sixth Edition, 2019.
3.	Gerd keiser, 'Optical fiber communications', Tata McGraw Hill Publishing Co. Ltd, 5th Edition, 2017.
4.	Orazio Svelto, David C. Hanna, 'Principles of Lasers', Springer Science & Business Media, LLC, 2010.
E-Reference	
1	https://nptel.ac.in/courses/115105129
2	https://nptel.ac.in/courses/115107095

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

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	1						2		
CO2	2	3	1	1	2	1						2		
CO3	3	2	1	1								1		
CO4	3	2	1	1	2		1					1		
CO5	2	2	1	1	2							1		
Avg	**2.6**	**2.2**	**1**	**1**	**1.75**	**1**	**1**					**1.4**		

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

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

Course Learning Objectives

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

Unit I	SPECTROSCOPIC TECHNIQUES	9	3	0	12

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

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

Unit II	WATER TECHNOLOGY AND NANOTECHNOLOGY	9	3	0	12

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

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

Unit III	SURFACE CHEMISTRY AND PHASE EQUILIBRIA	9	3	0	12

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

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

Unit IV	ELECTROCHEMISTRY	9	3	0	12

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

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

Unit V	POLYMERS AND FUELS	9	3	0	12

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

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

Total (45L+15T) = 60 Periods

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

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

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O 1	PS O2
CO1	3	3		3									3	1
CO2	3	2		1		2							3	1
CO3	3	1		1									2	1
CO4	2	1		1		2							2	3
CO5	3	2		3		2							1	1
Avg	**2.8**	**1.8**		**1.8**		**1.2**							**2.2**	**1.4**

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

22CS101	PROBLEM SOLVING AND C PROGRAMMING (Common to CSE, CSE (AI and ML) , ECE, Civil, Mechanical and Metallurgy)	SEMESTER	I

PREREQUISITES	CATEGORY	ES	Credit		3
NIL	Hours/week	L	T	P	TH
		3	0	0	3

Course Objectives:

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

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

High level programming language – Machine level language – Role of system software (Editor, Compiler, Assembler, Linker, Loader, and Operating System) in developing and executing a C program

C Programming: Character Set – Case sensitivity – Identifiers – Keywords –Literals – Data types – Declaration statement– Variables and their associated information– Formatted and unformatted console input-output statements – Type conversion – Operators – Precedence and Associativity – Pre-processor directives (#include and #define) – the main() function.

General problem-solving Techniques: Algorithm – Flow-chart – Pseudocode – Developing solutions for problems involving only operators and writing their equivalent C programs

UNIT II	CONTROL STATEMENTS	9	0	0	9

General problem-solving Techniques: Representing Decision making: if-else statement – switch-case statement – Looping statements: for loop, while loop and do-while loop – Branching statements: break and continue with Algorithm, Flow-chart, and Pseudocode.

C Programming: Decision Making: if-else statement – switch-case statement – Looping statements: for loop, while loop and do-while loop – Branching statements: break and continue – Nesting

Developing solutions for problems involving control statements using General problem-solving Techniques and their equivalent C programs

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

One-dimensional and two-dimensional Arrays: Declaration – Initialization – Processing – Pointers: Declaration – Initialization – Processing – Relation between pointers and arrays – Strings – String operations – C Library support for String handling

Developing solution for problems involving arrays, pointers and strings using General problem-solving Techniques and their equivalent C programs

UNIT IV	FUNCTIONS	9	0	0	9

Function – Library functions and user-defined functions – Function prototypes and function definitions – Parameter passing mechanisms –Recursion – Storage classes – Working with multiple source files

Developing solution for problems involving functions using General problem-solving Techniques and their equivalent C programs.

UNIT V	STRUCTURES, UNIONS AND FILE	9	0	0	9

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

Total (45 L)= 45 Periods

Text Books:

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

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

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

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

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

பாடநெறிநோக்கங்கள்: மாணவர்களால்

1.	தமிழ் மொழி மற்றும் இலக்கியம் பற்றிய அறிவைப் பெறமுடியும்.
2.	பாரம்பரியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் மற்றும் சிற்பக் கலைகள் பற்றி தெரிந்து கொள்ள முடியும்
3.	நாட்டுப்புறக் கலைகள் மற்றும் வீரவிளையாட்டுகள் பற்றி அறிந்து கொள்ளமுடியும்
4.	தமிழர்களின் ஒழுக்க நெறிமுறைகளைப் பற்றி தெரிந்து கொண்டு அதன் படிநடந்து கொள்ளமுடியும்.
5.	பழங்கால இந்தியதேசிய இயக்கம் பற்றியும், இந்தியமக்களின் பன்பாட்டில் தமிழர்களின் பங்களிப்பு பற்றியும் நன்கு அறிந்து கொள்ளமுடியும்.

அலகு I	*மொழி மற்றும் இலக்கியம்*	*3*	*0*	*0*	*3*

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

அலகு II	*மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை சிற்பக்கலை*	*3*	*0*	*0*	*3*

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன்சிலைகள் – பழங்குடியினர் மற்றும் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண்சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள்- குமரிமுனையில் திருவள்ளுவர்சிலை- இசைக்கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III	*நாட்டுப் புறக்கலைகள் மற்றும் வீர விளையாட்டுகள்*	*3*	*0*	*0*	*3*

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஒயிலாட்டம், தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV	*தமிழர்களின் திணைக் கோட்பாடுகள்*	*3*	*0*	*0*	*3*

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்று மதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V	*இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு*	*3*	*0*	*0*	*3*

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப்பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சுவரலாறு.

Total= 15 Periods

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

பாடநெறிமுடிவுகள்: இந்தப் படிப்புமுடிந்ததும்,மாணவர்களால்		Bloom's Taxonomy Mapped
CO1	இந்தியமொழிகள், இந்திய மொழிக் குடும்பங்கள் பற்றியும் மற்றும் இலக்கியம், இலக்கியதின் வளர்ச்சி,தமிழ் இலக்கியவளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்புகளை பற்றியும் அறிந்து கொண்டனர்.	Understand
CO2	சிற்பக் கலைகளில் அடங்கியுள்ள பாறைஓவியங்கள் முதல் நவினஓவியங்கள் வரைபற்றியும்,தமிழர்களின் சமூக, பொருளாதார வாழ்வில் கோவில்களின் பங்கினைபற்றியும் தெரிந்துகொண்டனர்.	Understand
CO3	தமிழர்களின் வாழ்வியல் முறைகளோடு ஒன்றிய நாட்டுபுறக் கலைகள் மற்றும் தமிழர்களின் வீரவிளையாட்டுகளை பற்றி அறிந்துகொண்டனர்.	Understand
CO4	சங்க காலத்தில் தமிழர்கள் பின்பற்றிய தினைக் கோட்பாடுகள் பற்றி நடந்து கொண்டனர்.	Apply
CO5	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்க்குத் தமிழர்களின் பங்கினை பற்றியும் அறிந்து கொண்டனர்.	Understand

COURSE ARTICULATION MATRIX

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

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

22MC102	HERITAGE OF TAMILS	Semester			I
PREREQUISITES	Category	HS MC	Credit		1
Basics of Tamil Language and Literature	Hours/Week	L	T	P	TH
		1	0	0	1

1.	To Obtain the knowledge of Tamil Language and Literature
2.	To familiarize with painting and Sculpture
3.	To Know about the folks and martial arts
4.	To understand the Thinai concept of Tamils
5.	To know about the contribution of Tamils to Indian National Movement and Indian Culture.

Unit I	LANGUAGE AND LITERATURE	3	0	0	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)

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

COURSE ARTICULATION MATRIX															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**	**PSO 3**
CO1			3			2				1			2		
CO2			3			2				1			2		
CO3			3			2				1			2		
CO4			3			2				1			2		
CO5			3			2				1			2		
Avg			**3**			**2**				**1**			**2**		
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)															

22CS102	**COMPUTER PRACTICE AND C PROGRAMMING LABORATORY (Common to CSE, CSE (AI and ML), ECE, EEE, Civil, Mechanical and Metallurgy)**	**Semester**	**I**

PREREQUISITES	Category	ES	Credit		1.5
NIL	Hours/Week	L	T	P	TH
		0	0	3	3

Course Learning Objectives

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

EXPERIMENTS

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

B. Spread Sheet

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

C. Simple C Programming

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

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

Total (45 P)= 45 Periods

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

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										3				

CO2	3	3												
CO3	3	3	2	2	2	1	1	1			2	3	3	2
CO4	3	3	2	2	2	1	1	1			2	3	3	2
Avg	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**		**3**	**2**	**3**	**3**	**2**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

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

Course Learning Objectives

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

LIST OF EXPERIMENTS

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

Total (60P) = 60 Periods

Reference Books:

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

E-Reference:

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

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

COURSE ARTICULATION MATRIX														
COs/ POs	**PO1**	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**
CO1						3								
CO2		3		2	1									
CO3		3		2	1									
CO4		3		2	1									
CO5		3		2	1									
Avg		**3**		**2**	**1**	**3**								
3/2/1 – indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22MA202	LINEAR ALGEBRA AND LINEAR PROGRAMMING PROBLEMS	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 transformation - 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 Taxonomy Mapped**
CO1	:	Use the concepts of vector space and subspaces.	Apply
CO2	:	Apply the concept of linear transformations in diagonalizability.	Apply
CO3	:	Illustrate the concept of inner product spaces in orthogonalization	Understand
CO4	:	Solve LPP by using Graphical and Simplex methods.	Apply
CO5	:	Obtain the solution of Transportation and Assignment models.	Understand

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

22HS201	UNIVERSAL HUMAN VALUES		SEMESTER			II
PRE-REQUISITE:		**Category**	**HS**	**Credit**		**3**
1.Introduction of Universal Human Values		**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	BASIC CONCEPTS OF HUMAN VALUES	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	UNDERSTANDING HARMONY IN THE HUMAN BEING	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	UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY	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	UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE	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	HOLISTIC UNDERSTANDING OF HARMONY	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 Hours

Text 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, Jeevan Vidya Prakashan, 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1			1			1		2		1		3	2	
CO 2			1			3		1		1		3	1	
CO 3			1			2		1		1		3	1	
CO 4			2			1		1		1		3	1	
Avg			**1.25**			**1.75**		**1.25**		**1**		**3**	**1.25**	

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

22AL201	DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION	SEMESTER	II

PREREQUISITES	CATEGORY	ES	Credit		3
NIL	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To Analyze and design combinational circuits and sequential circuits
2.	To understand the basic structure and operation of a digital computer
3.	To study the design of data path unit, control unit for processor and to familiarize with the hazards
4.	To understand the concept of various memories and I/O interfacing.

UNIT I	COMBINATIONAL LOGIC	9	0	0	9

Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers - Demultiplexers

UNIT II	SYCHRONOUS SEQUENTIAL LOGIC	9	0	0	9

Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis, and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters.

UNIT III	COMPUTER FUNDAMENTALS	9	0	0	9

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High-Level Language.

UNIT IV	PROCESSOR	9	0	0	9

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

UNIT V	MEMORY AND I/O	9	0	0	9

Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA

Total (45 L) = 45 Periods

Text Book:

1.	M. Morris Mano, Michael D. Ciletti, “Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Sixth Edition, Pearson Education, 2018.
2.	David A. Patterson, John L. Hennessy, “Computer Organization and Design, The Hardware/Software Interface”, Sixth Edition, Morgan Kaufmann/Elsevier, 2020.

Reference Books:

1.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, “Computer Organization and Embedded Systems”, Sixth Edition, Tata McGraw-Hill, 2012.
2.	William Stallings, “Computer Organization and Architecture – Designing for Performance”, Tenth Edition, Pearson Education, 2016.
3.	M. Morris Mano, “Digital Logic and Computer Design”, Pearson Education, 2016.

E-References:

1.	https://nptel.ac.in/courses/117105080/
2.	https://nptel.ac.in/courses/106102062/

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Design various combinational digital circuits using logic gates.	Analyze
CO2	Design sequential circuits and analyze the design procedures.	Analyze
CO3	Apply the fundamental concepts of computer systems to analyze the execution process of instructions.	Apply
CO4	Analyze different types of control design and identify hazards	Analyze
CO5	Identify the characteristics of various memory systems and I/O communication.	Understand

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	
CO 3		3											3	1
CO 4				3						3			2	2
CO 5					3				3				3	1
Avg	**3**	**3**	**3**	**3**	**3**				**3**	**3**			**2.8**	**1.3**

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

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

Course Learning Objectives

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

Unit I	DC CIRCUITS	9	3	0	12

Electrical circuit elements (R, L and C) - Voltage and current sources - Ohm's law and Kirchhoff's laws- Series and parallel circuits - Analysis of simple electrical circuits with DC excitation using fundamental laws – Superposition theorem, Thevenin's and Norton's theorems.

Unit II	AC CIRCUITS	9	3	0	12

Introduction to single phase AC circuits - Representation of sinusoidal waveforms, peak and RMS values, phasor representation- Analysis of single-phase AC circuits consisting of RL, RC, RLC combinations (series and parallel): real power, reactive power, apparent power and power factor. Three phase AC circuits, voltage and current relations in star and delta connections.

Unit III	ELECTRICAL MACHINES AND TRANSFORMERS	9	3	0	12

DC Motor: Construction, operation, types and applications, Speed control of DC shunt motor - Construction and working of three-phase induction motors - Working of single-phase induction motor and its applications – Transformers: Ideal and practical transformer, Construction and working, losses and efficiency in transformers, Introduction to three phase transformers.

Unit IV	BASICS OF ELECTRONICS SYSTEM	9	3	0	12

Introduction - Basic structure of semiconductors devices- PN junction diode, Zener diode and V-I characteristics- BJT – CE, CB, CC configuration and working principle. Operational Amplifier-principle of operation, Characteristics, Applications: Inverting Amplifier, non inverting amplifier, summing amplifier and differential amplifier.

Unit V	ELECTRICAL INSTALLATIONS	9	3	0	12

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB - Types of wires and cables – Earthing - Basics of house wiring tools and components, types of house wiring – Batteries: Principle characteristics-Types and its applications - Introduction to UPS and SMPS.

Total (45L+15T) = 60 Periods

Text Books:

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

Reference Books:

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

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

COURSE ARTICULATION MATRIX

COs\ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1									1	1		
CO 2	1	1									1	1		
CO 3	1										1	1		
CO 4	1										1	1		
CO 5	1										1	1		
Avg	**1**	**1**									**1**	**1**		

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

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 (15L+60T) = 75 Periods

Text Books:

1	Bhatt, N.D.,Panchal V M and Pramod R. Ingle, “Engineering Drawing”, Charotar Publishing House, 53rd Edition,
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	PS O 1	PS O2
CO1	3	1											3	1
CO2	3	1											3	1
CO3	3	1											3	1
CO4	3	1											3	1
CO5	3	1											3	1
Avg	**3**	**1**											**3**	**1**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**														

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

Course Learning Objectives

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

Unit I	STREET FIGHTING ENGINEERING	0	6	0	6

Why street fight engineering - How to street fight engineering - Decode real-world problems - Observe key patterns - relationship study - Derive actionable inferences - Perform data - driven insights - Generate concepts and case studies.

Unit II	PROGRAMMING PARADIGM	0	6	0	6

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

Unit III	BRAINS OF MACHINES	0	6	0	6

Key innovations in Tesla Electric car - Case study - Brains of Electric cars - Tran disciplinary systems - Adapting Tran disciplinary systems to Accelerate Innovation - Idea Hexagon - Exercise to think of new innovations using Idea Hexagon - Brains of Digital camera.

Unit IV	MACHINES THAT MAKE-UP THE WORLD	0	6	0	6

Basics of Electronics passive components - Need for sensors & Actuators - Analyzing& Understanding electronic circuits - How to Build a Basic Custom Hardware - Boot loader & its purposes.

Unit V	ENGINEERING THE REAL WORLD	0	6	0	6

Real-world as systems - Introducing to Systems Thinking - Stock and Flow Diagrams - System Traps - Intervening circuits - Living in a World of Systems.

Total = 30 Periods

Text Books:

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

Reference Books:

1	Learning to code : How to think like a programmer

2	How to find innovative ideas : Ramesh Raskar's note
3	Case Study ; How Tesla changed the auto industry
4	Ultimate Guide : How to develop a new electronic hardware product

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

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O2**	**PS O3**
CO1	2	3	2	2	2	0	0	0	0	0	0	0	2	2	2
CO2	3	3	3	2	3	0	0	0	0	0	0	0	3	3	2
CO3	1	2	2	1	1	0	0	0	0	0	0	0	2	2	2
CO4	3	3	3	2	2	0	0	0	0	0	0	0	3	3	3
CO5	2	3	3	3	3	0	0	0	0	0	0	0	3	3	3
Avg	**2.2**	**2.8**	**2.6**	**2**	**2.2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2.6**	**2.6**	**2.4**
0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation															

22MC201	தமிழரும் தொழில்நுட்பமும் B.E (Common to all Branches)		Semester			II
முன்நிபந்தனைகள்:		ஊயவநபழசல	ர்ளுஆ ஊ	ஊசநனைவ		1
இலக்கணம் மற்றும் இலக்கியத்தின் அடிப்படைகள்		ர்ழரசள/றுநநம	டு	வு	ீ	வுர்
			1	0	0	1

பாடநெறிநோக்கங்கள்: மாணவர்களால்

1.	நெசவுத் தொழிலின் நன்மைகள்,அதன் பயன்கள்,பானைத் தொழில் நுட்பத்தைப் பற்றி நன்கு அறிந்து கொள்ள முடியும்.
2.	கட்டிடம் கட்டுதல் மற்றும் கட்டிடத் தொழிலுள்ள நுட்பங்கள் பற்றி அறிந்து கொள்ள முடியும்.
3.	உற்பத்தி தொழில் நுட்பம், இரும்பு,உலோகம், கனிமம், தொழிற்சாலைகள் பற்றிஅறிந்து அவற்றின் பயன்பாடுகளை வெளிப்படுத்த முடியும்.
4.	வேளாண்மை மற்றும் நீர் பாசன முறைகள், தொழில் நுட்பம், ஏர் உழுதல் போன்ற பண்டைய கால நெறிமுறைகளைப் பற்றி தெரிந்து நடைமுறைப் படுத்த முடியும்.
5.	இன்றைய காலகட்டத்தில் உள்ளவாறு அறிவியல் வளர்ச்சி, கணினித் தமிழ் பற்றி தெரிந்து கொண்டு அறிவை விரிவாக்க முடியும்.

அலகு ஐ	நேசவு மற்றும் பானை தொழில்நுட்பம்	3	0	0	3

சங்ககாலத்தில் நெசவுத் தொழில் - பானைதொழில் நுட்பம் - கருப்புசிவப்பு பாண்டங்கள்- பாண்டங்களில் கீறல் குறியீடுகள்

அலகு ஐஐ	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3	0	0	3

சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ரூசங்ககாலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்ககாலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்- சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்ல புரச் சிற்பங்களும்,கோவில்களும் - கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிறவழிபாட்டுத் தலங்கள்- நாயக்கர் காலக் கோயில்கள் - மாதிரிகட்டகமைப்புகள் பற்றி அறிதல், மதுரைமீனாட்சி அம்மன் ஆலயம் மற்றம் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ சாரோசெனிக் கட்டிடக் கலை.

அலகு ஐஐஐ	உற்பத்தித் தொழில் நுட்பம்	3	0	0	3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எ;கு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்கநாணயங்கள் - நாணயங்கள் அச்சிடித்தல் - மணி உருவாக்கம் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடிமணிகள் - சுடுமண் மணிகள் - சங்குமணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு ஐஏ	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3	0	0	3

அனை, ஏரி, குளங்கள், மதகு, - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு ஏ	அறிவியல் தமிழ் மற்றும் கணித்தமிழ்	3	0	0	3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களைமின் பதிப்பு செய்தல் - தமிழ் மென் பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

Total = 15 Periods

Text Books:

1	தமிழகவரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல் மற்றும் கல்வியல் பணிகள் கழகம்)
2	கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3	கீழடி – வைகை நதிக்கரையில் சங்க காலநகர நாகரிகம் (தொல்லியல் துறைவெளியீடு)
4	பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறைவெளியீடு)

பாடநெறிமுடிவுகள்: இந்தப் படிப்பு முடிந்ததும், மாணவர்களால்		**Bloom's Taxonomy Mapped**
CO1	சங்காலத்தில் இருந்த நல்ல தொழில்களையும் கைவிணை கலைகளால் ஏற்படும் நன்மைகளையும் பற்றி அறிந்து கொண்டனர்.	Understand
CO2	கட்டிடங்கள் மற்றும் வீட்டுப்பொருட்களை வடிவமைப்பது, சங்காலத்தில் இருந்த கோவில்களை பற்றி அறிந்து கொண்டனர்	Understand
CO3	உலோகவியல், இரும்பு தொழிற்சாலைகள், தொல்லியல் சான்றுகள், உற்பத்திதொழல் நுட்பத்தை பற்றி அறிந்து கொண்டனர்.	Apply
CO4	பழங்காலத்தில் வேளாண்மை, நீர்பாசனம், மீன் வளம், கால்நடைபராமரிப்பு, அறிவுசார் சமுகம் பற்றி அறிந்து கொண்டனர்.	Apply
CO5	அறிவியல் தமிழன் வளர்ச்சி, கணித்தமிழ் வளர்ச்சி,மென்பொருள் உருவாக்கம், இணைய கல்விகழகம், இணையத்தில் தமிழ் அகராதிகள் பற்றிஅறிந்துகொண்டனர்.	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO12**	**PSO 1**	**PSO2**
CO1			3			2						1	2	
CO2			3			2						1	2	
CO3			3			2						1	2	
CO4			3			2						1	2	
CO5			3			2						1	2	
Avg			**3**			**2**						**1**	**2**	
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**														

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

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

Unit I	WEAVING AND CERAMIC TECHNOLOGY	3	0	0	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

Unit II	DESIGN AND CONSTRUCTION TECHNOLOGY	3	0	0	3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar 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 gold Coins 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 Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

Unit V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3	0	0	3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

Total = 15 Periods

Text Books:

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

7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

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

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PS O2**
CO1			3			2						1	2	
CO2			3			2						1	2	
CO3			3			2						1	2	
CO4			3			2						1	2	
CO5			3			2						1	2	
Avg			**3**			**2**						**1**	**2**	

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

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, Maharana Pratap, Ratan Tata, Kiran Majumdar, Jhansi Ki Rani, Narayan Murty, Prakash Padukone, 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
PREREQUISTIES	**CATEGORY**	**HS**	**Credit**		**1**
Basic language skills listening, speaking, reading and writing	**Hours/Week**	**L**	**T**	**P**	**TH**
		0	**0**	**2**	**2**

COURSE OBJECTIVES

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

UNIT I	NARRATION	0	0	6	0

Reading – Reading a short story – learning pronunciation, intonation, splitting of sentences to form meaningful units.
Speaking – Narrating a story without any help of handouts.

UNIT II	PRESENTATION	0	0	6	0

Reading – Reading a poem – learning the skill of reciting, appreciate rhyme and music, change in tone as per the emotion of the poem.
Speaking – Power-point presentation on a general topic.

UNIT III	SHORT SPEECH	0	0	6	0

Reading – Reading newspaper article – learning vocabulary and language pattern of official communication.
Speaking - Oral presentation on a topic from basic engineering pertained to their branch.

UNIT IV	ORGANIZING EVENTS	0	0	6	0

Reading – Reading dialogue scripts – learning expression, tone, stress and co-operative reading.
Speaking –Proposing welcome address, vote of thanks and organizing events

UNIT V	DESCRIBING PROCESS	0	0	6	0

Reading – Reading technical description of gadgets – learning the different parts of devices.
Speaking – Describing a process – everyday technical activities like taking print outs, purchasing equipment for a company booking a hall for meeting etc

Total (30P)= 30 Periods

REFERENCE BOOKS:

1.	Reading Fluency. Switzerland, MDPI AG, 2021.
2.	McJacobs, Wade. Dare to Read: Improving Your Reading Speed and skills. Sustralia, Friesen Press, 2021
3.	Hoge, A. J. Effortless English: Learn to Speak English Like a Native. United States, Effortless English LLC, 2014.

E-RESOURCES:

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

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

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

22PH103	PHYSICS LABORATORY	SEMESTER	II

PREREQUISTIES	CATEGORY	BS	Credit		1.5
NIL	Hours/Week	L	T	P	TH
		0	0	3	3

Course Objectives:

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

LIST OF EXPERIMENTS

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

Total (45P) = 45 Periods

Text Books:

1.	C. S. Robinson, Dr. Ruby Das, ' A Textbook of Engineering Physics Practical', Laxmi Publication Pvt. Ltd., 2016.
2.	S. Panigrahi, 'Engineering Practical Physics', Cengage Learning India, 2015.

Reference Books:

1.	M.N. Srinivasan, 'Text Book of Practical Physics', Sultan Chand & Sons, 2013
2.	Singh Harman, 'B.Sc. Practical Physics', S Chand & Company Ltd, 2022.

E-References:

1.	https://nptel.ac.in/courses/115105110
2.	https://nptel.ac.in/courses/115105120

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

COURSE ARTICULATION MATRIX													
CO/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2		3	3				3	1		2		
CO2	3	2		2	1				2			1		
Avg	**3**	**2**		**2.5**	**2**				**2.5**	**1**		**1.5**		
3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)														

22CY102	CHEMISTRY LABORATORY	SEMESTER	II

PREREQUISTIES	CATEGORY	BS	Credit		1.5
NIL	Hours/Week	L	T	P	TH
		0	0	3	3

Course Objectives:

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

LIST OF EXPERIMENTS

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

Total (45P) = 45 Periods

E-References:

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

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

COURSE ARTICULATION MATRIX														
CO/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	1	1		3									2	
CO2	1	2		3									2	
CO3	2	2		3									2	
Avg	**1.3**	**1.7**		**3**									**2**	
3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)														

22EE102	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	SEMESTER	II

PREREQUISTIES	Category	ES	Credit		1.5
	Hours/Week	L	T	P	TH
		0	0	3	3

Course Objectives:

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

LIST OF EXPERIMENTS

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

Total (45 P) = 45 Periods

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

COURSE ARTICULATION MATRIX

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	1									1	1		
CO2	1	1									1	1		
CO3	1										1	1		
CO4	1										1	1		
CO5	1										1	1		
Avg	**1**	**1**									**1**	**1**		

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

22MA307	PROBABILITY, STATISTICS AND STOCHASTIC PROCESSES B.E.- CSE (AI&ML)	SEMESTER III

	CATEGORY	BS	Credit	4

PREREQUISTIES	Hour/ Week	L	T	P	TH
Basic 12th level knowledge of Probability and Statistics.		3	1	0	4

Course Objectives:

1.	To obtain the knowledge about discrete and continuous distributions.
2.	To acquire knowledge of bivariate distributions and the problems related to coefficient of correlation.
3.	To understand the statistical averages and fitting of curve.
4.	To gain the knowledge of significance test for small samples.
5.	To understand the concept of random processes, correlation and spectral densities.

UNIT I	STANDARD DISTRIBUTION	9	3	0	12

Binomial, Poisson, Exponential, Gamma and Normal Distributions and their properties - Chebyshev's inequality.

UNIT II	TWO DIMENSIONAL RANDOM VARIABLES	9	3	0	12

Joint distributions – Marginal and Conditional distributions – Correlation, Regression and rank correlation.

UNIT III	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 IV	TEST OF HYPOTHESIS	9	3	0	12

Test of significance: 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 V	RANDOM PROCESSES, CORRELATION AND SPECTRAL DENSITIES	9	3	0	12

Definition and examples – First order, Second order strictly stationary- Wide sense stationary processes- Auto Correlation- Cross Correlation- Properties- Power spectral density- Cross Spectral density.

Total (45L+15T) = 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",8th edition, Cengage Learning, New Delhi, , 2012.

Reference Books:

1.	Fruend John, E. and Miller, Irwin, "Probability and Statistics for Engineering", 5th Edition, Prentice Hall, 1994.
2.	Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
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 standard distributions	Apply
CO2	:	Analyze the two-dimensional random variables	Analyze
CO3	:	Learn about statistical averages and fitting the curves by Least Square Method.	Understand
CO4:	:	Use the tests for small samples.	Apply
CO5:	:	Understand the concept of random processes, correlation and spectral densities.	Understand

COURSE ARTICULATION MATRIX

COs /POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	3	2	2	2									2			
CO2	3	2	2	2									2			
CO3	3	2	2	2									2			
CO4	3	2	2	2									2			
CO5	3	2	2	2									2			
Avg	**3**	**2**	**2**	**2**	-	-	-	-	-	-	-	-	**2**	-	-	-

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

22AL301	ARTIFICIAL INTELLIGENCE	SEMESTER III

PREREQUISITES	CATEGORY	PC	Credit		3
NIL	Hour/ 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
4.	To identify and describe major real-world applications of AI

UNIT I	INTRODUCTION	9	0	0	9

Introduction to Artificial Intelligence – The Foundations of Artificial Intelligence – History and the State-of-the-art – Intelligent Agents: Agents and Environment – Rationality – Nature of Environments – Structure of Agents- Problem solving agents- Examples..

UNIT II	PROBLEM SOLVING BY SEARCHING TECHNIQUES	9	0	0	9

Search Algorithms -Uninformed search strategies – Avoiding Repeated States – Searching with Partial Information - Informed search strategies – Heuristic functions. 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 Adversarial Search– Game Theory- Alpha-beta pruning-Constraint Satisfaction Problem.

UNIT III	KNOWLEDGE AND REASONING	9	0	0	9

Knowledge-based agents – The Wumpus world – Logic – Propositional Logic – Propositional theorem proving – Propositional model checking – Agents based on Propositional Logic- First Order Logic- Syntax and Semantics- Using First Order Logic- Knowledge Engineering in First-Order Logic. Inference in First Order Logic.

UNIT IV	SOFTWARE AGENTS	9	0	0	9

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

UNIT V	APPLICATIONS OF AI	9	0	0	9

Introduction to AI Applications - AI in Natural Language Processing (NLP) - AI in Computer Vision - AI in Robotics and Autonomous Systems - AI in Expert Systems and Decision Support - AI in Games and Simulation - AI in Finance and Business - AI in Education, Agriculture, and Social Good - Ethical and Societal Considerations.

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. Mack worth, ―Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010
2.	G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Fourth Edition, Pearson Education, 2008.
3.	Nils J. Nilsson, ―The Quest for Artificial Intelligence, Cambridge University Press, 2009

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recall the fundamentals of Artificial Intelligence	Remember
CO2	Explore various applications of AI	Understand
CO3	Apply the problem-solving strategies in Artificial Intelligence	Apply
CO4	Analyse the principles, architectures, and algorithms of Artificial Intelligence for domain-specific applications across varied environments.	Analyze
CO5	Develop AI based solutions for a given problem.	Create
CO6	Collaborate effectively in teams to evaluate AI-based solutions, integrating diverse skills and perspectives to address complex real-world problems.	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1							2						3	
CO2							2							
CO3	3													3
CO4		2		2					1					
CO5			2		2									
CO6						2				3		2	3	
Avg	**0.5**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.6**		**0.1**	**0.5**		**0.3**	**1**	**0.5**

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

22AL302	PYTHON PROGRAMMING FOR PROBLEM SOLVING AND DATA ANALYSIS	SEMESTER	III

PREREQUISITES	CATEGORY	PC	Credit		3
		L	T	P	TH
NIL	Hours / Week	3	0	0	3

Course Objectives:

1.	Understand the fundamentals of Python programming, including data types, operators, control structures, and functions.
2.	Apply Python programming concepts such as exceptions, modules, packages, file handling, OOP, and database integration for problem solving.
3.	Analyze problems using advanced features such as inheritance, polymorphism, NumPy, and Pandas for data manipulation and scientific computation.
4.	Create applications by integrating GUI frameworks, databases, and visualization libraries for real-world problem solving.

UNITI	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.Conditionals and loops-if statement-else statement – elif-Conditional Expressions-while statement-for statement – break-continue –pass

UNITII	PYTHON FUNCTIONS, EXCEPTIONS, MODULES ,PACKAGES AND FILES	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- Errors and Exceptions – Introduction-Detecting and handling Exceptions- Raising Exceptions – Assertions-Standard Exceptions – Modules – Packages - Files and Input/ Output.

UNITIII	OBJECT ORIENTED PROGRAMMING	9	0	0	9

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

UNITIV	DATABASE INTEGRATION, ENVIRONMENT AND FRAMEWORKS	9	0	0	9

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

UNIT V	DATA VISUALIZATION WITH PANDAS	9	0	0	9

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

Total(45L)=45Periods

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

Reference Books:	
1.	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

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the fundamental concepts of Python programming, including data types, control structures, functions, OOP features, and libraries.	Understand
CO2	Implement Python programs using functions, modules, exceptions, file handling, database integration, and scientific libraries to solve computational problems.	Apply
CO3	Analyze problems using object-oriented principles, data handling techniques, and visualization tools to derive meaningful insights.	Analyze
CO4	Design and develop complete Python applications by integrating OOP, databases, and visualization frameworks for real-world problem solving.	Create

COURSE ARTICULATION MATRIX

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

22AL303	DATA STRUCTURES AND ALGORITHM ANALYSIS	SEMESTER III

PREREQUISITES	CATEGORY	PC	Credit		3
Nil	Hours / Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To Provide a strong foundation in analyzing algorithm efficiency using both mathematical and empirical techniques.
2.	To Develop skills to apply linear and non-linear data structures for solving real-world computational problems.
3.	To Foster the ability to evaluate, compare, and optimize sorting, searching, and hashing methods.

UNIT I	INTRODUCTION TO ALGORITHMS	9	0	0	9

Introduction-Algorithm Design Techniques-Performance Analysis of Algorithms-Types of Algorithm's Analysis-Order of Growth-Asymptotic Notations-Recursion-Recurrence Relation-Substitution Method.

UNIT II	LIST, STACKS AND QUEUES	9	0	0	9

Abstract Data Types (ADTs) -List ADT - Array based Implementation and complexity analysis - Linked List Implementation – Singly Linked Lists -Circularly Linked Lists - Doubly-Linked Lists - Applications of Lists –Stack ADT – Operations and complexity analysis - Applications of Stacks - Evaluating Arithmetic Expression - Conversion of infix to postfix Expression - Queue ADT - Operations and complexity analysis- Circular Queue - DeQueue - Applications of Queue.

UNIT III	TREES	9	0	0	9

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

UNIT IV	GRAPHS	9	0	0	9

Definition – Representation of Graphs –Types of Graphs - Graph Traversals - Breadth First Search and complexity analysis - Depth First Search and complexity analysis - Application of Graph Structures: Shortest Path Problem: Dijkstra's Algorithm with complexity analysis- MinimumSpanning Trees: Prim's Algorithm - Kruskal's Algorithms with Complexity Analysis.

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

Searching: Linear Search - Binary Search with complexity analysis- Sorting Algorithms - Insertion Sort - Selection Sort - Bubble Sort - Quick Sort - Merge Sort and comparative complexity analysis- Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing-Performance Analysis of Hashing Techniques.

Total(45L)=45Periods

Text Books:	
1.	Anany Levitin."Introduction to the Design and Analysis of Algorithms", Pearson, 2021.
2.	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 TataMcGraw-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.

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the fundamentals of algorithms, data structures, and complexity measures.	Understand
CO2	Apply suitable data structures and algorithms to solve problems efficiently.	Apply
CO3	Analyze the performance of data structures and algorithms using complexity measures.	Analyze

COURSE ARTICULATION MATRIX

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

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

22AL304	OPERATING SYSTEMS	SEMESTER III

PREREQUISITES	CATEGORY	PC	Credit		3
		L	T	P	TH
NIL	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

UNITI	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.

UNITII	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.

UNITIII	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.

UNITIV	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.

UNITV	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(45L)=45Periods

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.

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

COURSE ARTICULATION MATRIX

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

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

22MCIN02	INNOVATION SPRINTS				SEMESTER III			
PREREQUISITES		**CATEGORY**	**EE**		**Credit**		**1**	
NIL		**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 perto typing tools & techniques	Apply
CO5	Develop an innovation pitch to effectively communicate the idea to solve the identified problem	Analyze

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		3				2	1		2					
CO2		3		2					2					
CO3			3	2					2					
CO4	2		3					1	2					
CO5									2	3				
Avg	**0.4**	**1.2**	**1.2**	**0.8**	**0**	**0.4**	**0.2**	**0.2**	**2**	**0.6**				

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

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

Course Objectives:

1. To maintain the unity and disciplines to the students

UNIT I	**SOCIAL SERVICE & COMMUNITY DEVELOPMENT**	**9**	**0**	**0**	**9**

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

UNIT II	**GENERAL AWARENESS & ADVENTURE**	**9**	**0**	**0**	**9**

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

UNIT III	**AEROENGINES & NAVIGATION**	**9**	**0**	**0**	**9**

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

UNIT IV	**AIRFRAME & METEOROLOGY**	**9**	**0**	**0**	**9**

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

UNIT V	**FLIGHT INSTRUMENTS & AEROMODELLING**	**9**	**0**	**0**	**9**

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

Total = 45 Periods

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

COURSE ARTICULATION MATRIX

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

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

22AL305	OPERATING SYSTEMS LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	PC	Credit		2
C Programming	Hours/Week	L	T	P	TH
		0	0	4	4

Course Objectives:

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

EXPERIMENTS

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

1.	Basics of UNIX Commands
2.	Shell programming
3.	Writeprogramsusingthefollowingsystemcallsofoperatingsystem: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 Banker's algorithm for the purpose of deadlock avoida
8.	Implementation of memory management schemes(First fit, Bestfi & Worst fit)
9.	Implement page replacement algorithms(FIFO,LRU& Optimal)
10.	Implementation of File allocation techniques

Total = 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

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

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

22AL306	DATA STRUCTURES AND ALGORITHMS LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	PC	Credit	2
C Programming	Hours/Week	L	T	P	TH
		0	0	4	4

Course Objectives:

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

EXPERIMENTS

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

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	Apply various linear data structures such as stacks, queue and list.	Apply
CO2	Apply various linear and non-linear data structures such trees and graphs.	Apply
CO3	Demonstrate various sorting and searching techniques.	Apply

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

22AL307	PYTHON PROGRAMMING AND FRAMEWORKS LABORATORY				SEMESTER III
PREREQUISITES		**CATEGORY**	**PC**	**Credit**	**2**
Nil		**Hours/Week**	**L**	**T**	**P**	**TH**
			0	**0**	**4**	**4**

Course Objectives:

1.	To implement Python programming constructs such as sequences, control structures, and functions in solving problems.
2.	To use exception handling, modular programming, file operations, and multithreading for program development.
3.	To develop applications using object-oriented programming, regular expressions, GUI, database operations, and data visualization techniques.

EXPERIMENTS

1.	Implement programs using sequences
2.	Program using Control structures
3.	Program using functions
4.	Program to create own Exceptions and catch the exceptions
5.	Program to Create and use modules and packages.
6.	Program to create package sand import the package
7.	Program to implement File operations
8.	Program to implement the Multiple threads
9.	Programs to implement classes, objects, and attributes.
10.	Demonstrate inheritance, method overriding, and operator overloading.
11.	Program to Connect Python to a database and perform CRUD (Create, Retrieve, Update, Delete) operations.
12.	Visualize a dataset using Pandas and Matplotlib by creating line and bar charts to analyze trends.

Total(60 P)=60Periods

Course Outcomes: Afterthesuccessfulcompletionofthepracticalsession,thestudentswillbeableto		**Bloom's Taxonomy Mapped**
CO1	Implement Python sequences, control structures, and functions to solve computational tasks.	Apply
CO2	Demonstrate the use of exception handling, modules, packages, file operations, and multithreading in Python applications.	Apply
CO3	Develop applications by integrating OOP concepts, regular expressions, GUI, database connectivity, and data visualization techniques.	Apply

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

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

Course Objectives:

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

UNIT I	LOGIC AND PROOFS	9	3	0	12

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

UNIT II	COMBINATORICS	9	3	0	12

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

UNIT III	GRAPHS	9	3	0	12

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

UNIT IV	ALGEBRAIC STRUCTURES	9	3	0	12

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

UNIT V	LATTICES AND BOOLEAN ALGEBRA	9	3	0	12

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

Total (45L+15T) = 60 Periods

Text Books:

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

Reference Books:

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

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

COURSE ARTICULATION MATRIX

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

22AL401	JAVA PROGRAMMING	SEMESTER IV

PREREQUISITES	Category	PC	Credit		3
	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 application sand applet applications
3	To build simple chart application and Database Connectivity

UNIT I	INTRODUCTIONTO JAVA	9	0	0	9

Fundamentals of object oriented programming – Java features, comparing Java with C and C++, Javaenvironment; 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.

UNITII	JAVAFEATURES	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.

UNITIII	APPLET ANDEVENTHANDLING	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 awindowed program, working with graphics, working with color, working with fonts.

UNITIV	AWTANDSWINGCONTROLS	9	0	0	9

AWT-AWT controls, Layout Managers, Menu Bars and Menus, Dialog Boxes, File Dialogs; Swings-J app let, J Label and Image Icon, J Text Field, Swing Buttons, J Tabbed Pane, J Scroll Pane, JList, J Combo Box, Trees, J Tables.

UNIT V	NETWORKINGANDJDBC	9	0	0	9

Networking-Networking Basics, Inet Address, TCP/IP Client Sockets, URL, URL Connection, TCP/IP Server Sockets, Datagrams;DesignofJDBC-JDBCdrivers;JDBCprogrammingconcepts-Databaseconcepts, making connection, executing SQL commands, managing connections, statements, and result sets; Query execution- Prepared Statements.

Total(45 L)=45Periods

Text Books:

1.	Patric Naughton, Herbert Schildt,"The Complete Reference Java2",Twelfth edition, Tata McGraw Hill,2021.
2.	E.Balaguruswamy, "Programming with Java", Sixth Edition, Tata McGraw Hills, 2019.

Reference Books:

1.	CayS.Horstmann, Gary Cornell" CoreJava2", 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.

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

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

22AL402	COMPUTER NETWORKS	SEMESTER IV			
PREREQUISITES	**CATEGORY**	**PC**	**Credit**		**3**
NIL	**Hours/Week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

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

UNITI	**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.

UNITII	**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.

UNITIII	**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.

UNITIV	**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.

UNITV	**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(45L)=45Periods

Text Book:	
1.	Behrouz A.Ferouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, 2017.
Reference Books:	
1.	AndrewS.Tanenbaum,"Computernetworks"PHI,4th edition2008
2.	WilliamStallings,"Dataandcomputercommunications",10th edition, PHI,2012
3.	DouglasE.comer,"InternetworkingwithTCP/IP-Volume-I",6th edition,PHI,2008

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

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

22AL403	FOUNDATIONS OF DATA SCIENCE			SEMESTER IV		
PREREQUISITES		Category	PC	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives

1.	To understand the data science fundamentals and process.
2.	To learn to describe the data for the data science process.
3.	To learn to describe the relationship between data.
4.	To utilize the Python libraries for Data Wrangling.
5.	To present and interpret data using visualization libraries in Python

UNIT I	INTRODUCTION	9	0	0	9

Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model– presenting findings and building applications – Data Mining – Data Warehousing – Basic Statistical descriptions of Data

UNITII	DESCRIBING DATA	9	0	0	9

Types of Data – Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores

UNITIII	DESCRIBING RELATIONSHIPS	9	0	0	9

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

UNITIV	PYTHON LIBRARIES FOR DATA WRANGLING	9	0	0	9

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, Boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

UNIT V	DATA VISUALIZATION	9	0	0	9

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn.

Total(45 L)=45Periods

Text Books:

1.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I)
2.	Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3.	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V)

Reference Books:

1.	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Make use of the python libraries, the basic Statistical and Probability measures for data science.	Apply
CO2	Perform descriptive, correlation and regression analytics on standard data sets.	Apply
CO3	Present and interpret data using visualization packages in Python	Analyze

COURSE ARTICULATION MATRIX

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

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

22AL404	MACHINE LEARNING	SEMESTER IV

PREREQUISITES	CATEGORY	PC	Credit		3
Basic Programming Knowledge, Mathematics fundamentals, Basic Statistics	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To Introduce the fundamentals of machine learning and key concepts like bias and variance.
2.	To explore the architecture and training of artificial neural networks and advanced models such as radial basis functions.
3.	To study dimensionality reduction techniques and their role in efficient data representation and learning.
4.	To understand and apply probabilistic learning models, support vector machines, graphical models, and emerging AI technologies like Generative and Explainable AI

UNIT I	INTRODUCTION	9	0	0	9

Machine Learning – Types of machine Learning – Supervised Learning – Machine Learning Process – Terminologies in machine learning – Testing Machine Learning Algorithms – Tuning data into probabilities –Bayes Theorem- Training vs Testing – Learning Curve- Over fitting – Under fitting – Bias – Variance –Trade off..

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	PROBABILISTIC MODELS 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	GRAPHICAL MODELS AND ADVANCED LEARNING	9	0	0	9

Graphical Models – Directed Graphical Models – Bayesian Networks – Conditional Independence Properties – Undirected graphical Models – Markov Random Fields – Hidden Markov Models-Generative AI -Explainable AI. Case Studies : Disease Diagnosis Using Medical Images, Product Recommendations, Crop Yield Production.

Total(45 L)=45Periods

Text Books:

1.	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020
2.	Stephen Marsland, “Machine Learning -An Algorithmic Perspective”, Chapman and Hall/CRC Press, Second Edition, 2014

Reference Books:	
1.	Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar ,Foundations of Machine Learning ,second edition, MIT Press, 2018.
2.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3.	Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, First Indian Edition, 2017.
4.	Machine Learning Course by Andrew NG.https://www.coursera.org/learn/machine-learning-course/

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explore the fundamentals of machine learning and its models	Understand
CO2	Apply machine learning techniques for real world problems	Apply
CO3	Develop machine learning based models for real world problems based on specifications	Create
CO4	Compare the performance of ML models for a specific problem	Analyse

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1													2	2
CO2	3													
CO3			2		2									
CO4		2		2					1					
Avg	**0.7**	**0.5**	**0.5**	**0.5**	**0.5**				**0.2**				**0.5**	**0.5**

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

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

Course Objectives:

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

UNIT I	DESIGN FUNDAMENTALS	3	0	0	3

Introduction to Visual Design, History and Modernism, Design Thinking methodology, seven elements of design, principles of design, principles of good design, designing a product and a service.

UNIT II	SYSTEM THINKING AND REVERSE ENGINEERING	3	0	0	3

System Thinking for Engineering Problem Solving, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components - Re-Engineering a complex system

UNIT III	USER INTERFACE & USER EXPERIENCE	3	0	0	3

Introduction to UI/UX, Human-Computer interface, user-centered Design Principles, User research techniques, UX Design workflow, Information Architecture, UI Components, need for UI prototyping, Wireframes

UNIT IV	MECHANICAL PROTOTYPING	3	0	0	3

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Introduction - Working with Fusion 360 - 3D Modeling - 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

UNIT V	ELECTRONIC & SOFTWARE PROTOTYPING	3	0	0	3

Introduction to Lumped Circuits - Electronic Prototyping - Tinker CAD - Designing in KI CAD - PCB design - Source code management and version control - GitHub - GitHub Actions - GitBash - Continuous Integration - Platform as service - Heroku - Build Packs

Total(15 L)=15Periods

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

COURSE ARTICULATION MATRIX														
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3		1						2					
CO2	2	3							2					
CO3	3		1						2					
CO4			3	2	3				2					
CO5	2		2		1				2					
Avg	**2**	**0.6**	**1.4**	**0.4**	**0.8**				**2**					
3 / 2 / 1 – indicates strength of correlation (3 – High, 2 – Medium, 1 – Low)														

22CYMC01	ENVIRONMENTAL SCIENCE	SEMESTER IV

PREREQUISTIES	CATEGORY	MC	Credit		0
NIL	Hours/Week	L	T	P	TH
		2	0	1	3

Course Objectives:

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

ENVIRONMENTAL AWARENESS	30	0	0	30

Various types of traditional power Plant --Advantage and Disadvantage of conventional Power Definition of non-conventional energy sources Plants – Conventional vs. Non-conventional power generation. – types of non-conventional energy sources - India's current energy resources and their long-term viability – India's Energy requirement and management Solar Energy Basics- Solar Thermal Energy- Solar Photovoltaic Energy- Benefits and Drawbacks -Effects on the environment and safety. Wind turbine power and energy- India's wind energy potential- Wind turbine types. Environmental benefits and impacts of offshore wind energy.

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

ENVIRONMENTAL ACTIVITIES	0	0	15	15

Group activity on water management – Group discussion on recycle of waste (4R's)- Slogan making contest – Poster making event – Expert lecture on environmental awareness – Imparting knowledge on reduction of electricity usage.

Identification and segregation of biodegradable and non-biodegradable waste – Campus cleaning activity – Plantation of trees in the college campus and local waste lands – Identification of varieties of plants and their usage – Shutting down the fans and ACs of the campus for an hour.

Total (30L+15P) =45 Periods

Text Books:

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

Reference Books:

1.	Introduction to Environmental Engineering and Science, Gilbert M. Masters; Wendell P. Ela Publisher: Prentice-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	Analyze
CO2	Predict the methods to conserve energy and ways to make optimal use of the energy for the future.	Apply

COURSE ARTICULATION MATRIX															
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		1	3			3	1	1				1	2		1
CO2		1	3			3	1	1				1	2		1
Avg		**1**	**3**			**3**	**1**	**1**				**1**	**2**		**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

22AL405	DATA SCIENCE LABORATORY	SEMESTER IV

PREREQUISITES	CATEGORY	PC	Credit	2	
	Hours/Week	L	T	P	TH
		0	0	4	4

Course Objectives:

1.	To understand the python libraries for data science
2.	To understand the basic Statistical and Probability measures for data science.
3.	To learn descriptive analytics on the benchmark data sets.
4.	To apply correlation and regression analytics on standard data sets.
5.	To present and interpret data using visualization packages in Python.

EXPERIMENTS

1.	Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.
2.	Working with Numpy arrays
3.	Working with Pandas data frames
4.	Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5.	Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following: a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. b. Bivariate analysis: Linear and logistic regression modeling c. Multiple Regression analysis d. Also compare the results of the above analysis for the two data sets.
6.	Apply and explore various plotting functions on UCI data sets. a. Normal curves b. Density and contour plots c. Correlation and scatter plots d. Histograms e. Three dimensional plotting
7.	Visualizing Geographic Data with Basemap

List of Equipments:(30 Students Per Batch)

Tools: Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh

Total(60 P)=60Periods

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Make use of the python libraries, the basic Statistical and Probability measures for data science.	Apply
CO2	Perform descriptive, correlation and regression analytics on standard data sets.	Apply
CO3	Present and interpret data using visualization packages in Python	Analyze

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

22AL406	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LABORATORY		SEMESTER IV			
PREREQUISITES		**CATEGORY**	**PC**	**Credit**		**2**
Fundamentals of AI, Machine learning and Python Programming		**Hours/Week**	**L**	**T**	**P**	**TH**
			0	**0**	**4**	**4**

Course Objectives:

1.	To develop hands-on skills in implementing AI and ML algorithms
2.	To gain practical exposure to modern deep learning techniques.
3.	To integrate classical AI approaches with data-driven ML methods.
4.	To apply AI/ML concepts in end-to-end projects.

EXPERIMENTS

1. Python Foundations for AI & ML (Numpy, Pandas, Matplotlib – data preprocessing and visualization).
2. Search Algorithms in AI(Implement BFS, DFS, A* for puzzle/game solving).
3. Knowledge Representation & Reasoning (Use Prolog/Python to represent facts & rules, perform inference).
4. Expert Systems (Simple rule-based system (e.g., medical diagnosis or career guidance)).
5. Linear & Logistic Regression (Predictive modeling tasks (price prediction, binary classification)).
6. Naïve Bayes & Bayesian Classifier. (Sentiment/text classification using probability-based learning).
7. Decision Trees & Random Forests (Customer churn/loan approval classification).
8. KNN & SVM (Distance and margin-based classification on datasets (e.g., Iris, MNIST)).
9. Clustering Algorithms (K-Means, Hierarchical, DBSCAN for customer segmentation).
10. Perceptron & MLP (Implement XOR and digit recognition with ANN).
11. Convolutional Neural Networks (CNNs) (Image classification (MNIST / CIFAR-10)).
12. Recurrent Neural Networks (RNNs &LSTMs)(Text generation / sentiment analysis).
13. Natural Language Processing (NLP) (Text preprocessing (tokenization, TF-IDF) and sentiment classification).
14. Reinforcement Learning (Q-learning or Open AI Gym (CartPole balancing)).
15. Capstone Integrated Project (A real-world AI+ML pipeline (e.g., chatbot with intent detection, recommender system, or intelligent tutoring system).

Total(60 P)=60Periods

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply AI and ML techniques to solve real-world problems.	Apply
CO2	Compare and analyze the performance of AI/ML models for specific tasks.	Analyze
CO3	Develop AI/ML-based models and intelligent systems as per given specifications.	Evaluate
CO4	Engage in individual study and collaborative teamwork to design, implement, and critically evaluate AI/ML solutions for real-world problems, and present findings effectively.	Create

COURSE ARTICULATIONMATRIX

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

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

22AL407	JAVA PROGRAMMING LABORATORY				SEMESTER IV
PREREQUISITES		CATEGORY	PC	Credit	2
		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.	Todevelopsimplechatapplicationsanddatabaseconnectivityapplications

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 as implechat using Sockets programming
15.	Program to implement as implechat using Datagrams.
16.	Program to implement JDBC connectivity

Lab Requirements: for a batch of 30 students
Operating Systems: Linux / Windows
Front End Tools: Eclipse IDE / Netbeans IDE
Back End Tools: MySQL, Oracle, MS Access

Total(60 P) =60Periods

Course Outcomes: Afterthesuccessfulcompletionofthepracticalsession,thestudentswillbeableto		**Bloom's Taxonomy Mapped**
CO1	Implement object oriented programming concepts and java features	Apply
CO2	Develop Java standalone applications and applet applications	Create
CO3	Builds implechat applications and database connectivity applications	Create

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

22AL501	SOFTWARE ENGINEERING	SEMESTER V

PREREQUISITES	CATEGORY	PC	Credit	3	
		L	T	P	TH
NIL	Hours/Week	3	0	0	3

Course Objectives:

1.	To understand the different lifecycle 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–process technology-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 - TestStrategies for Object-Oriented Software - Test Strategies for Web Apps - 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 Web Apps-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- Establishinga Software Metrics Program- Decomposition- Empirical Estimation Models-Specialized EstimationTechniques-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-"AnIntegrated Approach to Software Engineering, Narosa Publications", Third Edition,2008.
2.	James F Peters and Witold Pedryez," Software Engineering An Engineering Approach", John Wiley and Sons, New Delhi,2000.
3.	IanSommerville, "Software engineering", Pearson education Asia, 6th edition, 2006.

E-References:	
1.	Software Engineering NPTEL video lecturesby 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.	Understand
CO2	Design and develop software systems	Evaluate
CO3	Differentiate and Apply the various testing techniques for project management	Analyze

COURSE ARTICULATION MATRIX

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

22AL502	DATABASE MANAGEMENT SYSTEMS	SEMESTER V

PREREQUISITES	CATEGORY	PC	Credit	3
NIL	Hours/Week	L	T	P	C
		3	0	0	3

Course 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 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 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: XMLHierarchicalModel,DTD,XMLSchema,XQuery–DataWarehousingandDataMining-informationRetrieval: IR Concepts, Retrieval Models, Queries in IR systems.

Total(45L)=45Periods

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 byDr.S.Srinath, IIITBangalore, 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	Apply
CO2	Design a database using ER diagrams and map ER into Relations and normalize the relations and summarize the transaction management and recovery management techniques adopted in database management system	Create
CO3	Describe and analyze the general idea of data storage, indexing techniques and query processing and Develop a simple database for applications	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3					3						3	3	3
CO2	3	3	3			3						3	3	3
CO3	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)														

25AL503	AUTOMATA THEORY AND COMPILER DESIGN	SEMESTER V

PREREQUISITES	CATEGORY	PC	Credit	3
✓ Discrete Structures ✓ Data Structures and Algorithms ✓ Object Oriented Programming	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To understand the mathematical models of computation and the theory of formal languages.
2.	To study the principles, algorithms, and data structures essential for compiler design.
3.	To gain theoretical knowledge in constructing lexical analysers, parsers, and intermediate code generators.
4.	To be familiar with code generation techniques and fundamental optimization methods.

UNIT I	FINITE AUTOMATA	9	0	0	9

Introduction- Basic Mathematical Notation and techniques - Finite State systems - Basic Definitions – Finite Automaton - DFA & NFA - Regular Languages - Regular Expression - Equivalence of NFA and DFA -Equivalence of finite Automaton and regular expressions - Minimization of DFA - Pumping Lemma for Regular sets.

UNITII	CONTEXT FREE GRAMMAR AND PDA	9	0	0	9

Grammar Introduction - Types of Grammar - Context Free Grammars (CFG) and Languages – Derivations and Languages - Ambiguity - Relationship between derivation and derivation trees - Simplification of CFG- Griesbach Normal form - Chomsky normal form. Pushdown Automata - Definitions - Moves - Instantaneous descriptions - Deterministic pushdown automata - Equivalence of Pushdown automata and CFL - Pumping lemma for CFL.

UNITIII	COMPILERS AND PARSERS	9	0	0	9

Compilers: Language Processors - Structure of a Compiler - Grouping of Phases into Passes - Lexical Analysis: Role of Lexical Analyzer - Input Buffering - Specification of tokens - Recognition of Tokens. SYNTAX Analysis Introduction- Role of the parser-Types of Parsing- Top-Down Parsing – Backtracking top-down process – Brute force parsing- non-back tracking top-down process – Recursive-descent parsing – Predictive parsing – LL (1).

UNITIV	BOTTOM-UP PARSING AND SYNTAX-DIRECTED TRANSLATION	9	0	0	9

Bottom-up parsing – concepts and definitions – Shift-Reduce Parser – Implementation of Shift-Reduce Parsing- Conflicts during Shift-Reduce parsing – SLR (1) Parsing- Constructing Canonical LR Parsing Tables- Canonical of LR (1) Item – Algorithm for constructing a Canonical LR Parsing Table- Constructing LALR Parsing Table-SDT Concepts and Definitions- SDD- Types- Syntax Directed Translation Schemes- Attribute Grammar.

UNIT V	OPTIMIZATION AND CODE GENERATION	9	0	0	9

Intermediate Code Generation – Translation of Simple Statements – Control Flow Statements-Issues in the Design of a Code Generator - The Target Language - Basic Blocks and Flow Graphs -Optimization of Basic Blocks - A Simple Code Generator - Principal Sources of Optimization- Storage Allocation Strategies.

Total(45 L)=45 Periods

Text Book:	
1.	Hopcroft J.E, Motwani R, and Ullman J D, Introduction to Automata Theory, Language and Computations, 3rd Edition, Pearson Education (ISBN 1292039051), 2014.
2.	Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman Compilers: Principles, Techniques and Tools,2nd Edition, Pearson, 2012.
Reference Books:	
1.	Kamala Krithi Vasan and Rama R, Introduction to Formal Languages, Automata Theory andComputation, Pearson Education 2009.
2.	Dasaradh Ramiah K, Introduction to Automata and Compiler Design, PHI Learning Private Limited, New Delhi, 2011
E-References:	
1.	https://nptel.ac.in/courses/106104028
2.	https://nptel.ac.in/courses/106108113/
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	Apply foundational mathematical models to analyze and design formal languages and finite automata	Apply
CO2	Construct context-free grammar and pushdown automata, and analyze their properties such as equivalence, ambiguity, and normal forms.	Analyze
CO3	Identify the phases of a compiler and develop lexical analyzers and top-down parsers such as predictive parsers.	Apply
CO4	Design bottom-up parsers like SLR, LR (1), and LALR, and implement syntax-directed translation schemes with intermediate code generation.	Create
CO5	Evaluate optimization techniques and implement storage allocation and basic block-level optimizations.	Evaluate

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

22AL504	NATURAL LANGUAGE PROCESSING	SEMESTER V

PREREQUISITES	CATEGORY	PC	Credit		3
		L	T	P	TH
NIL	Hours/week	3	0	0	3

Course Objectives:

1.	To learn the mathematical foundations and basics of Natural Language Processing.
2.	To understand the text data processing technologies for processing text data
3	To understand the role of Information Retrieval and Information Extraction in Text Analytics
4	To acquire knowledge of text data analytics using language model
5	To learn about NLP Tools and real-time examples of NLP.

UNIT I	INTRODUCTION TO NATURAL LANGUAGE PROCESSING	9	0	0	9

Natural Language Processing–Linguistic Background –Mathematical Foundations–Morphological Analysis – Tokenization – Stemming – Lemmatization – Boundary Determination.

UNIT II	TEXT DATA ANALYSIS	9	0	0	9

Reading unstructured data – Representing text data – Part of spESh tagging – Syntactic representation – Text similarity – WordNet-based similarity – Shallow parsing – Semantic representation.

UNIT III	INFORMATION RETRIEVAL AND EXTRACTION	9	0	0	9

Information Retrieval: Design features of Information Retrieval Systems-Classical, Nonclassical, Alternative Models of Information Retrieval – Information extraction – Named Entity Recognition – Relation Identification - Template filling.

UNIT IV	LANGUAGE MODELLING	9	0	0	9

Language model – Probabilistic Models – n-gram language models- Hidden Markov Model- Topic Modelling - Graph Models -Feature Selection and classifiers -Rule-based Classifiers - Maximum entropy classifier – Clustering-Word and Phrase-based Clustering.

UNIT V	NLPTOOLS AND APPLICATIONS	9	0	0	9

Tools: Natural Language Toolkit, Apache OpenNLP. Applications of Text Analytics – Applications in social media - Life science - Legal Text – Visualization - Case studies.

Total (45 L)= 45 Periods

Text Books:

1.	Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing," MIT Press, 1999.
2.	StevenStruhl, “Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence”, Kogan Page, 2015.
3.	Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”,1st Edition, O'Reilly Media, 2009.

Reference Books:

1.	Matthew A. Russell, “Mining the Social Web, "O'Reilly Media, 2013.
2.	Daniel Juraf sky and James H.Martin “SpEShandLanguageProcessing,"3rdedition, Prentice Hall, 2009.
3.	Nitin Indurkhya , Fred J. Damerau“Hand book of Natural Language Processing,"Second Edition, CRC Press, 2010.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the mathematical foundations and basics of Natural Language Processing.	Understand
CO2	Process text data at the syntactic and semantic level.	Apply
CO3	Extract key information from text data.	Analyze
CO4	Analyze text content to provide predictions related to a specific domain using language processing.	Analyze
CO5	Design an innovative application using NLP components.	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1									
CO2	3	3	2	2	3									
CO3	2	3	2	3	3									
CO4	2	3	2	3	3									
CO5	1	2	3	2	3									
Avg	**2.2**	**2.6**	**2.0**	**2.2**	**2.6**									
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

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

Course Objectives:

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

UNIT I	INNOVATION 101	0	0	6	6

Difference between a startup and a small business enterprise - Idea worth prototyping -Risk of innovations - Defining &validating hypothesis through Product Innovation Hypothesis (PIH) & Forge Innovation Rubric (FIR)

UNIT II	PROBLEM VALIDATION & CUSTOMER DISCOVERY	0	0	6	6

Tools and techniques of the managed innovation process (iTOOLS - innovation toolkit) -Customer-Centric Innovation: Customer centric design thinking and validate the problem scenario, its significance, severity, and incidence - Discover & identify the right buyer beneficiary/Customer - rigorous Gap analysis of the existing solution - Adoption barriers of the solutions.

UNIT III	DESIGNING & CRAFTING VALUE PROPOSITION	0	0	6	6

Understand Customer Jobs, Pains & gains - Design Product/Service - Define & quantify Value Proposition - Build a compelling value proposition.

UNIT IV	MUPSOLUTION CONCEPT EXPLORATION & DESIGN GENERATION	0	0	6	6

Solution: Concept Generation, Concept Assessment, Solution, Capability, Usability, and Feasibility- MUP Design and Technology Block Diagrams- Bill of Materials Generation - BoM Optimization

UNIT V	PROOF OF CONCEPT DEVELOPMENT & DEMONSTRATION	0	0	6	6

Proof-of-Concept design - hack to build PoC with critical features -Test PoC for technical feasibility test deliver of Value proposition - Innovation Brief documentation (Proposal) - Demonstrate a PoC;

Total=30Periods

Text Books:

1. Tim Brown, Change by Design:How design thinking transforms organizations and inspires innovation – HarperCollins ebooks, 2009
2. Alexander Osterwalder, Value Proposition Design: How to Create Products and Services Customers Want (Strategyzer) - John Wiley & Sons, 2014
3. Ulrich Karl and Eppinger Steven D, Product Design and Development - McGraw Hill, 5th edition, 2020
4. Blank Steve, Four Steps to Epiphany: Successful strategies for products that win, KS Ranch, 5th edition, 2013

Reference Books:	
1.	Everything you need about value proposition: https://blog.forgeforward.in/everything-you-need-to-know-about-valueproposition-7247493c940c
2.	Test your Value Proposition:http://businessmodelalchemist.com/2012/09/test-your-value-proposition-supercharge-leanstartup-and-custdev-principles.html
3.	Valuation Risk versus Validation Risk in Product Innovations:https://blog.forgeforward.in/valuation-risk-versus-validationrisk-in-product-innovations-49f253ca8624
4.	User Guide for Product Innovation Rubric: https://blog.forgeforward.in/user-guide-for-product-innovation-rubric857181b253dd
5.	Innovation Risk Diagnostic - Product Innovation Rubric: https://blog.forgeforward.in/product-innovation-rubricadf5ebdfd356
6.	Evaluating Product Innovations - proof, potential, & progress: https://blog.forgeforward.in/evaluating-product-innovationse8178e58b86e

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Apply a scientific method to understand the inherent risks of product innovation	Apply
CO 2	Apply innovation tools & techniques to validate the problem scenario and to assess the market potential of product innovation;	Apply
CO3	Design solution concept based on the proposed value by exploring various alternate solutions to achieve value-price fit;	Create
CO4	Demonstrate technical skills by applying technology to build and demonstrate proof of concept for the solution proposed	Understand
CO5	Develop skills to articulate the solution concept into a proposal for grants.	Apply

COURSE ARTICULATION MATRIX

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

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

22MC301	INDIAN CONSTITUTION (Common to all branches)				SEMESTER V			
PREREQUISITES		CATEGORY	MC		Credit		0	
		Hours/week	L		T	P	TH	
			2		0	0	2	

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	Understand
CO2	explain the key concepts of Indian Political System	Understand
CO3	describe the role of constitution in a democratic society.	Remember
CO4	present the structure and functions of the Central and State Governments, the Legislature and the Judiciary	Understand

22AL505	DATABASE MANAGEMENT SYSTEMS LABORATORY				SEMESTER V
PREREQUISITES		**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 assertion sand indexes.
8.	Use of frontend tools to manipulate the database.
9.	Generate reports using are porting tool.
10.	Database Design and implementation of an application system.(Suggested Mini Project)

Total(60 P)=60Periods

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

COURSE ARTICULATION MATRIX

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

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

22AL506	NATURAL LANGUAGE PROCESSING LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	PC	Credit		
	Hours/Week	L	T	P	TH
		0	0	4	4

Course Objectives:

1.	To learn the fundamental NLP concepts and familiarize students with text preprocessing and linguistic feature extraction.
2.	To provide hands-on experience in implementing NLP techniques using tools like NLTK and Apache OpenNLP.
3.	To develop the ability to design and evaluate models for tasks such as POS tagging, named entity recognition, and relation extraction.
4	To explore various approaches for information retrieval, text classification, and topic modeling.
5	To enable learners to apply NLP methods for analyzing social media, customer reviews, and legal or scientific documents.

EXPERIMENTS

1.	Implement to kenization and compare the effectiveness of stemming versus lemmatization in improving text preprocessing for sentiment analysis.
2.	Developapart-of-spEShtagging system using NLTK and evaluate its accuracy on acorpus of news articles.
3.	Explore various text similarity metrics, Including Word Net-based similarity, for clustering news headlines into topics.
4.	Build an information retrieval system using classical and non classical models and compare their performance on a dataset of scientific papers.
5.	Implement an amedentity recognition model using Apache Open NLP and assessits accuracy on legal text documents.
6.	Investigate different approaches for relation identification in biomedical text sand evaluate their precision and recall.
7.	Construct a language model using n-gram models and compare its performance with a hidden Markov model on a corpus of tweets.
8.	Apply topic modelling techniques to extract the mes froma collection of customer reviews and visualize the results using t-SNE.
9.	Develop a rule-based classifier to categorize legal documents into different types and measure its accuracy against a maximum entropy classifier.
10.	Utilize word and phrase-based clustering algorithms to identify patterns in social media conversations and analyze their implications for marketing strategies.

Total(60 P) =60Periods

TEXTBOOKS:

1.Natural Language Processing in Action 2nd Ed by Hobson Lane (Author), Maria Dyshel (Author)

2.Natural Language Processing A Textbook With Python Implementation (English,Hardback) By Lee, Raymond S T (Author) By Springer Verlag (Publication)

Course Outcomes: Afterthesuccessfulcompletionofthepracticalsession,thestudentswillbeableto		**Bloom's Taxonomy Mapped**
CO1	Apply tokenization, stemming, and lemmatization techniques for efficient text preprocessing.	Apply
CO2	Build and evaluate POS tagging models using NLP libraries	Evaluate
CO3	Analyze text similarity and perform clustering using semantic similarity measures.	Analyze
CO4	Design and implement information retrieval systems using both classical and modern approaches.	Create
CO5	Develop named entity recognition systems and evaluate their accuracy on real-world datasets.	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	3								2	2
CO2	3	3	2	3	3								2	2
CO3	2	3	2	3	3								2	2
CO4	2	3	3	3	3								2	2
CO5	2	3	3	3	3								2	2
Avg	2.4	2.8	2.2	2.6	3.0								2	2
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

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

COURSE OBJECTIVES:

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

UNIT I	**WRITING SKILLS**	**0**	**0**	**12**	**12**

Letter seeking permission to go on industrial visit, Letter of invitation, Resume and cover letter, Job application, E-mail writing, Report writing, progress in project work

UNIT II	**SPEAKING SKILLS**	**0**	**0**	**12**	**12**

Welcome address and vote of thanks, Analysing and presenting business articles, Power point presentation, Presenting the visuals effectively, Group discussion, Participating in group discussions, Understanding group dynamics, Brain-storming the topics

UNIT III	**SOFT SKILLS**	**0**	**0**	**12**	**12**

Employability and career skills, Self-introduction, Introducing oneself to the audience, introducing the topic, Interview skills, Interview etiquette, Dress code, Body language, Attending job interviews

UNIT IV	**VERBAL ABILITIES**	**0**	**0**	**12**	**12**

Error Spotting, Listening Comprehension, Reading comprehension, Rearranging Jumbled sentences, Vocabulary

UNIT V	**REASONING ABILITIES**	**0**	**0**	**12**	**12**

Series completion, Analogy, Classification, Coding-Decoding, Blood relations, Seating Arrangements, Directional Sense, Venn Diagram, Logical reasoning, Statements and Conclusions

Total (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	Apply
CO2	develop adequate soft skills and career skills required for the workplace	Create
CO3	make effective presentations on given topics	Create
CO4	apply their verbal ability and reasoning ability in campus interviews	Apply

COURSE ARTICULATION MATRIX

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

22AL601	MINI PROJECT	SEMESTER VI

PREREQUISITES	CATEGORY	EE	Credit		3
NIL	Hours/Week	L	T	P	TH
		0	0	6	6

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. Six 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, literaturesurvey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.

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

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

COURSE ARTICULATION MATRIX

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

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

22AL701	DATA PRIVACY AND SECURITY	SEMESTER	VII

PREREQUISITES	CATEGORY	PC	Credit		3
		L	T	P	TH
COMPUTER NETWORKS	Hours/week	3	0	0	3

Course Objectives:

1.	To understand the core concepts and principles of data security with the theoretical aspects of symmetric and asymmetric encryption techniques, as well as authentication mechanisms.
2.	To aware of the legal, ethical, and professional responsibilities in handling personal and sensitive data.

UNIT I	INTRODUCTION TO SECURITY	9	0	0	9

Introduction: The OSI Security Architecture - Security Attacks - Security Services - Mechanisms - A model for Network Security.
Classical Encryption techniques: Symmetric Cipher Model - Substitution Techniques - Transposition Techniques.

UNIT II	SYMMETRIC AND ASYMMETRIC ENCRYPTION ALGORITHMS	9	0	0	9

Symmetric Key Cipher: Block Cipher Principles - The Data Encryption Standard - The AES Cipher - Multiple Encryption and Triple DES - Block Cipher Modes of Operation.
Asymmetric Key Ciphers: Principles of Public Key Cryptosystems - The RSA Algorithms - Key management - Diffie-Hellman Key Exchange - Elliptic Curve Cryptography.

UNIT III	HASH FUNCTIONS AND DIGITAL SIGNATURE	9	0	0	9

Authentication requirements - Authentication Functions - Message Authentication Codes - Hash Functions - Secure Hash Algorithm - Whirlpool - HMAC - CMAC - Digital Signatures - Authentication Protocols - Digital Signature Standard.

UNIT IV	PRIVACY IN COMPUTING	9	0	0	9

Privacy Concepts - Privacy Principles and Policies - Authentication and Privacy – Data Mining - Privacy on the Web - E-Mail Security - Impacts on Emerging Technologies.

UNIT V	LEGAL AND ETHICAL ISSUES IN COMPUTER SECURITY	9	0	0	9

Protecting Programs and Data - Information and the Law - Rights of Employees and employers - Redress for Software Failures - Computer Crime – Ethical Issues in Computer Security - Case Studies of Ethics.

Total (45 L)= 45 Periods

Text Books:

1.	William Stallings, "Cryptography and Network Security – Principles and Practices", Fourth Edition, 2006. (Unit I - III)
2.	Security in Computing by Charles Pfleeger, Shari Lawrence Pfleeger, 5th Edition, PHI,2015. (Unit IV-V)

Reference Books:

1.	AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, Fourth Edition, 2019.
2.	Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, Course Technology, 9th Edition, 2020.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the fundamentals concepts and principles of data security and apply symmetric and asymmetric encryption techniques and authentication mechanisms.	Apply
CO2	Aware of the legal, ethical, and professional responsibilities in handling personal and sensitive data.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	3	3	2	1	-	-	2	2	3	2
CO2	2	1	1	-	1	2	1	3	-	-	1	1	2	1
Avg	**2.5**	**2**	**2**	**-**	**2**	**2.5**	**1.5**	**2**	**-**	**-**	**1.5**	**1.5**	**2.5**	**1.5**
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22AL702	COMPUTER VISION				SEMESTER VII			
PREREQUISITES		**Category**	**PC**		**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

Textbooks:	
1	Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
Reference Books:	
1	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Understand basic knowledge, theories and methods in image processing and computer vision.	Understand
CO2	Implement basic and some advanced image processing techniques in Open CV.	Apply
CO3	Apply 2D a feature-based based image alignment, segmentation and motion estimations.	Apply
CO4	Apply 3D image reconstruction techniques	Apply
CO5	Design and develop innovative image processing and computer vision applications.	Create

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

22AL703	DEEP LEARNING	SEMESTER VII

PREREQUISITES	Category	PC	Credit	3
Programming Language, Mathematics, Statistics	Hours/Week	L	T	P	TH
		3	0	0	3

Course Learning Objectives

1	Explain the fundamental methods involved in deep learning, including the underlying optimization concepts (gradient descent and back propagation), 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 the orem for Perceptron Learning Algorithm.

Feed forward Networks: Multilayer Perceptron, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization, autoencoders.

UNIT II	DEEP NEURAL NETWORKS	9	0	0	9

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise 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 inneural 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 Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs

Convolutional Neural Networks: LeNet, Alex Net.

UNIT IV	GENERATIVE MODELS	9	0	0	9

Generativemodels: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

UNIT V	RECENTTRENDS	9	0	0	9

Recenttrends:Variational Auto encoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning

Total (45 L) =45 Periods

Text Books:

1.	Deep Learning, I an Good fellow 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	Understand
CO2	Explain the concept behind Recurrent Neural Networks and Identify the Generative Deep learning models	Analyze
CO3	Recognize the tangible applications of Deep learning.	Create

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

22MG701	PRINCIPLES OF MANAGEMENT	SEMESTER VII

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

Course Learning 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 ORGANIZATION	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.

UNITII	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.

UNITIII	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.

UNITIV	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.

UNITV	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 L) =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.	NeuralNetworks:ASystematicIntroduction,RaúlRojas,1996
2.	PatternRecognitionandMachineLearning,ChristopherBishop,2007
3.	Robert Kreitner & Mamata Mohapatra, ― Management‖, Biztantra, 2008.

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

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1					1			2	1	1	2			2
CO2					1			2	1	1	2			2
CO3					1			2	1	1	2			2
CO4					1			2	1	1	2			2
CO5					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)

22AL704	DATA PRIVACY AND SECURITY LABORATORY	Semester	VII

PREREQUISITES	Category	PC	Credit		2
		L	T	P	TH
Computer Networks	Hours/Week	0	0	4	4

Course Learning Objectives	
1	To provide knowledge to work with Symmetric method
2	To be familiar with how RSA, Secure hash algorithm and Diffie-Hellman Algorithm are implemented
3	To be familiar with simulation of firewall concepts and virus attacks

EXPERIMENTS	
1	Implementation of Caesar Cipher Algorithm.
2	Implementation of Playfair Cipher Algorithm.
3	Implementation of Hill Cipher Algorithm.
4	Implementation of DES Algorithm.
5	Implementation of AES Algorithm.
6	Implementation of RSA Algorithm.
7	Implement and simulate Diffie –Hellman Algorithm.
8	Implementation of Secure Hash Algorithm.
9	Create a model to simulate Digital Signature concept.
10	Create a model to simulate firewall concept.
11	Create a model to simulate the concept of virus attack.

Software Required: Borland C++ / Java

Total (45 P)= 45 Periods

Course Outcomes: After the successful completion of the practical session, the students will be able to		Bloom's Taxonomy Mapped
CO1	Understand how Symmetric methods are implemented.	Apply
CO2	Familiar with how RSA, Secure hash algorithm and Diffie-Hellman Algorithm are implemented	Analyze
CO3	Familiar with simulation of firewall concepts and virus attacks	Understand

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

22AL801	PROJECT WORK	SEMESTER VIII			
PREREQUISITES		**CATEGORY**	**EE**	**Credit**	**7**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			0	**0**	**14**	**14**

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

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

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

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

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

COURSE ARTICULATION MATRIX

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

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

PROFESSIONAL ELECTIVES

22ALPE101	GRAPH THEORY				PE I	
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1.	To introduce the fundamental concepts, definitions, types of graphs, and their basic properties essential for studying advanced topics in graph theory.
2.	To develop the ability to analyze graph structures such as trees, connectivity, cycles, and matchings, and strengthen the student's capability to construct mathematical proofs and reasoning.
3.	To provide understanding of standard graph algorithms such as graph traversal, shortest path computation, minimum spanning trees, and maximum flow, with emphasis on their correctness and computational complexity.
4.	To enable students to model real-world and computer science engineering problems using graph-theoretic concepts, and identify appropriate solution techniques for routing, scheduling, network design, and optimization contexts.
5.	To introduce advanced concepts like planar graphs and graph coloring to enhance understanding of combinatorial structures and classification of graph problems.
6.	To promote independent learning and interest in graph theory research trends, tools, libraries, and applications relevant to modern computing domains such as social networks, compilers, data science, and network analysis.

UNIT I	**BASIC CONCEPTS & REPRESENTATIONS**	**9**	**0**	**0**	**9**

Graph definitions: simple, directed, weighted, multigraphs, subgraphs, complement-Degree, paths, cycles, connectivity, reachability-Graph representations: adjacency matrix, adjacency lists, incidence lists; complexity tradeoffs-Special graphs: complete, bipartite, trees, regular graphs.

UNIT II	**TREES, CONNECTIVITY & TRAVERSAL**	**9**	**0**	**0**	**9**

Trees: definitions, properties, rooted trees, parent/child, leaf, centroid-Spanning trees, Cayley's formula (statement), Prüfer code idea (optional)-Graph traversal: DFS, BFS — applications, complexity, parent/finish times, topological sort-Biconnectivity, articulation points, bridges, block-cut tree

UNIT III	**MATCHING, EULERIAN & HAMILTONIAN GRAPHS**	**9**	**0**	**0**	**9**

Eulerian trails/circuits: necessary & sufficient conditions-Hamiltonian cycles: sufficient conditions (Dirac, Ore — statements), heuristics-Matchings in bipartite graphs: Hall's theorem, maximum matching (augmenting path idea / Hungarian algorithm outline)

UNIT IV	**GRAPH ALGORITHMS: MST, SHORTEST PATHS & FLOWS**	**9**	**0**	**0**	**9**

Minimum spanning trees: Kruskal, Prim — correctness proofs and complexity-Shortest paths: Dijkstra (non-negative edges), Bellman-Ford (negative edges), single-source vs all-pairs (Floyd-Warshall overview)-Network flows: max-flow min-cut theorem, Ford–Fulkerson / Edmonds–Karp algorithm idea and complexity; applications (bipartite matching, connectivity)

UNIT V	**PLANARITY, COLORING & ADVANCED TOPICS**	**9**	**0**	**0**	**9**

Planar graphs: Euler's formula, Kuratowski's theorem (statement), planar embeddings, graph duality (overview)-Graph coloring: vertex coloring, chromatic number, greedy coloring, bipartite tests-Introduction to spectral ideas / graph isomorphism (overview), basic graph metrics (diameter, eccentricity, clustering)-Optional/advanced: Random graphs, network models, introduction to graph databases & applications (social networks, compilers, routing)

Total (45 L) =45 Periods

Text Books:	
1.	Introduction to Graph Theory — Douglas B. West (suitable for CS students; good mix of theory and examples)
Reference Book:	
1.	Graph Theory with Applications — J.A. Bondy and U.S.R. Murty (classic, application-focused)
2.	Graph Theory — Reinhard Diestel (more rigorous; free electronic edition often available)
3.	Algorithms / Algorithm Design — (e.g., by Kleinberg & Tardos or by Cormen/Leiserson/Rivest/Stein) for algorithmic implementations (MST, shortest paths, flows)

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recall and use definitions, notations and basic properties of graphs and trees.	Understand
CO2	Analyze and design algorithms for graph traversal, spanning trees, and connectivity problems (BFS, DFS, MST).	Evaluate
CO3	Formulate and solve shortest path and network flow problems; apply max-flow/min-cut ideas to real problems.	Apply
CO4	Apply matching, Eulerian and Hamiltonian concepts to modelling and solve related decision problems.	Evaluate
CO5	Understand planarity and coloring basics; relate graph-theoretic concepts to applications in CS (routing, compilers, social networks).	Understand
CO6	Model a practical problem as a graph, choose and justify an appropriate algorithm, and analyze its correctness and complexity.	Evaluate

COURSE ARTICULATION MATRIX														
COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	-	1	-	2	-	1	-		
CO2	3	3	3	2	2	-	1	-	2	-	1	-		
CO3	2	3	3	2	3	-	1	-	2	-	1	-		
CO4	2	3	2	2	2	-	1	-	2	-	1	-		
CO5	2	2	2	1	2	-	1	-	2	1	1	-		
CO6	3	3	3	3	3	1	2	2	3	1	2	-		
Avg	**2.3**	**3**	**2.3**	**1.8**	**2.2**	**0.2**	**1.2**	**0.3**	**2.2**	**0.3**	**1.2**	**-**		
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALPE102	SOFTWARE PROJECT MANAGEMENT		PE I			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Software Engineering		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

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

UNIT I	INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT	9	0	0	9

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

UNIT II	PROJECT EVALUATION	9	0	0	9

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

UNIT III	ACTIVITY PLANNING AND RISK MANAGEMENT	9	0	0	9

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

UNIT IV	MONITORING AND CONTROL	9	0	0	9

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

UNIT V	MANAGING PEOPLE AND ORGANIZING TEAMS	9	0	0	9

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

Total (45 L)=45 Periods

Text Books:

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

Reference Books:

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

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

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

22ALPE103	STATISTICAL LEARNING				PE I			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**		
		Hours/Week	**L**	**T**	**P**	**TH**		
			3	**0**	**0**	**3**		

Course Objectives

1.	To introduce fundamental concepts of statistical modeling and inference used in machine learning.
2.	To develop the ability to apply regression and classification models on complex datasets.
3.	To explain model selection, regularization, bias–variance trade-off, and resampling techniques.
4.	To enable students to apply statistical learning methods to real data analysis problems using modern tools.
5.	To introduce advanced learning methods including tree-based models, SVMs, neural networks, and unsupervised learning.
6.	To promote analytical, experimental, and research thinking in statistical learning applications.

UNIT I	**INTRODUCTION TO STATISTICAL LEARNING**	**9**	**0**	**0**	**9**
Statistical learning overview-Data types & structures-Supervised vs unsupervised learning-Regression vs classification-Estimation theory, bias-variance trade-off-Loss functions, risk minimization.					
UNIT II	**LINEAR REGRESSION & CLASSIFICATION**	**9**	**0**	**0**	**9**
Simple & multiple linear regression-Maximum likelihood estimation-Logistic regression-Linear discriminant analysis (LDA), QDA-Naive Bayes classifier-Model diagnostics, residual analysis.					
UNIT III	**MODEL SELECTION & REGULARIZATION**	**9**	**0**	**0**	**9**
Subset selection: best-subset, stepwise-Shrinkage methods: Ridge, Lasso, Elastic Net-Principal component regression (PCR), Partial least squares (PLS)-High-dimensional data challenges-Bias-variance decomposition.					
UNIT IV	**RESAMPLING METHODS & TREE-BASED MODELS**	**9**	**0**	**0**	**9**
Cross-validation (k-fold, LOOCV)-Bootstrap methods-Decision trees, classification/regression trees (CART)-Random forests, bagging-Gradient boosting (GBM, XGBoost).					
UNIT V	**SUPPORT VECTOR MACHINES & MODERN LEARNING TRENDS**	**9**	**0**	**0**	**9**
Support Vector Machines for classification & regression-Kernel methods-Neural networks – basics-Unsupervised learning: k-means, hierarchical clustering-PCA, t-SNE for dimensionality reduction-Case studies in text, image, and network data.					
Total (45 L) =45 Periods					

Text Books:

1.	"An Introduction to Statistical Learning"**Authors: Gareth James, Daniela Witten, Trevor Hastie, Robert TibshiraniSpringer (widely used, practical focus)**

Reference Book:	
1.	**"The Elements of Statistical Learning"**Authors: Trevor Hastie, Robert Tibshirani, Jerome FriedmanSpringer (advanced theory)
2.	**"Pattern Recognition and Machine Learning"**Author: Christopher BishopSpringer (probabilistic ML approach)
3.	**"Machine Learning: A Probabilistic Perspective"**Author: Kevin P. MurphyMIT Press (advanced models & inference)

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the concepts of statistical learning, supervised and unsupervised methods, and inference principles.	Understand
CO2	Apply regression and classification algorithms and evaluate their performance using statistical metrics.	Evaluate
CO3	Use regularization and model selection strategies to improve generalization and reduce overfitting.	Apply
CO4	Implement resampling methods such as cross-validation and bootstrap for model evaluation.	Analyze
CO5	Employ advanced statistical learning techniques such as SVMs, decision trees, ensemble learning, and neural networks.	Apply
CO6	Analyze real datasets, interpret results, and communicate findings through reports and presentations.	Evaluate

COURSE ARTICULATION MATRIX														
COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1				2					
CO2	2	3	2	1	2		1		2		1			
CO3	2	3	3	2	2		1		2		1			
CO4	2	3	3	3	3		1		3		1			
CO5	2	2	3	2	3		1		2		1			
CO6	1	2	3	2	3	1	2	1	3	1	1			
Avg														
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALPE104	MULTIMEDIA ANALYTICS			PE I		
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1.	To understand the different media and design issues in multimedia systems
2.	To understand communication standards for Multimedia
3.	Exploration of security for multimedia systems

UNIT I	**MULTIMEDIA ELEMENTS**	**9**	**0**	**0**	**9**

Introduction - Definitions - Applications - Elements - Text - Image/Graphics Audio - Video - Animation

UNIT II	**AUDIO AND SPEECH**	**9**	**0**	**0**	**9**

Data acquisition - sampling and quantization - human speech - digital model of speech production - analysis and synthesis - psychoacoustics - low bit rate speech compression - MPEG audio compression.

UNIT III	**IMAGES AND VIDEO**	**9**	**0**	**0**	**9**

Image acquisition and representation - bi-level image compression standards: ITU (formerly CCITT) Group III and IV standards - JPEG image compression standards - MPEG - H.264/AVC video compression standards - Transcoding.

UNIT IV	**MULTIMEDIA NETWORKS**	**9**	**0**	**0**	**9**

Protocol - QOS Issues - RTP - RTCP - RTSP - SIP - Media on demand - ITV - STB Broadcast Schemes for VoD Buffer Management - Multimedia over wireless networks.

UNIT V	**MULTIMEDIA SECURITY AND FORENSICS**	**9**	**0**	**0**	**9**

Multimedia encryption - Digital Watermarking Security Attacks - Digital Forensics taxonomy - goals/ requirements - Forensic Data Acquisition - Forensics Analysis and Validation.

Total (45 L) =45 Periods

Text Books:

1.	K. Andleigh, Kiran Thakrar, “Multimedia Systems Design”, PHI, 2007.
2.	ZeNian Li, S. Drew, “Fundamentals of Multimedia”, PHI, 2006.
3.	Ze-Nian Li, Mark S. Drew, “Fundamentals of Multimedia”, Pearson Prentice Hall, 2004.

Reference Book:

1.	Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindergh, Richard L. Baker, “Digital Compression for Multimedia: Principles and Standards”, Elsevier, 2006.
2.	Ralf Steinmetz, Klara, “Multimedia Computing, Communications and Applications”, Pearson Education, 2009.
3.	Chun-Shien Lu, “Multimedia Security: Steganography and Digital Watermarking Techniques for Protection of Intellectual Property”, Springer Inc., 2007.
4.	Wenjun Zeng, Heather Yu, Ching, Yung Lin, “Multimedia Security Technologies for Digital Rights Management”, Elsevier Inc., 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Design multimedia components efficiently	Analyze
CO2	Develop integrated, collaborative multimedia systems	Apply
CO3	Understand various compression standards and techniques in multimedia	Understand
CO4	Understand protocols for multimedia	Understand
CO5	Develop security algorithms for the specialized applications	Apply

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

22ALPE105	COMPUTER GRAPHICS		PE I			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
NIL		**Hours/week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To familiarize students with fundamental computer graphics hardware, software, and basic OpenGL output primitives
2.	To impart knowledge on attributes of graphics primitives
3.	To develop understanding of implementation algorithms for graphics primitives and two-dimensional geometric transformations
4.	To explain two-dimensional viewing concepts and clipping techniques
5.	To provide insight into three-dimensional viewing and projection transformations

UNIT I	**COMPUTER GRAPHICS HARDWARE,SOFTWARE AND OUTPUT PRIMITIVES**	**9**	**0**	**0**	**9**

Computer Graphics Hardware: Video Display Devices, Raster-Scan Systems, Graphics Networks, Graphics on the Internet. Computer Graphics Software: Coordinate Representations, Graphics Functions, Software Standards, Other Graphics Packages, Introduction to OpenGL.
Graphics Output Primitives: Coordinate Reference Frames, Specifying a Two-Dimensional World-Coordinate Reference Frame in OpenGL, OpenGL Point Functions, OpenGL Line Functions, OpenGL Curve Functions.

UNIT II	**ATTRIBUTES OF GRAPHICS PRIMITIVES**	**9**	**0**	**0**	**9**

Fill-Area Primitives, Polygon Fill Areas, OpenGL Polygon Fill-Area Functions, OpenGL Vertex Arrays, Pixel-Array Primitives, OpenGL Pixel-Array Functions, Character Primitives, OpenGL Character Functions, Picture Partitioning, OpenGL Display Lists, OpenGL Display-Window Reshape Function.
Attributes of Graphics Primitives: OpenGL State Variables, OpenGL Color Functions, OpenGL Point-Attribute Functions, OpenGL Line-Attribute Functions, Curve Attributes, OpenGL Fill-Area Attribute Functions.

UNIT III	**GRAPHICS PRIMITIVES & ATTRIBUTES ALGORITHMS AND TWO-DIMENSIONAL GEOMETRIC TRANSFORMATION**	**9**	**0**	**0**	**9**

Implementation Algorithms for Graphics Primitives and Attributes: Line-Drawing Algorithms, Parallel Line Algorithms, Setting Frame-Buffer Values, Circle-Generating Algorithms.
Two-Dimensional Geometric Transformations: Basic Two-Dimensional Geometric Transformations, Matrix Representations and Homogeneous Coordinates, Inverse Transformations, Two-Dimensional Composite Transformations, Other Two-Dimensional Transformations, Raster Methods for Geometric Transformations.

UNIT IV	**TWO-DIMENSIONAL VIEWING**	**9**	**0**	**0**	**9**

Two-Dimensional Viewing: The Two-Dimensional Viewing Pipeline, The Clipping Window, Normalization and Viewport transformations, OpenGL Two-Dimensional Viewing Functions, Clipping Algorithms, Two-Dimensional Point Clipping, Two-dimensional Line Clipping (Cohen-Sutherland Line Clipping and Liang-Barsky Line Clipping), Polygon Fill-Area Clipping (Sutherland- Hodgman Polygon Clipping.

UNIT V	**THREE-DIMENSIONAL VIEWING**	**9**	**0**	**0**	**9**

Three-Dimensional Viewing: Overview of Three-Dimensional Viewing Concepts, The Three-Dimensional Viewing Pipeline, Three-Dimensional Viewing-Coordinate Parameters, Transformation from World to Viewing Coordinates, Projection Transformations, Orthogonal Projections, Perspective Projections, The Viewport Transformation and Three-Dimensional Screen Coordinates, OpenGL Three-Dimensional Viewing Functions, Three-Dimensional Clipping Algorithms, OpenGL Optional Clipping Planes.

Total (45 L)= 45 Periods

Text Books:

1. Donald Hearn, M Pauline Baker, "Computer Graphics with OpenGL" ,4th Edition, Pearson Education Limited,2012.

Reference Books:	
1.	FS Hill, Stephen M Kelley,"Computer Graphics using OpenGL",3rd Edition, Pearson Education Limited,2007

E-Books:	
1.	Richard Szeliski, "Computer Vision: Algorithms and Applications ",2nd Edition, https://math.hws.edu /graphicsbook/, 2022

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply suitable software modules for developing graphics applications using OpenGL.	Apply
CO2	Analyze various graphic transformation algorithms.	Analyze
CO3	Design graphics-based applications using different transformations and viewing.	Create

COURSE ARTICULATION MATRIX

COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3												2	1
CO2		3											2	1
CO3			3						2	2			2	1
Avg	**1**	**1**	**1**						**0.6**	**0.6**			**2**	**1**

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

22ALPE201	SOFTWARE TESTING METHODOLOGIES			PE II			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Software Engineering		**Hours/week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To provide knowledge of the concepts in software testing such as testing process, criteria, strategies, and methodologies.
2.	To develop skills in software test automation and management using the latest tools.

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

Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT II	**TRANSACTION FLOW AND DOMAIN TESTING**	**9**	**0**	**0**	**9**

Transaction Flow Testing: transaction flows, transaction flow testing techniques. Data Flow testing: Basics of data flow testing, strategies in data flow testing, application of data flow testing.

Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT III	**PATH PRODUCTS AND REGULAR EXPRESSIONS**	**9**	**0**	**0**	**9**

Paths, Path products and Regular expressions: path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.

Logic Based Testing: overview, decision tables, path expressions, kv charts, specifications.

UNIT IV	**STATE GRAPHS AND TRANSITION TESTING**	**9**	**0**	**0**	**9**

State, State Graphs and Transition testing: state graphs, good & bad state graphs, state testing, Testability tips.

UNIT V	**GRAPH MATRICES AND APPLICATION**	**9**	**0**	**0**	**9**

Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like Jmeter/selenium/soapUI/Catalon).

Total (45 L)= 45 Periods

Text Books:

1.	Software Testing techniques - Baris Beizer, Dreamtech, second edition.
2.	Software Testing Tools – Dr. K. V. K. K. Prasad, Dreamtech.

Reference Books:

1.	The craft of software testing - Brian Marick, Pearson Education.
2.	Software Testing Techniques – SPD(Oreille)
3.	Software Testing in the Real World – Edward Kit, Pearson
4.	Effective methods of Software Testing, Perry, John Wiley.
5.	Art of Software Testing – Meyers, John Wiley.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand purpose of testing and path testing	Understand
CO2	Understand strategies in data flow testing and domain testing	Understand
CO3	Develop logic-based test strategies	Apply
CO4	Understand graph matrices and its applications	Understand
CO5	Implement test cases using any testing automation tool	Analysis

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

22ALPE202	COMPUTATIONAL NEURO SCIENCE		PE II			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
✓ Engineering Mathematics ✓ Introduction to AI ✓ Python Programming		**Hours/week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To introduce the fundamental principles, history, and computational perspectives of neuroscience, including levels of brain organization and analysis.
2.	To develop a strong mathematical foundation required for modeling neural systems, including dynamical systems, bifurcation analysis, and linear algebra concepts.
3.	To understand the biophysical mechanisms underlying neural dynamics through models such as the Hodgkin–Huxley and GHK equations.
4.	To explore biological sensory and motor systems along with artificial neural network models and learning algorithms inspired by the brain.
5.	To apply information theory and network analysis for understanding structural and functional connectivity in computational neuroscience case studies.

UNIT I	**INTRODUCTION TO COMPUTATIONAL NEUROSCIENCE**	**9**	**0**	**0**	**9**

Introduction and history of Computational Neuroscience-Tools and specializations in neuroscience-Levels of organization in the brain-Levels of analysis- Computational theory of the brain

UNIT II	**MATHEMATICAL FOUNDATIONS FOR NEURAL MODELLING**	**9**	**0**	**0**	**9**

Linear systems-Eigenvalues and eigenvectors for symmetric matrices-Quadratic forms, solving a system of linear equations-Dynamic Systems-Bifurcation map in terms of trace and determinant-Phase plane analysis: nullclines-Hopf bifurcation and limit cycles

UNIT III	**NEURAL DYNAMICS AND BIOLOGICAL MODELS**	**9**	**0**	**0**	**9**

Neuron structure-Membrane potential and action potential-Electrophysiology basics-Goldman–Hodgkin–Katz voltage equation-Hodgkin–Huxley Model-Components of neural signalling-Neurotransmission

UNIT IV	**SENSORY, MOTOR, AND ARTIFICIAL NEURAL SYSTEMS**	**9**	**0**	**0**	**9**

Biological Systems-Models of Sensory Systems: Vision, Touch, Hearing-Motor Systems; Artificial Neural Networks-McCulloch-Pitts Neuron-Perceptron-Multilayer Perceptron (MLP)-Backpropagation – case studies (Past tense learning, NetTalk)-Self-organizing map-Hopfield Network-Biological plausibility of backpropagation-Hebbian Learning and PCA-Linsker's model of the visual system- Reinforcement Learning-Spiking neuron networks

UNIT V	**INFORMATION THEORY AND CASE STUDIES**	**9**	**0**	**0**	**9**

Communication channel and information gain-Information measure and entropy- Joint and conditional information measures-Markov Source-Non-linear correlation measures; **Case Studies:**Complex network analysis-Structural and functional brain networks

Total (45 L)= 45 Periods

Text Books:	
1.	Eric Kandel, James Thomas Schwartz and Jessel, “Principles of Neural Science”, McGraw-Hill, 2013.
2.	Feng J., “Computational Neuro Science: A Comprehensive Approach”, Chapman and Hall / CRC, 2004.
3.	Randall C. O'Reilly and Yuko Munakata, “Computational Explorations in cognitive Neuroscience: Understanding the Mind”, MIT Press, 2000.
4.	Thomas P. Trappenberg, “Fundamental of Computational Neuroscience”, Oxford University press, 2010.
Reference Books:	
1.	Raymond W. Yeung, “Information Theory and Network Coding”, Springer, 2011.
2.	Cover T. M. and Thomas J. A., “Elements of Information Theory”, John Wiley& Sons, 2006.
3.	Claude Elwood Shannon and Warren Weaver, “The Mathematical Theory of Communication”, University of Illinois Press, 1999.
E-References:	
1.	http://en.wikipedia.org/wiki/Computational_neuroscience
2.	http://www.scholarpedia.org/article/Encyclopedia_of_computational_neuroscience
3.	http://home.earthlink.net/~perlewitz/

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Explain the basic concepts, history, tools, and theoretical frameworks of computational neuroscience.	Understand
CO2	Apply mathematical techniques such as eigenvalue analysis, phase plane analysis, and bifurcation methods to model neural systems.	Analyze
CO3	Analyze neuronal behavior using biophysical models, including membrane potentials, action potentials, and Hodgkin–Huxley formulations.	Analyze
CO4	Compare and evaluate biological sensory–motor pathways with artificial neural network architectures and learning algorithms.	Analyze
CO5	Interpret and assess information-theoretic measures and network analysis techniques to study structural and functional brain connectivity.	Evaluate

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

22ALPE203	PATTERN RECOGNITION	PE II			
PREREQUISITES	**CATEGORY**	**PE**	**Credit**		**3**
✓ Fundamentals of Machine Learning ✓ Neural Networking Basics	**Hours/week**	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To understand the in-depth concept of Pattern Recognition
2.	To implement Bayes Decision Theory
3.	To understand the in-depth concept of Perception and related Concepts
4.	To understand the concept of ML Pattern Classification
5.	To Understand the concept of DL Pattern Recognition.

UNIT I	PATTERN RECOGNITION	9	0	0	9

Induction Algorithms. Rule Induction. Decision Trees. Bayesian Methods. Overview. Naïve Bayes. The Basic Naive Bayes Classifier. Naive Bayes Induction for Numeric Attributes. Correction to the Probability Estimation. Laplace Correction. No Match. Other Bayesian Methods. Other Induction Methods. Neural Networks. Genetic Algorithms. Instance-based Learning. Support Vector Machines.

UNIT II	STATISTICAL PATTERN RECOGNITION	9	0	0	9

About Statistical Pattern Recognition. Classification and regression. Features, Feature Vectors, and Classifiers. Pre-processing and feature extraction. The curse of dimensionality. Polynomial curve fitting. Model complexity. Multivariate non-linear functions. Bayes' theorem. Decision boundaries. Parametric methods. Sequential parameter estimation. Linear discriminant functions. Fisher's linear discriminant. Feed-forward network mappings

UNIT III	BAYES DECISION THEORY CLASSIFIERS	9	0	0	9

Bayes Decision Theory. Discriminant Functions and Decision Surfaces. The Gaussian Probability Density Function. The Bayesian Classifier for Normally Distributed Classes. Exact interpolation. Radial basis function networks. Network training. Regularization theory. Noisy interpolation theory. Relation to kernel regression. Radial basis function networks for classification. Comparison with the multi-layer perceptron. Basis function optimization.

UNIT IV	LINEAR DISCRIMINANT FUNCTIONS	9	0	0	9

Linear Discriminant Functions and Decision Surfaces. The Two-Category Case. The Multicategory Case. The Perceptron Criterion Function. Batch Perceptron. Perceptron Algorithm Convergence. The Pocket Algorithm. Mean Square Error Estimation. Stochastic Approximation and the LMS Algorithm. Convergence Proof for Single-Sample Correction. Fixed increment descent. Some Direct Generalizations. Fixed increment descent. Batch variable increment Perceptron. Balanced Winnow algorithm. Relaxation Procedures. The Descent Algorithm.

UNIT V	NONLINEAR CLASSIFIERS	9	0	0	9

The Two Layer Perception. The Three Layer Perception. Algorithms Based on Exact Classification of The Training Set. Feed forward operation and classification. General feed forward operation. Expressive power of multilayer networks. Back propagation algorithm. Network learning. Training protocols. Stochastic Back propagation. Batch Back propagation. Radial basis function networks (RBF). Special bases. Time delays neural networks (TDNN). Recurrent networks. Counter propagation. Cascade-Correlation. Cascade-correlation. Neocognitron

Total (45 L) =45 Periods

Text Books:

1.	Pattern Classification, 2nd Edition, Richard O. Duda, Peter E. Hart, and David G. Stork. Wiley, 2000
2.	Pattern Recognition, Jürgen Beyerer, Matthias Richter, and Matthias Nagel. 2018

Reference Books:

1.	Pattern Recognition and Machine Learning, Christopher M. Bishop. Springer, 2010
2.	Pattern Recognition and Classification, Dougherty, and Geoff. Springer, 2013
3.	Practical Machine Learning and Image Processing, Himanshu Singh. Apress, 2019

E-References:

1.	NPTEL Courses (Pattern Recognition, Machine Learning)
2.	MIT OpenCourseWare (Pattern Recognition, ML)
3.	Stanford CS229 Materials

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discover and interpret temporal patterns using appropriate imaging and signal–processing techniques.	Analyze
CO2	Identify and analyze structural data patterns using statistical and computational methods.	Analyze
CO3	Implement pattern classification techniques using various machine learning classifiers.	Apply
CO4	Implement pattern recognition approaches using deep learning architectures and algorithms.	Analyze
CO5	Apply image pattern recognition techniques for real-world visual data analysis.	Apply

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

22ALPE204	DIGITAL IMAGE PROCESSING				PE II
PREREQUISITES	**CATEGORY**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Objectives:

1.	To learn the basic concepts of digital image processing and various image transforms.
2.	To familiarize the student with the image enhancement techniques.
3.	To expose the student to a broad range of image processing techniques and their applications.
4.	To appreciate the use of current technologies that are specific to image processing systems.
5.	To expose the students to real-world applications of image processing.

UNIT I	**FUNDAMENTALS OF IMAGE PROCESSING**	**9**	**0**	**0**	**9**

Image Transforms: Discrete Fourier Transform – Fast Fourier Transform – Discrete Cosine Transform – Image Enhancement in Spatial and Frequency Domain – Grey Level Transformations – Histogram Processing –Spatial Filtering – Smoothing And Sharpening Frequency Domain: Filtering in Frequency Domain.

UNIT II	**IMAGE ENHANCEMENT**	**9**	**0**	**0**	**9**

Image Transforms: Discrete Fourier Transform – Fast Fourier Transform – Discrete Cosine Transform – Image Enhancement in Spatial and Frequency Domain – Grey Level Transformations – Histogram Processing – Spatial Filtering – Smoothing And Sharpening Frequency Domain: Filtering in Frequency Domain.

UNIT III	**IMAGE RESTORATION AND MULTI-RESOLUTION ANALYSIS**	**9**	**0**	**0**	**9**

Multi Resolution Analysis: Image Pyramids – Multi Resolution Expansion – Wavelet Transforms – Image Restoration – Image Degradation Model – Noise Modeling – Blur – Order Statistic Filters – Image Restoration Algorithms

UNIT IV	**IMAGE SEGMENTATION AND FEATURE EXTRACTION**	**9**	**0**	**0**	**9**

Image Segmentation – Detection of Discontinuities –Edge Operators –Edge Linking and Boundary Detection – Thresholding – Region based Segmentation – Image Features and Extraction – Image Features – Types of Features – Feature extraction – SIFT, SURF and Texture – Feature reduction algorithms.

UNIT V	**IMAGE PROCESSING APPLICATIONS**	**9**	**0**	**0**	**9**

Image Classifiers – Supervised Learning – Support Vector Machines, Image Clustering – Unsupervised Learning – Hierarchical and Partition based Clustering Algorithms – EM Algorithm.

Total (45 L) =45 Periods

Text Books:

1.	Rafael Gonzalez, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018.
2.	S. Sridhar, “Digital Image Processing”, Second Edition, Oxford University Press, 2016.

Reference Books:

1.	Pattern Recognition and Machine Learning, Christopher M. Bishop. Springer, 2010
2.	Pattern Recognition and Classification, Dougherty, and Geoff. Springer, 2013
3.	Practical Machine Learning and Image Processing, Himanshu Singh. Apress, 2019

E-References:	
1.	MIT OpenCourseWare – Digital Image Processing: https://ocw.mit.edu/courses/6-866-machine-vision-fall-2012/
2.	Stanford University – Computer Vision & Image Processing Notes: https://web.stanford.edu/class/cs231a/
3.	NPTEL – Digital Image Processing (Prof. P.K. Biswas): https://nptel.ac.in/courses/106/105/106105216/

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Implement basic image processing operations.	Apply
CO2	Apply and develop new techniques in the areas of image enhancement and restoration.	Apply
CO3	Understand the image segmentation algorithms.	Understand
CO4	Extract features from images.	Apply
CO5	Apply classifiers and clustering algorithms for image classification and clustering.	Apply
CO6	Design and develop an image processing application that uses different concepts of image processing.	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2											3	
CO2			3										3	
CO3				3									3	
CO4					3								3	
CO5										3			3	
CO6			3	3	3					3	3	3	3	3
Avg	**3**	**2**	**3**	**3**	**3**					**3**	**3**	**3**	**3**	**3**
3 / 2 /1 – indicates strength of correlation (3-High, 2-Medium, 1-Low)														

22ALPE205	WEB FRAMEWORKS AND APPLICATIONS		PE II			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1.	To introduce the fundamentals of the Internet and the core principles of effective web design.
2.	To construct basic, well-structured websites using HTML and Cascading Style Sheets (CSS).
3.	To build dynamic and interactive web pages with form validation using JavaScript objects and React components.
4.	To develop modern, full-featured interactive web applications using Django and Node.js frameworks.
5.	To design and implement web applications with database integration for data storage, retrieval, and management.

UNIT I	**INTRODUCTION TO WEB DESIGN**	**9**	**0**	**0**	**9**

Concept of WWW, Internet and WWW, HTTP Protocol: Request and Response, Web browser and Web servers, features of latest version of Web. Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

UNITII	**HTML & STYLE SHEETS**	**9**	**0**	**0**	**9**

Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of latest version of HTML.Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of latest version of CSS.

UNITIII	**FRONT-END FRAMEWORKS**	**9**	**0**	**0**	**9**

Client side scripting - JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML: Combining HTML, CSS and JavaScript, Events and buttons.

React Introduction - React ES6 - React Render HTML - React JSX - Components -React Classes – Composing Components - Passing Data -Dynamic Composition - React state- setting State - Event Handling Communicating from Child to Parent - Stateless Components - Designing components- React Forms- React CSS.

UNITIV	**SERVER-SIDE FRAMEWORKS**	**9**	**0**	**0**	**9**

Introduction to Back-End Web Development -Django-HTTP protocol MVC Model-Virtual Environment- Django Structure-Generic Views-HTML templates-URL dispatcher.

Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Frameworks for Node.js - Node.js Data Access

UNIT V	**FRAMEWORKS WITH DATABASES**	**9**	**0**	**0**	**9**

MongoDB MongoDB Basics Documents Collections Query Language Installation The mongo Shell Schema Initialization MongoDB Node.js Driver Reading from MongoDB Writing to MongoDB CRUD operations projections - Indexing Aggregation Replication Sharding Creating backup Deployment.

Total(45 L)=45Periods

Reference Books:	
1.	Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, A Press Publisher, 2019.
2.	Kogent Learning Solutions Inc., Web Technologies Black Book, Dreamtech Press, 2009.
3.	Caleb Dayley Brad Dayley, Brendan Dayley, Node.js, Mongo DB and Angular Web Development, 2nd Edition, Pearson, 2018.
4.	Joel Sklar, Principles of Web Design, Cengage Learning, 6th Edition, 2015.
5.	Internet and World Wide Web How to program, Paul J. Deitel, Harvey M. Deitel, andAbbey Deitel, 5th Edition, Pearson Education, 2011.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	To familiarize the fundamental web design principles, front-end frameworks, back-end frameworks, and database integration in modern web development.	Understand
CO2	To apply web design principles, utilize front-end frameworks, implement back-end technologies, and integrate databases to develop functional web applications.	Apply
CO3	To analyze the structure and behavior of full-stack web applications by examining front-end design patterns, back-end processing workflows, and database interactions for performance, usability, and scalability improvements.	Analyze

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

22ALPE301	REINFORCEMENT LEARNING		PE III			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1.	To introduce the fundamental concepts of reinforcement learning, Markov decision processes and value functions.
2.	To provide knowledge of core RL algorithms including dynamic programming, Monte-Carlo, and temporal-difference learning.
3.	To develop understanding of model-free and model-based RL techniques.
4.	To explain policy gradient methods, actor-critic algorithms, and deep RL architectures.
5.	To enable students to apply reinforcement learning to real-world problems through simulations and research-oriented tools.
6.	To promote independent learning, experimentation, and research skills in RL applications.

UNIT I	**INTRODUCTION & FOUNDATIONS**	**9**	**0**	**0**	**9**

RL problem framework-Agent-environment interaction-Rewards, returns, episodic vs. continuing tasks-Markov Decision Process (MDP)-Policies, value functions, Bellman equations.

UNIT II	**DYNAMIC PROGRAMMING**	**9**	**0**	**0**	**9**

Policy evaluation-Policy iteration-Value iteration-Convergence properties-Limitations of dynamic programming.

UNIT III	**MONTE-CARLO & TEMPORAL DIFFERENCE LEARNING**	**9**	**0**	**0**	**9**

Monte-Carlo prediction & control-Exploring starts & off-policy methods-TD prediction-TD(0), TD(λ)-SARSA and Q-Learning-Eligibility traces.

UNIT IV	**POLICY GRADIENT & ACTOR-CRITIC METHODS**	**9**	**0**	**0**	**9**

Policy parameterization-REINFORCE algorithm-Policy gradient theorem-Actor-critic methods-Natural gradients-Trust region optimization (TRPO overview).

UNIT V	**DEEP REINFORCEMENT LEARNING & ADVANCED TOPICS**	**9**	**0**	**0**	**9**

Deep Q Networks (DQN)-Experience replay & target networks-Double DQN-Proximal Policy Optimization (PPO)-Continuous control (DDPG, TD3 overview)-Multi-agent RL basics-Applications: robotics, games, networking, recommendation, autonomous systems.

Total(45 L)=45Periods

Text Book

1.	**"Reinforcement Learning: An Introduction"**Authors: Richard S. Sutton and Andrew G. Barto, MIT Press

Reference Books:

1.	**"Algorithms for Reinforcement Learning"** Author: Csaba Szepesvári, Morgan & Claypool
2.	**"Hands-On Reinforcement Learning with Python"** Authors: Sudharsan Ravichandiran, Packt Publishing
3.	**"Deep Reinforcement Learning"**Authors: Yuxi Li, Springer.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the foundations of reinforcement learning and formulate decision-making problems as MDPs.	Understand
CO2	Apply dynamic programming, Monte-Carlo and temporal difference approaches to solve RL problems.	Apply
CO3	Design and implement value-based methods such as Q-Learning and SARSA.	Analyze
CO4	Develop policy gradient and actor-critic methods for continuous and complex environments.	Analyze
CO5	Implement Deep Reinforcement Learning algorithms using neural networks, e.g., DQN and PPO.	Apply
CO6	Apply reinforcement learning to real-world tasks and evaluate performance using experimental results.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	2				2					
CO2	3	3	2	2	2		1		2		1			
CO3	2	3	3	2	3		1		2		1			
CO4	2	3	3	3	3		1		3		1			
CO5	1	2	3	3	3		1	1	3		1			
CO6	1	2	3	3	3	1	2	2	3	1	1			
Avg	**2**	**2.5**	**2.5**	**2.3**	**2.6**	**0.04**	**1**	**0.5**	**2.5**	**0.04**	**0.8**			
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22ALPE302	MOBILE APPLICATION DEVELOPMENT		PE III			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1. Understand the android SDK
2. Understanding of Android application development
3. Inculcate working knowledge of Android Studio development tool

UNIT I	INTRODUCTION	9	0	0	9

The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest fil

UNIT II	ANDROID APPLICATION DESIGN ESSENTIALS	9	0	0	9

Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions

UNIT III	ANDROID USER INTERFACE DESIGN ESSENTIALS	9	0	0	9

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation

UNIT IV	ANDROID SOFTWARE DEVELOPMENT PROCESS	9	0	0	9

Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources

UNIT V	USING COMMON ANDROID APIs	9	0	0	9

Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World

Total (45 L)= 45 Periods

Text Book:

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)

Reference Books:

1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

E-Reference:

1. https://youtu.be/9z7AEAyhAG8

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify various concepts of mobile programming that make it unique from programming for other platforms	Apply
CO2	Critique mobile applications on their design pros and cons	Analyze
CO3	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces	Apply
CO4	Program mobile applications for the Android operating system that use basic and advanced phone features	Apply
CO5	Deploy applications to the Android marketplace for distribution	Create

COURSE ARTICULATION MATRIX														
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	1	1	1			1					1		1	1
CO2	1	3	3			1					1		1	1
CO3	1	2	2			1					1		1	1
CO4	1	3	2			1					1		1	1
CO5	1	2	3			1					1		1	1
Avg	**1**	**2.2**	**2.2**			**1**					**1**		**1**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)														

22ALPE303	SOCIAL NETWORK DATA ANALYTICS		PE III			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1.	Understand Foundations of Online Social Networks.
2.	Analyze Statistical Properties of Social Networks
3.	Apply Random Walk Techniques to Social Graphs
4.	Discover and Interpret Community Structure
5.	Perform Node Classification in Social Networks
6.	Model and Analyze Social Influence, Expertise, and Link Formation

UNIT I	**INTRODUCTION**	**5**	**0**	**0**	**5**
On line Social Networks – Terminologies - Research topics					
UNIT II	**STATISTICAL PROPERTIES OF SOCIAL NETWORKS**	**5**	**0**	**0**	**5**
Static properties – Dynamic properties.					
UNIT III	**RANDOM WALKS AND COMMUNITY DISCOVERY IN SOCIAL NETWORKS**	**13**	**0**	**0**	**13**
Random walks on graphs – Algorithms – Applications. Methods using local classifiers – Random walk based methods – Algorithms - Applications - Node classification to large scale social networks					
UNIT IV	**NODE CLASSIFICATION IN SOCIAL NETWORKS**	**10**	**0**	**0**	**10**
Methods using local classifiers – Random walk based methods – Algorithms - Applications - Node classification to large scale social networks					
UNIT V	**MODELS AND ALGORITHMS**	**12**	**0**	**0**	**12**
Social influence analysis – Expert location in social networks – link prediction					
					Total (45 L) =45 Periods

Text Books:

1.	Charu C. Aggarwal, “Social Network Data Analytics”, Springer Publications, 2011

Reference Book:

1.	Marshall Sponder “Social Media Analytics Effective tools for building, interpreting, and using metrics”, McGrawHill, 2011.
2.	Stanley Wasserman, Katherine Faust, “Social network analysis: Methods and applications “, Cambridge University Press, 1995
3.	Stephen Borgatti, Martin Everett, Jeffrey Johnson, “ Analysing Social Networks”, SAGE Publications Ltd., 2013.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the fundamental concepts, terminologies, and research issues related to online social networks.	Understand
CO2	Analyze static and dynamic statistical properties of social networks using appropriate graph-theoretic measures.	Analyze
CO3	Apply random walk principles and algorithms on social graphs for tasks such as ranking, traversal, and information retrieval.	Apply
CO4	Identify, detect, and evaluate community structures in social networks using core community discovery techniques.	Analyze
CO5	Perform node classification using local classifiers and random-walk–based methods, and design scalable solutions for large network datasets.	Apply
CO6	Model and analyze social influence, identify experts, and apply link prediction algorithms to real social network scenarios.	Analyze

COURSE ARTICULATION MATRIX														
COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	1	1	1	-	-	-	-	1	-	2	2	1
CO2	2	2	1	1	1	-	-	-	-	1	-	2	2	1
CO3	2	2	1	1	1	-	-	-	-	1	-	2	2	1
CO4	2	2	1	1	1	-	-	-	-	1	-	2	2	1
CO5	2	2	1	1	1	-	-	-	-	1	-	2	2	1
CO6	2	2	1	1	1	-	-	-	-	1	-	2	2	1
Avg	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2**	**1**

22ALPE304	GAME THEORY AND ITS APPLICATIONS				PE III			
PREREQUISITES		**CATEGORY**	**PE**		**Credit**			**3**
NIL		**Hours/Week**	**L**		**T**		**P**	**TH**
			3		**0**		**0**	**3**

Course Objectives:

1.	To understand the principles and strategies of games theory
2.	To solve the real time games and present its optimized solution
3.	To apply the concept of games theory to identify the certainty of games.

UNIT I	**GAMES**	**9**	**0**	**0**	**9**

Games: Reasoning about Behavior in Game – Best responses and Dominant Strategies – Nash Equilibrium – Mixed Strategies – Pareto Optimality – Dominated strategies and dynamic strategies.

UNIT II	**NON-COOPERATIVE GAMES**	**9**	**0**	**0**	**9**

Discrete static games – Continuous static games – Relation to other Mathematical Problems: Nonlinear optimization – Fixed point problems.

UNIT III	**EQULIBRIA AND DYNAMIC GAMES**	**9**	**0**	**0**	**9**

Existence of Equilibria – Computation of Equilibria – Special matrix games – Uniqueness of Equilibria – Repeated and Dynamic games – Games under uncertainty.

UNIT IV	**COOPERATIVE GAMES**	**9**	**0**	**0**	**9**

Solutions based on characteristic function – Conflict Resolution – Multi objective optimization – Social choice.

UNIT V	**CASE STUDIES AND APPLICATIONS**	**9**	**0**	**0**	**9**

A salesman's Dilemma – Oligopoly in water management – A forestry management problem – International fishing – Water distribution problem.

Total(45 L)=45 Periods

Text Books:

1.	David Easley and Jon Kleinberg, " Networks, Crowds and Markets: Reasoning about a highly Connected World", Cambridge University, 2010 (Unit I).
2.	Matsumoto A., Szidarovszky F, "Game Theory and Applications", Springer, 2016 (Units II –V).

Reference Books:

1.	E.M.Barron, "Game Theory: An Introduction", Wiley, 2009.
2.	Leon Petrosjan, Valdimir V.Mazalov, "Game Theory &Applications", Nova Science Publishers, Inc, 2015.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the principles and strategies of games theory	Understand
CO2	Solve the real time games and present its optimized solution	Create
CO3	Apply the concept of games theory to identify the certainty of games.	Apply

COURSE ARTICULATION MATRIX														
COs/ Pos	**PO1**	**PO2**	**PO4**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
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)														

22ALPE305	ALGORITHMS FOR BIOINFORMATICS		PE III			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1.	To deal with various algorithms used to solve biological problems
2	To understand the algorithms for sequence alignment, promoter and gene prediction
3	To learn machine learning algorithms to build computational biology models
4	To articulate the trade-offs behind algorithms in bioinformatics
5	To locate and critically evaluate scientific information

UNIT I	**INTRODUCTION TO ALGORITHMS AND SEQUENCE ALIGNMENT**	**9**	**0**	**0**	**9**

Introduction to algorithms, history, algorithm complexity and pseudocode. Introduction to dynamic programming, divide and conquer, brute-force and greedy approaches. Flowchart and pseudocode representations. Concepts of homologous, orthologous, paralogous and xenologous sequences. Pairwise sequence alignment and gap penalties. Dot plot method. Dynamic programming algorithms for global alignment (Needleman–Wunsch) and local alignment (Smith–Waterman). Database searching for similar sequences, heuristic algorithms such as FASTA and BLAST, and types of BLAST.

UNIT II	**MULTIPLE SEQUENCE ALIGNMENT AND SCORING METHODS**	**9**	**0**	**0**	**9**

Multiple sequence alignment. Dynamic programming for MSA. Heuristic approaches. Progressive alignment method. CLUSTAL W and CLUSTAL X. Branch and bound methods. Consensus sequences and PSSM. Scoring matrices including PAM and BLOSUM. Concepts and applications of whole genome alignment. Cluster of Orthologous Groups.

UNIT III	**PROMOTER, GENE AND MOTIF PREDICTION**	**9**	**0**	**0**	**9**

Promoter prediction in prokaryotes and eukaryotes. Gene and gene structure prediction for prokaryotic and eukaryotic organisms. Sequence and structural motifs. Motif prediction tools. RNA structure prediction algorithms. Splice site prediction. Genetic algorithms. Graph theory applications, adjacency matrix and network properties.

UNIT IV	**MACHINE LEARNING AND DEEP LEARNING FOR BIOINFORMATICS**	**9**	**0**	**0**	**9**

Machine learning and deep learning algorithms. Clustering techniques such as K-means and hierarchical clustering. Dimensionality reduction algorithms. Logistic regression, naive Bayes, decision trees and random forest. Neural networks and support vector machines. Deep learning concepts and applications in bioinformatics.

UNIT V	**PRACTICAL APPLICATIONS**	**9**	**0**	**0**	**9**

Finding similar sequences using BLAST and local BLAST. Performing multiple sequence alignment using CLUSTAL and interpreting conserved and variable regions. ORF prediction. Gene prediction in prokaryotes and eukaryotes. Primer designing. Promoter prediction using NNPP. Splice site prediction using neural network models. Predicting protein function from 3D structure using ProFunc.

Total (45 L)=45Periods

Textbooks:

1.	Jones NC and Pevzner PA. An Introduction to Bioinformatics Algorithms. The MIT Press
2.	Gusfield D. Algorithms on Strings, Trees, and Sequences. Cambridge University Press
3.	Mount DW. Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press

Reference Books:	
1.	Cormen TH, Leiserson CE, Rivest RL, Stein C. Introduction to Algorithms. The MIT Press
2.	Dey DK, Ghosh S, Mallick BK. Bayesian Modelling in Bioinformatics. Chapman and Hall
3.	Klir GJ, Yuan B. Fuzzy Sets and Fuzzy Logic: Theory and Applications. Prentice Hall
4.	Mitchell T. Machine Learning. The McGraw-Hill Company
5.	Mitra S, Dutta S, Perkins T, Michailidis G. Introduction to Machine Learning and Bioinformatics. Chapman and Hall
6.	Rao SS. Optimization: Theory and Applications. Wiley Eastern Ltd Sharma V, Munjal A, Shanker A. A Textbook of Bioinformatics. Rastogi Publications
7.	Waterman M. Introduction to Computational Biology: Maps, Sequences and Genomes. Chapman & Hal
8.	Witten IH, Frank E, Hall MA, Pal CJ. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiarity with the use of various computational algorithms	Understand
CO2	Ability to apply algorithms in solving biological problems	Apply
CO3	Capability to design and analyze algorithms for biological data	Analyze
CO4	Ability to apply paradigms learned in class to solve real-world problems	Apply
CO5	Ability to present scientific content to a technical audience	Evaluate

COURSE ARTICULATION MATRIX														
COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	2	1	1		1					
CO2	2	3	2	2	3				2					
CO3	2	3	3	3	3	1			2					
CO4	1	2	3	3	3	1	1		3					
CO5	1	1	2	2	2	3	2		2					
Avg	**1.8**	**2.2**	**2.2**	**2.4**	**2.6**	**1.5**	**1.3**		**2**					
3 / 2 /1 – indicates strength of correlation (3-High,2-Medium,1-Low)														

22ALPE401	PARALLEL AND DISTRIBUTED COMPUTING	PE IV

PREREQUISITES	CATEGORY	PE	Credit		3
Nil	Hours/week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To build a foundational understanding of parallel and distributed computing, including parallelism, concurrency, architectures, memory models, and distributed system concepts.
2.	To develop practical skills for designing, implementing, and managing parallel algorithms and distributed systems using modern programming models and tools.
3.	To enable students to analyze and compare different parallel and distributed architectures, communication models, synchronization techniques, and object-based systems for real-world applications.
4.	To train students to assess system performance, overhead, scalability, fault tolerance, and security aspects of parallel and distributed solutions.

UNIT I	INTRODUCTION TO PARALLEL COMPUTING	9	0	0	9

The Idea of Parallelism, Power and potential of parallelism, examining sequential and parallel programs, Scope and issues of parallel and distributed computing, Goals of parallelism, Parallelism and concurrency using multiple instruction streams.

UNIT II	PARALLEL ARCHITECTURE	9	0	0	9

Pipeline architecture, Array processor, Multi-processor architecture, Systolic architecture, Dataflow architecture, Architectural classification schemes, Memory access classification, Memory Issues: Shared vs. distributed, Symmetric multiprocessing (SMP), SIMD, Vector processing, GPU co-processing, Flynn's Taxonomy, Instruction Level support for parallel programming, Multiprocessor caches and Cache Coherence, Non-Uniform Memory Access (NUMA).

UNIT III	PARALLEL ALGORITHM DESIGN PRINCIPLES AND PROGRAMMING	9	0	0	9

Need for communication and coordination/synchronization, Scheduling and contention, Independence and partitioning, Task Based Decomposition, Data Parallel Decomposition, Characteristics of task and interaction, Load balancing, Data Management, parallel algorithm models, Sources of overhead in parallel programs, Performance metrics for parallel algorithm implementations, Parallel algorithmic patterns like divide and conquer, Map and Reduce, Specific algorithms like parallel Merge Sort, Parallel graph Algorithms.

UNIT IV	DISTRIBUTED SYSTEMS	9	0	0	9

Architectures Of Distributed Systems - Architectural Styles – System Architectures - Architectures Versus Middleware - Self-Management In Distributed Systems - Processes - Threads - Virtualization - Clients -Servers - Communication - Remote Procedure Call – Message Oriented Communication - Stream-Oriented Communication - Multicast Communication

UNIT V	DISTRIBUTED OBJECT BASED SYSTEMS	9	0	0	9

Architecture - Processes - Communication - Naming - Synchronization - Fault Tolerance - Security - Distributed System Examples - File Systems And Web Based Systems

Total (45 L) =45 Periods

Text Books:

1.	Ananth Grama, Anshul Gupta, and George Karypis, Vipin Kumar; Introduction to Parallel Computing; Addition Wesley; 2nd Edition; 2003.
2.	A.S. Tanenbaum; Distributed Operating Systems; Create Space Independent Publishing Platform; 3rd edition, 2017.

Reference Books:

1.	Introduction To Parallel Programming, Steven Brawer, Academic Press
2.	M. Sasikumar, Dinesh Shikhare & P. Ravi Prakash; Introduction to Parallel Processing; PHI Learning; 2nd Edition; 2014.
3.	Randy Chow, Theodore Johnson; Distributed Operating Systems and Algorithms; Addison-Wesley; 1st Edition; 1997.
4.	Ian Foster: Designing and Building Parallel Programs – Concepts and tools for Parallel Software Engineering, Pearson Publisher, 1st Edition, 2019.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the principles of parallelism, concurrency, and the basics of parallel and distributed system architectures	Understand
CO2	Apply task-based and data-based decomposition, synchronization, and communication techniques to implement parallel algorithms and distributed applications.	Apply
CO3	Analyze parallel and distributed system architectures, algorithm performance, and communication models to select appropriate solutions.	Analyze
CO4	Evaluate the efficiency, scalability, reliability, and security of parallel and distributed computing solutions.	Evaluate

COURSE ARTICULATION MATRIX

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

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

22ALPE402	QUANTUM COMPUTING	PE IV

PREREQUISITES	CATEGORY	PE	Credit		3
Nil	Hours/week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To know the background of classical computing and quantum computing.
2.	To learn the fundamental concepts behind quantum computation.
3.	To study the details of quantum mechanics and the relation to Computer Science.
4.	To gain knowledge about the basic hardware and mathematical models of quantum computation.
5.	To learn the basics of quantum information and the theory behind it.

UNIT I	FUNDAMENTAL CONCEPTS	9	0	0	9

Global Perspectives – Quantum Bits – Quantum Computation – Quantum Algorithms –Experimental Quantum Information Processing – Quantum Information.

UNIT II	QUANTUM MECHANICS AND OVERVIEW OF COMPUTATIONAL MODELS	9	0	0	9

Quantum Mechanics: Linear Algebra – Postulates of Quantum Mechanics – Application:Superdense Coding – Density Operator – The Shmidt Decomposition and Purifications –EPR and the Bell Inequality – Computational Models: Turing Machines – Circuits – Analysis of Computational Problems.

UNIT III	QUANTUM COMPUTATION	9	0	0	9

Quantum Circuits: Quantum Algorithms – Universal Quantum Gates – Quantum CircuitModel of Computation – Simulation – Quantum Fourier Transform and Applications –Quantum Search Algorithms – Quantum Computers

UNIT IV	QUANTUM INFORMATION	9	0	0	9

Quantum Noise and Quantum Operations: Classical Noise and Markov processes –Quantum Operations – Examples – Applications – Distance Measures for Quantum Information – Quantum Error Correction – Entropy

UNIT V	QUANTUM INFORMATION THEORY	9	0	0	9

Quantum States and Accessible Information – Data Compression – Classical Information Over Noisy Quantum Channels – Quantum Information Over Noisy Quantum Channels –Entanglement as a Physical Resource – Quantum Cryptography.

Total (45 L) =45 Periods

Text Books:

1.	Michael A. Nielsen, Issac L. Chuang, “Quantum Computation and Quantum Information”, Tenth Edition, Cambridge University Press, 2010.

Reference Books:

1.	Scott Aaronson, “Quantum Computing Since Democritus”, Cambridge University Press, 2013.
2.	N. David Mermin, “Quantum Computer Science: An Introduction”, Cambridge University Press, 2007.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the basics of quantum computing.	Understand
CO2	Understand the background of Quantum Mechanics.	Understand
CO3	Analyse the computation models.	Analyze
CO4	Model the circuits using quantum computation.	Apply
CO5	Understand the quantum operations such as noise and error–correction.	Understand
CO6	Appreciate the need of quantum computing.	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2												
CO2	3	2												
CO3	3	2							3				3	3
CO4	3	2	3	3	3				3				3	3
CO5	3	2	3			3	3	3						
CO6	3	2	3	3	3			3	3				3	3
Avg	**3**	**2**	**1.5**	**1**	**1**	**0.5**	**0.5**	**1**	**1.5**				**1.5**	**1.5**
3 / 2 /1 – indicates strength of correlation (3-High, 2-Medium, 1-Low)														

22ALPE403	EVOLUTIONARY COMPUTING ALGORITHMS		PE IV			
PREREQUISITES		Category	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives

1.	To grasp the overview, principles, and different types of evolutionary computation methods.
2.	To learn the fundamentals, representation, genetic algorithm.
3.	To understand the fundamentals, applications, and implementations of DE (Differential Evolution).
4.	To learn the fundamentals, and implementation of Ant colony optimization and its variants.
5.	To understand the fundamentals, and implementations of multi-objective optimization and memetic algorithms.

UNIT I	INTRODUCTIONHEURISTIC AND META HEURISTIC APPROACHES	9	0	0	9

Challenges in Solving Complex Problems - Evolutionary Algorithms: Principles, Historical Development, Features, Classification and Components, Advantages, Applications. Heuristic Search: Hill Climbing: Principles, Local and Global maxima, Ridges, Plateau - Steepest Ascent - Simulated Annealing: Annealing schedule, Parameter Selection

UNITII	GENETIC ALGORITHM	9	0	0	9

Biological Background - Simple Genetic Algorithm (SGA) - Representation types - Recombination Types - Mutation Types - GA Algorithm - Schema Theorem - Variations of GA: Adaptive GA, Real Coded GA

UNITIII	DIFFERENTIAL EVOLUTION	9	0	0	9

Principles, Mutation, Crossover, Selection. SWARM INTELLIGENCE: Particle Swarm Optimization: Swarms, Operating principles, PSO Algorithm, Neighborhood Topologies - Variations of PSO: Binary, weighted

UNIT IV	ANT COLONY OPTIMIZATION	9	0	0	9

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tablesnt Foraging Behavior, Theoretical Considerations, ACO Algorithm, Variations of ACO: Elitist Ant System (EAS), Min Max Ant System (MMAS) and Rank Based Ant Colony System (RANKAS)

UNIT V	MULTI-OBJECTIVE OPTIMIZATION AND MEMETIC ALGORITHMS	9	0	0	9

Multi-Objective Principles - Classical Methods - Challenges - Evolutionary algorithms for Multi-Objective Optimization - Multimodal Function Optimization – Non-Dominated Sorting Genetic Algorithm (NSGA): Non-Elitist, Elitist - Controlled Elitism in NSGA

Total(45 L)=45Periods

Text Books:

1.	Eiben A E and Smith J E, " Introduction to Evolutionary Computing", 2nd edition, Springer, Heidelberg,2015.
2.	Deb K, "Multi –Objective Optimization Using Evolutionary algorithms", Wiley- Blackwell, USA, 2011.

Reference Books:

1.	Rich E and Knight K,"Artificial Intelligence", Tata McGraw Hill Education Private Limitted, India, 2011
2.	Xin-She Yang, "nature Inspired Computation and Swarm Intelligence: Algorithms,Theroy of Applications ", Elsevier Science, United Kingdom, 2020.
3.	Aboul Ella Hassanien and Eid/emery, Swarm Intelligence: Principles, Advances and Applications, CRC Press,New York, 2016.
4.	Kenneth A.De Jong, "Evolutionary Computation: A Unified Approach", Bradford Books, Reprint Edition, 2016.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Demonstrate a comprehensive understanding of evolutionary computing principles and algorithms.	Understand
CO2	Apply evolutionary computing techniques to various domains, such as engineering design, scheduling, and data mining.	Apply
CO3	Evaluate the performance of evolutionary algorithms using appropriate metrics and benchmarks and compare different algorithms and their variants.	Analyze

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

22ALPE404	DATA MINING AND ANALYTICS		PE IV			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1. To introduce the power of randomization in the design and analysis of algorithms.

UNIT I	**DATA MINING INTRODUCTION**	**9**	**0**	**0**	**9**

Introduction: Kinds of Data- Kinds of Patterns-Data Objects and Attribute Type- Data Visualization -Data Preprocessing: Data cleaning, Data Integration, Data Transformation, Data Discretization and Data Reduction: Attribute Subset Selection-Histograms, Clustering, Sampling

UNIT II	**ASSOCIATIONS AND CORRELATIONS**	**9**	**0**	**0**	**9**

Market Basket Analysis – Apriori Algorithm – Mining Frequent Item sets without Candidate Generation – Mining Frequent Itemsets Using Vertical Data Format – Mining Closed Frequent Item sets – Mining Multilevel Association Rules – Mining Multidimensional Association Rules – Correlation Analysis – Constraint-Based Association Mining

UNIT III	**CLASSIFICATION AND PREDICTION**	**9**	**0**	**0**	**9**

Basic Concepts- Decision Tree Induction-Attribute selection Measures-ID3 and CART algorithms, Tree Pruning-Bayes Classification Methods: Bayes‟ Theorem, Naive Bayesian Classification - Classification by Back propagation- Support Vector Machines-Lazy learners: KNN-Metrics for evaluating classifier performance-Techniques to improve classification accuracy-Prediction: Regression Analysis

UNIT IV	**CLUSTER ANALYSIS**	**9**	**0**	**0**	**9**

Cluster Analysis: Partitioning Methods- Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering-Probabilistic Model based Clustering - BIRCH, DBSCAN, STING, CLIQUE Techniques- Evaluation of clustering Techniques

UNIT V	**OUTLIERS AND STATISTICAL APPROACHES IN DATA MINING**	**9**	**0**	**0**	**9**

Introduction to outliers, Challenges in detecting Outliers, Outlier Detection Methods - Supervised, Semisupervised, Unsupervised- Statistical Data Mining approaches - Data mining in Recommender Systems, Data mining for Intrusion Detection, Data Mining for Financial Analysis

Total (45 L) =45 Periods

Text Books:

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012
2. Ian H. Witten, Eibe Frank and Mark A. Hall “Data Mining: Practical Machine Learning Tools and Techniques”, Fourth Edition, Elsevier, 2017.

Reference Book:

1. Rajeev Motwani, Prabhakar Raghavan, Randomized Algorithms, Cambridge University Press.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Do the preprocessing of data before mining of data for patterns	Apply
CO2	Make use of Association and Correlations Algorithms for framing association rules	Apply
CO3	Apply as well as Compare the performance of various classifiers	Analyze
CO4	Utilize different Clustering algorithms for generalization	Apply
CO5	Identify Outliers in the data given	Analyze

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

22ALPE405	BLOCKCHAIN TECHNOLOGIES	PE IV

PREREQUISITES	CATEGORY	PE	Credit		3
NIL	Horus/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

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

UNIT I	BLOCKCHAIN 101	9	0	0	9

Distributed systems – The history of blockchain – Introduction to blockchain – definitions – elements – Features – Applications of blockchain technology – Tiers – Types of blockchain – Consensus in blockchain – CAP theorem – Benefits and limitations of blockchain.

UNIT II	DECENTRALIZATION, CRYPTOGRAPHY AND TECHNICAL FOUNDATIONS	9	0	0	9

Introduction – Cryptography – Confidentiality – Integrity – Authentication – Cryptographic primitives – Asymmetric cryptography – Public and private keys – RSA – Discrete logarithm problem – Hash functions – Elliptic Curve Digital signature algorithm.

UNIT III	BITCOIN & ALTERNATIVE COINS	9	0	0	9

Bitcoin – Transactions – Blockchain – Bitcoin payments – Alternative Coins – Theoretical foundations – Bitcoin limitations – Namecoin - Litecoin – Primecoin – Zcash – Smart Contracts.

UNIT IV	ETHEREUM 101	9	0	0	9

Introduction – Ethereum blockchain – Elements of the Ethereum blockchain – Precompiled contracts – Accounts – Block – Ether – Messages – Mining - Clients and wallets – The Ethereum network –Ethereum Development.

UNIT V	HYPERLEDGER	9	0	0	9

Projects- Protocol – Hyper ledger fabric – Saw tooth lake – Corda – Blockchain – outside of currencies – Internet of Things – Government – Health –Finance.

Total(45 L)=45 Periods

Text Books:

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

Reference Books:

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

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

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

22ALPE501	SEMANTIC WEB TECHNOLOGY	PE V

PREREQUISITES	CATEGORY	PE	CREDIT	3

Web Technologies	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To understand the fundamentals of ontologies.
2.	To know about the Semantic Web and the different languages used in the context of semantic web.
3.	To learn the methodologies used for ontology learning for semantic web.
4.	To know about ontology management and tools used for Ontology annotation.
5.	To comprehend the role of semantics in web services and to discuss some of the security issues.

UNIT I	INTRODUCTION	9	0	0	9

Components – Types – Ontological Commitments – Ontological Categories – Philosophical Background - Knowledge Representation Ontologies – Top Level Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need – Foundation – Layers – Architecture.

UNIT II	LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES	9	0	0	9

Web Documents in XML – RDF - Schema – Web Resource Description using RDF- RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics – Pragmatics - Traditional Ontology Languages – LOOM- OKBC – OCML - Flogic Ontology Markup Languages – SHOE – OIL - DAML + OIL- OWL

UNIT III	ONTOLOGY LEARNING FOR SEMANTIC WEB	9	0	0	9

Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning – Importing and Processing Ontologies and Documents – Ontology Learning Algorithms – Evaluation.

UNIT IV	ONTOLOGY MANAGEMENT AND TOOLS	9	0	0	9

Overview – need for management – development process – target ontology – ontology mapping – skills management system – ontological class – constraints – issues. Evolution – Development of Tools and Tool Suites – Ontology Merge Tools – Ontology based Annotation Tools.

UNIT V	APPLICATIONS	9	0	0	9

Web Services – Semantic Web Services - Case Study for specific domain – Security issues –current trends.

Total =45 Periods

Text Books:

1.	Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez, "Ontological Engineering: with examples from the areas of Knowledge Management, e-Commerce and the Semantic Web" Springer, 2004.
2.	Grigoris Antoniou, Frank van Harmelen, "A Semantic Web Primer (Cooperative Information Systems)", The MIT Press, 2004.

Reference Books:	
1.	Alexander Maedche, “Ontology Learning for the Semantic Web”, Springer; 1 edition, 2002 .
2.	John Davies, Dieter Fensel, Frank Van Harmelen, “Towards the Semantic Web: Ontology – DrivenKnowledge Management”, John Wiley & Sons Ltd., 2003.
3.	Dieter Fensel (Editor), Wolfgang Wahlster, Henry Lieberman, James Hendler, “Spinning the Semantic Web: Bringing the World Wide Web to Its Full Potential”, The MIT Press, 2002.
4.	Michael C. Daconta, Leo J. Obrst, Kevin T. Smith, “The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management”, Wiley, 2003 .
5.	Steffen Staab (Editor), Rudi Studer, “Handbook on Ontologies (International Handbooks on Information Systems)”, Springer 1st edition, 2004.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Understand the fundamentals of ontologies.	Understand
CO2	Represent data from a chosen problem in XML with appropriate semantic tags obtained or derived from the ontology.	Analyze
CO3	Understand the semantic relationships among these data elements using Resource.	Understand
CO4	Manage ontology and apply ontology tools.	Apply
CO5	Design and implement a web services application that “discovers” the data and/or other Description Framework (RDF) web services via the semantic web and able to discover the capabilities and limitations of semantic web technology for social networks.	Evaluate

COURSE ARTICULATION MATRIX

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

22ALPE502	RANDOMIZED ALGORITHMS		PE V			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1. To introduce the power of randomization in the design and analysis of algorithms.

UNIT I	**INTRODUCTION TO RANDOMIZED ALGORITHMS**	**9**	**0**	**0**	**9**

Randomized algorithms – Motivation and advantages – Las Vegas and Monte Carlo algorithms – Expected running time and probability of correctness – Basic probabilistic tools. Randomized algorithms for bipartite matching – Constructing perfect matching using randomization – Performance analysis.

UNIT II	**RANDOMIZED COMPUTATIONAL GEOMETRY AND MARKOV CHAINS**	**9**	**0**	**0**	**9**

Randomized incremental algorithms – Randomized convex hull construction – Geometric duality – Half-space intersection – Delaunay triangulation – Trapezoidal decomposition – Random sampling techniques – Point location in arrangements – Randomized linear programming in fixed dimensions. Markov chains and transition matrices – Random walks – Stationary distribution – Ergodicity – Convergence and mixing time – Time reversal – Detailed balance condition – Applications in randomized algorithms.

UNITIII	**MULTITHREADED AND DISTRIBUTED ALGORITHMS**	**9**	**0**	**0**	**9**

Dynamic multithreaded computation – Fork–join parallelism – Performance measures: work, span and parallelism – Scheduling principles – Work-stealing scheduler – Analyzing multithreaded algorithms – Brent's theorem – Parallel loops – Race conditions and synchronization – Multithreaded matrix multiplication – Multithreaded merge sort. Distributed computation model – Symmetry breaking problems – Leader election – Byzantine agreement – Maximal independent set – Graph coloring – Randomized distributed algorithms – Algorithms for dynamic networks – k-machine model for large-scale graph processing.

UNITIV	**ONLINE ALGORITHMS AND HARDNESS OF APPROXIMATION**	**9**	**0**	**0**	**9**

Online computation model – Competitive analysis – Adversary models: oblivious and adaptive adversaries – Yao's minimax principle. Investment problem – Ski rental problem – Online paging – Randomized marking algorithm – Lower bound for online paging against an oblivious adversary – k-server problem. Approximation algorithms – NP-complete optimization problems – Reductions from NP-complete problems – Approximation-preserving reductions – Limits of approximation – Inapproximability results.

UNIT V	**STREAMING, PROPERTY TESTING** AND STRING MATCHING ALGORITHMS	**9**	**0**	**0**	**9**

Streaming model – One-pass and multi-pass algorithms – Space complexity – Approximate counting – Morris counter – Reservoir sampling – AMS sketching. Property testing model – Proximity parameter – Enforce and test paradigm – Testing graph connectivity – Testing bipartiteness – Testing triangle-freeness – Role of Szemerédi's regularity lemma. Basic notations – Naive string matching algorithm – Rabin–Karp algorithm – String matching using finite automata – Knuth–Morris–Pratt (KMP) algorithm – Time complexity analysis.

Total(45 L)=45Periods

Text Books:

1. **Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein**, *Introduction to Algorithms*, 3rd / 4th Edition, MIT Press.
2. **Rajeev Motwani and Prabhakar Raghavan**, *Randomized Algorithms*, Cambridge University Press.

Reference Book:	
1.	**Nisan, Roughgarden, Tardos and Vazirani**, *Algorithmic Game Theory*, Cambridge University Press.
2.	**Kleinberg and Tardos**, *Algorithm Design*, Pearson Education.
3.	**Michael Mitzenmacher and Eli Upfal**, *Probability and Computing: Randomized Algorithms and Probabilistic Analysis*, Cambridge University Press.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyze randomized algorithms and randomized data structures such as treaps, skip lists, and hashing techniques for efficient problem solving.	Understand
CO2	Apply randomized computational geometry techniques and analyze Markov chain properties such as ergodicity and time reversal for algorithmic applications.	Apply
CO3	Analyze multithreaded and distributed algorithms with respect to performance, scheduling, synchronization, and symmetry breaking.	Analyze
CO4	Analyze online algorithms and approximation hardness using competitive analysis, adversary models, Yao's minimax principle, and approximation-preserving reductions.	Analyze
CO5	Apply streaming, property testing, and string matching algorithms to process large-scale data efficiently and analyze their correctness and complexity.	Apply

COURSE ARTICULATION MATRIX

COs/Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2							2	2	2
CO2	3	3	2	3	2							2	2	2
CO3	3	3	3	2	3							2	2	2
CO4	3	3	2	3	2							2	2	2
CO5	3	3	2	2	3							2	2	2
Avg	**3**	**3**	**2.2**	**2.4**	**2.4**							**2**	**2**	**2**

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

22ALPE503	BUSINESS INTELLIGENCE AND ITS APPLICATIONS		PE V			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Data Mining and Warehousing		**Hours/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 BIarchitecture
3.	To learn the concept of ETL in Data warehousing
4.	To learn the basics of data176o deling, measurement technologies and process.

UNITI	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	BIARCHITECTURE 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. enterprised ash board, enterprise reporting using MSAccess/ MSExcel,best practices in the design of enterprise dashboards.

Total (45 L) =45 Periods

Text Books:

1. R.N.Prasad, Seema Acharya," Fundament also Business Analytics", second edition, Wiley Publications, 2016.

Reference Book:

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 road map, 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 contex to fa Business, BI architecture and various quality performance framework	Understand
CO2	Illustrate various soperations of OLAP on Multidimensional data.	Understand
CO3	Familiarize with ETL in the contex to f datawarehousing.	Understand
CO4	Develop a data model at conceptual and logical levels.	Apply

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

22ALPE504	AUGMENTED REALITY AND VIRTUAL REALITY	PE V

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

Course Objectives:

1.	To provide foundational and advanced understanding of Augmented, Mixed, and Virtual Reality technologies, their principles, components, and system architectures.
2.	To develop the ability to design, model, and implement immersive AR/VR environments using tracking, computer vision, spatial interaction, and real-time rendering techniques.
3.	To enable learners to apply AR/VR concepts to real-world domains such as education, medicine, industry, and data-driven intelligent systems, while considering human factors and usability.

UNIT I	INTRODUCTION TO AUGMENTED REALITY	9	0	0	9

Introduction to Augmented Reality – Definition and Scope – A Brief History of Augmented Reality – Examples – Related Fields – Displays: Multimodal Displays – Visual Perception -Requirements and Characteristics – Visual Displays - Tracking

UNIT II	ADVANCED TOPICS IN AUGMENTED & MIXED REALITY	9	0	0	9

Computer Vision for AR : Marker Tracking – Multiple-Camera Infrared Tracking – Natural Feature Tracking by Detection – Incremental Tracking – Simultaneous Localization and Mapping – Outdoor Tracking – Calibration and Registration.

UNIT III	INTRODUCTION TO VIRTUAL REALITY	9	0	0	9

Definition and fundamental concepts - Trajectories, hybrid space, and 3D navigation - Three I's of VR: Immersion, Interaction, Imagination

VR vs. 3D Computer Graphics - Benefits, limitations, and system components - Input devices: controllers, gloves, trackers - 3D position trackers and types - Gesture interfaces & gesture input devices - Output devices: Graphics displays, HMDs, Cave systems, Auditory displays,

Human visual and auditory perception and VR constraints.

UNIT IV	VR MODELING & PROGRAMMING	9	0	0	9

Geometric modeling: shapes, appearance, textures - Kinematics modeling - Transformation matrices - Object hierarchies & 3D scene structure - Physical modeling: collision detection, deformation - Force computation, mapping, haptics - Behavior modeling & intelligent agents in VR - Model management - VR programming toolkits: WorldToolKit, Java3D - Comparison of toolkits & scene graphs

UNIT V	GRAPHICAL MODELS AND ADVANCED LEARNING	9	0	0	9

Human factors in VR & ergonomics - Safety issues & VR sickness - Societal impact of immersive technologies - Applications in:Medical simulations - Education & training - Arts and entertainment – Military – Robotics – Manufacturing – Business - Data visualization - Emerging XR applications powered by AI/ML

Total(45 L)=45Periods

Text Books:

1.	Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley-IEEE Press, 2024.
2.	Schmalstieg, Hollerer, "AUGMENTED REALITY: PRINCIPLES AND PRACTICE", Pearson Education India; First Editio, 2016.

References:	
1.	Doerner, Ralf; Broll, Wolfgang; Jung, Bernhard; and Others (Editors).Virtual and Augmented Reality (Vr/Ar): Foundations and Methods of Extended Realities (Xr) Springer, 2022
2.	Aukstakalnis, Steve. Practical Augmented Reality: Guide to the Technologies, Applications, and Human Factors for AR and VR. Apress / O'Reilly, 2017.
3.	https://www.udemy.com -Extended Reality (XR) - Building AR | VR | MR Projects
4.	Coursera : Introduction to Augmented Reality and ARCore

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explore the fundamental concepts, history, terminology, system components, and tracking principles related to Augmented, Mixed, and Virtual Reality.	Understand
CO2	Implement basic AR/VR applications using Unity3D, tracking libraries, geometric modeling, and interaction techniques suitable for immersive environments.	Apply
CO3	Examine and evaluate AR/VR system performance, interaction methods, tracking accuracy, human factors, and ergonomic challenges through analytical techniques.	Analyze
CO4	Design and develop interactive AR/VR solutions integrating computer vision, modeling, spatial interaction, and AI/ML to address real-world applications in education, industry, and simulation	Create
CO5	Work effectively in multidisciplinary teams to plan, develop, and evaluate AR/VR applications.	Evaluate

COURSE ARTICULATIONMATRIX

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

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

22ALPE505	LARGE SCALE MACHINE LEARNING	PE V

PREREQUISITES	CATEGORY	PE	Credit	3
Machine Learning	Hours/Week	L	T	P	TH
		3	0	0	3

Course Objectives:

1	To introduce the concepts, algorithms, and computational models required for processing, analyzing, and learning from large-scale datasets.
2	To equip learners with scalable machine learning techniques, including similarity search, clustering, dimensionality reduction, and distributed learning methods.
3	To enable students to design, implement, and evaluate end-to-end large-scale ML systems for real-world applications involving big data, text, graphs, and streaming environments.

UNIT I	FOUNDATIONS OF LARGE-SCALE MACHINE LEARNING	9	0	0	9

Concept of Machine Learning – Approaches to Modelling – Importance of Words in Documents – Hash Functions – Indexes – Secondary Storage – The Base of Natural Logarithms – Power Laws – MapReduce – Stream Data Model – Sampling Data – Filtering Streams

UNIT II	SIMILARITY SEARCH & LINK ANALYSIS AT SCALE	9	0	0	9

Finding Similar Items – Shingling – Locality Sensitive Hashing (LSH) – Distance Measures – Incremental Similarity Computation – PageRank – Link Spam – Social Networks as Graphs – Similarity Functions

UNIT III	FREQUENT PATTERNS, CLUSTERING & LARGE-SCALE GRAPH MINING	9	0	0	9

Frequent Item Sets – Market Basket Analysis – A-Priori Algorithm – PCY Algorithm – Hierarchical Clustering – K-Means – Clustering in Non-Euclidean Spaces – BFR – CURE – Mining Social Network Graphs – Clustering – Partitioning – Sim Rank

UNIT IV	RECOMMENDATION SYSTEMS & DIMENSIONALITY REDUCTION	9	0	0	9

Recommendation Systems – Utility Matrix – Content-Based Filtering – Collaborative Filtering – UV Decomposition – Eigenvalue Decomposition – PCA – SVD – Dimensionality Reduction for Large Data – Feature Reduction.

UNIT V	ADVANCED LARGE-SCALE MACHINE LEARNING & TOOLS	9	0	0	9

Large-Scale Machine Learning – Neural Networks – Support Vector Machines – Kernel Methods for Non-Linear Classification – Overview of Deep Learning – Tools for Data Ingestion – Distributed Analytics – Visualization Tools – Applications in Large-Scale Text, Graph, and Social Media Analytics

Total(45 L)=45Periods

Text Books:

1.	Anand Rajaraman, Jure Leskovec and J.D. Ullman, “Mining of Massive Data Sets”, ebook, Cambridge University Press, 2014
2.	Probabilistic Machine Learning: Advanced Topics, Kevin Murphy, MIT Press, 2023.

References:	
1.	Kevin P. Murphey, "Machine Learning, a Probabilistic Perspective", The MIT Press Cambridge, Massachusetts, 2012,
2.	Machine Learning: A Constraint-Based Approach — Marco Gori, Alessandro Betti & Stefano Melacci — 2023 (2nd Edition)
3.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition
4.	Coursera : Machine Learning

COURSEOUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explore fundamental concepts of large-scale machine learning, including hashing, similarity measures, power laws, Map Reduce, and frequent pattern mining.	Understand
CO2	Apply appropriate large-scale ML algorithms (stream mining, clustering, similarity search, recommendation) to real-world large datasets using modern tools.	Apply
CO3	Analyze and evaluate the scalability, performance, and efficiency of ML algorithms on massive text, graph, and streaming data.	Analyse
CO4	Design and build end-to-end scalable machine learning pipelines integrating ingestion, processing, modeling, and evaluation for large-scale data applications.	Create
CO5	Work effectively in multidisciplinary teams to plan, develop, and evaluate AR/VR applications.	Evaluate

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

22ALPE601	RESEARCH METHODOLOGIES	PE VI

PREREQUISITES	CATEGORY	PE	Credit		3
	Hours/week	L	T	P	TH
		3	0	0	3

Course Objectives:

1.	To understand the fundamental concepts and types of research.
2.	To acquire skills for conducting effective literature reviews and identifying research gaps.
3	To learn data collection methods, sampling techniques, and research tools.
4	To analyze data using qualitative and quantitative techniques.
5	To prepare research proposals, reports, and scientific publications ethically.

UNIT I	INTRODUCTION TO RESEARCH	9	0	0	9

Meaning, objectives and significance of research – Characteristics of good research – Types of research: Basic, Applied, Descriptive, Analytical, Experimental, Qualitative, Quantitative, Mixed methods – Research process – Identification and formulation of research problem – Research gap analysis – Hypothesis: types and formulation.

UNIT II	LITERATURE REVIEW & RESEARCH DESIGN	9	0	0	9

Sources of literature – Journals, Books, Theses, Online databases (IEEE, Scopus, Springer, Elsevier) – Search strategies – Referencing styles: APA, MLA, IEEE – Plagiarism and research ethics – Research design: components and types – Sampling techniques: Probability and Non-probability – Validity and Reliability.

UNIT III	DATA COLLECTION & TOOLS	9	0	0	9

Data types: Primary and secondary – Methods: Survey, Interview, Observation, Experiment – Questionnaire design – Measurement scales: Nominal, Ordinal, Interval, Ratio – Data collection instruments – Introduction to tools: SPSS, R, Python – Descriptive statistics: Mean, Median, Mode, Variance, Standard deviation

UNIT IV	DATA ANALYSIS & INTERPRETATION	9	0	0	9

Data preparation – Coding, classification and tabulation – Hypothesis testing – Parametric tests: t-test, F-test, ANOVA – Non-parametric tests: Chi-square – Correlation and Regression – Qualitative data analysis: Coding, Thematic analysis – Data interpretation and presentation – Errors in research: Type I and Type II errors.

UNIT V	RESEARCH DOCUMENTATION & PUBLISHING	9	0	0	9

Structure of thesis, dissertation, and research papers – Research proposal writing – Technical report writing – Presentation of findings – Publication process: Peer review, indexing, impact factor – Ethical issues in research – Intellectual Property Rights (IPR): Patents, copyright – Case studies on research misconduct.

Total (45 L) = 45 Periods

Textbooks:

1.	C. R. Kothari & Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International.
2.	Ranjit Kumar, "Research Methodology: A Step-by-Step Guide for Beginners", SAGE Publications.
3.	Donald R. Cooper & Pamela S. Schindler, "Business Research Methods", McGraw-Hill.

Reference Books:	
1.	John W. Creswell, "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches", SAGE Publications.
2.	Uma Sekaran & Roger Bougie, "Research Methods for Business", Wiley.
3.	Wayne C. Booth et al., "The Craft of Research", University of Chicago Press.
4	Trochim & Donnelly, "Research Methods: The Essential Knowledge Base", Cengage.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the fundamental concepts and processes in research.	Understand
CO2	Conduct literature reviews and design appropriate research methodologies.	Apply
CO3	Use suitable data collection and sampling techniques.	Apply
CO4	Analyse data using relevant statistical and qualitative methods.	Analyze
CO5	Prepare research proposals and present findings ethically.	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1		2							2	1	
CO2	2	2	2		3							2	1	
CO3	2	3	2									2	1	
CO4	1		1		2							2	1	
CO5	2	2	2		3							2	1	
Avg	1.8	2	1.6		2.5							2	1	
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALPE602	INFORMATION RETRIEVAL	PE VI

PREREQUISITES	CATEGORY	PE	Credit		3
		L	T	P	TH
NIL	Hours/week	3	0	0	3

Course Objectives:

1.	To understand the basics of Information Retrieval
2.	To provide a comprehensive understanding of information retrieval models, techniques, and ranking methods
3.	To enable students to understand and apply indexing structures, searching methods, query processing techniques, and evaluation measures
4.	To understand machine learning techniques for text classification and clustering.
5.	To understand various search engine system operations.

UNIT I	INTRODUCTION	9	0	0	9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR —IR Versus Web Search– Components of a Search engine

UNIT II	MODELING	9	0	0	9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking – Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

UNIT III	INDEXING	9	0	0	9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

UNIT IV	CLASSIFICATION AND CLUSTERING	9	0	0	9

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning

UNIT V	SEARCHING THE WEB	9	0	0	9

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

Total (45 L)= 45 Periods

Text Books:

1.	Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, ―Introduction to Information Retrieval‖, Cambridge University Press, First South Asian Edition, 2008.
2.	Stefan Büttcher, Charles L. A. Clarke, and Gordon V. Cormack, "Information Retrieval:Implementing and Evaluating Search Engines", The MIT Press, Cambridge, Massachusetts London, England, 2010
3.	Ricardo Baeza – Yates, Berthier Ribeiro – Neto, ―Modern Information Retrieval: The concepts and Technology behind Search‖ (ACM Press Books), Second Edition, 2011

Reference Books:	
1.	Chowdhury. G.G, "Introduction to Modern Information Retrieval", Neal-Schuman Publishers, 2nd edition, 2003.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the concepts of Information Retrieval system	Understand
CO2	Analyze various models of retrieval methods.	Analyze
CO3	Design the various components of an Information Retrieval system.	Create
CO4	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval	Apply
CO5	Design an efficient search engine and analyze the Web content structure.	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					1							2	1
CO2		3	3	3		1							2	1
CO3			3	3	1	1							2	1
CO4	3	3	3	2	2	2							2	1
CO5			3	3	3	2							2	1
Avg	**2.5**	**3**	**3**	**2.7**	**2**	**1.4**							**2**	**1**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALPE603	AGILE TECHNOLOGY		PE VI			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

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

UNIT I	INTRODUCTION	9	0	0	9

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

UNIT II	MOTIVATION AND EVIDENCE	9	0	0	9

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

UNIT III	SCRUM AND EXTREME PROGRAMMING	9	0	0	9

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

UNIT IV	UNIFIED PROCESS AND EVE	9	0	0	9

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

UNIT V	PROJECT MANAGEMENT	9	0	0	9

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

Total (45 L)=45 Periods

Text Books:

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

Reference Books:

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

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

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1			2	1	2			1			1			1
CO 2			2	1	2			1			1			1
CO 3			2	1	2			1			1			1
CO 4			1	1	1			1			1			1
Avg			**1.7**	**1**	**1.7**			**1**			**1**			**1**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALPE604	INFORMATION STORAGE MANAGEMENT	PE VI

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

Course Objectives:

1.	To build a strong foundational understanding of storage concepts, architectures, networking technologies, virtualization, business continuity, and data replication.
2.	To enable students to apply storage technologies such as RAID, SAN, NAS, IP-SAN, CAS, and virtualization tools for configuring and managing enterprise storage systems.
3.	To develop analytical skills for comparing storage architectures, networking models, and data protection techniques to choose suitable solutions for organizational needs.
4.	To improve evaluation and decision-making abilities by assessing storage systems based on performance, scalability, security, availability, and cost to recommend effective storage strategies.

UNIT I	STORAGE SYSTEMS	9	0	0	9

Introduction to Information Storage and Management: Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment: Components of the Host. RAID: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Hot Spares. Intelligent Storage System: Components, Intelligent Storage Array.

UNIT II	STORAGE NETWORKING TECHNOLOGIES	9	0	0	9

Direct-Attached Storage and Introduction to SCSI: Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model. Storage Area Networks: Fiber Channel, SAN Evolution, SAN Components, Fiber Channel Connectivity, Fiber Channel Ports, Fiber Channel Architecture, Zoning, Fiber Channel Login Types, Fiber Channel Topologies. Network Attached Storage: Benefits of NAS, NAS File I/Components of NAS, NAS Implementations, NAS-Implementations, NAS File Sharing Protocols, NAS I/O Operations.

UNIT III	ADVANCED STORAGE NETWORKING AND VIRTUALIZATION	9	0	0	9

IP SAN: iSCSI, FCIP. Content-Addressed Storage: Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples. Storage Virtualization: Forms of Virtualization, NIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization.

UNIT IV	BUSINESS CONTINUITY	9	0	0	9

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Recovery: Backup Purpose, Considerations, Granularity, Recovery Considerations, Backup Methods and Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies.

UNIT V	REPLICATION	9	0	0	9

Local Replication: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface. Remote Replication: Modes of Remote Replication and its Technologies, Network Infrastructure.

Total (45 L) =45 Periods

Text Books:

1.	EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", 2nd Edition, Wiley, India, 2012.

Reference Books:	
1.	Robert Spalding, ―Storage Networks: The Complete Reference ―, Tata McGraw Hill, Osborne, 2003.
2.	Marc Farley, ―Building Storage Networks‖, Tata McGraw Hill, Osborne, 2001.
3.	Meeta Gupta, Storage Area Networks Fundamentals, Pearson Education Limited, 2002.

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the basic concepts of information storage, storage architectures, networking technologies, virtualization, business continuity, and replication	Understand
CO2	Apply various storage technologies and techniques to configure, manage, and operate enterprise storage environments.	Apply
CO3	Analyze different storage solutions, architectures, and protection mechanisms to determine their suitability for organizational needs.	Analyze
CO4	Evaluate storage performance, security, scalability, and availability to recommend optimal storage strategies.	Evaluate

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	2	2		1		1			1	3
CO 2	3	2	1	1	2	2		1		1			1	3
CO 3	3	2	1	1	2	2		1		1			1	3
CO 4	3	2	1	1	2	2		1		1			1	3
Avg	3	2	1	1	2	2		1		1			1	3

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

22ALPE605	EXPERT SYSTEMS	PE VI

PREREQUISITES	CATEGORY	PE	Credit		3
		L	T	P	TH
NIL	Hours/week	3	0	0	3

Course Objectives:

1.	Introduce the concept, architecture, and characteristics of expert systems.
2.	Explain various knowledge representation techniques and logical inference mechanisms.
3	Teach uncertainty handling using probabilistic, fuzzy, and evidential reasoning.
4	Familiarize students with expert system development life cycle and applications.
5	Enable learners to build simple rule-based expert systems.

UNIT I	INTRODUCTION TO EXPERT SYSTEMS	9	0	0	9

Meaning of expert systems, problem domain vs knowledge domain, advantages and characteristics of expert systems, development stages. Rule-based systems, procedural vs non-procedural paradigms, neural systems. Logic fundamentals, semantic nets, frames, schemas, PROLOG translation, propositional & predicate logic, quantifiers, limitations of semantic nets.

UNIT II	LOGICAL REASONING AND KNOWLEDGE INFERENCE	9	0	0	9

Trees, lattices, graphs, problem spaces, AND–OR trees. Methods of inference, rules of inference, resolution rule, resolution systems, deduction, causal reasoning. First-order logic resolution, forward & backward chaining, meta-knowledge, Markov decision process.

UNIT III	UNCERTAINTY AND PROBABILISTIC REASONING	9	0	0	9

Types of uncertainty, errors, classical/experimental/subjective probability, conditional and compound probability. Hypothetical reasoning, temporal reasoning, Markov chains, sufficiency & necessity, odds of belief. Combining evidence, inference nets, probability propagation.

UNIT IV	FUZZY LOGIC & EXPERT SYSTEM DEVELOPMENT	9	0	0	9

Sources of uncertainty, handling uncertainty, Dempster–Shafer theory, fuzzy logic and applications. Selecting expert system problems, development stages & error types, role of the knowledge engineer, expert system lifecycle and models.

UNIT V	APPLICATIONS & CASE STUDIES OF EXPERT SYSTEMS	9	0	0	9

Medical diagnosis systems (MYCIN, INTERNIST-I) Engineering & manufacturing expert systems
Financial decision support & credit assessment systems Agricultural and environmental expert systems
Fault diagnosis systems in power/telecom networks- Natural language–based expert advisors
Knowledge-based configuration systems-Detailed case studies demonstrating architecture, knowledge base design, inference mechanisms, rule implementation, and uncertainty handling.

Total (45 L)= 45 Periods

Text Books:

1.	J. Giarratano & G. Riley, Expert Systems — Principles and Programming, 4th Ed., PWS Publishing, 2004.
2.	Durkin J., Expert Systems Design and Development, Macmillan, 1994.
3.	Elias M. Awad, Building Expert Systems, West Publishing, 1996.

Reference Books:

1.	Peter Jackson, Introduction to Expert Systems, Addison Wesley, 1999.
2.	Gonzalez & Dankel, Engineering of Knowledge-Based Systems, Prentice Hall, 1994.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain fundamentals and characteristics of expert systems.	Understand
CO2	Apply logical reasoning and inference techniques	Apply
CO3	Analyze uncertainty using probability, D-S theory, and fuzzy logic	Analyze
CO4	Design expert system components & reasoning modules	Apply
CO5	Evaluate applications and case studies of expert systems	Evaluate

COURSE ARTICULATION MATRIX														
COs/ POs	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3	2	1	1	1				1	2		1	3	2
CO2	3	3	2	2	1				1	2	1	2	3	2
CO3	2	3	2	2	2				1	1		2	2	1
CO4	3	3	3	2	2				2	2	2	3	3	3
CO5	2	2	2	1	1				2	3	2	3	2	3
Avg	**2.6**	**2.6**	**2**	**1.6**	**1.4**				**1.4**	**2**	**1.6**	**2.2**	**2.6**	**2.2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

ELECTIVES FOR HONOURS

PROFESSIONAL ELECTIVE COURSES: VERTICALS -Honours

22ALH101	EXPLORATORY DATA ANALYSIS				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To outline an overview of exploratory data analysis.
2	To implement data visualization using Matplotlib.
3	To perform univariate data exploration and analysis.
4	To apply bivariate data exploration and analysis.
5	To use Data exploration and visualization techniques for multivariate and time series data.

UNIT I	**EXPLORATORY DATA ANALYSIS**	**9**	**0**	**0**	**9**

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT II	**EDA USING PYTHON**	**9**	**0**	**0**	**9**

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT III	**UNIVARIATE ANALYSIS**	**9**	**0**	**0**	**9**

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

UNIT IV	**BIVARIATE ANALYSIS**	**9**	**0**	**0**	**9**

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

UNIT V	**MULTIVARIATE AND TIME SERIES ANALYSIS**	**9**	**0**	**0**	**9**

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

Total (45 L) =45 Periods

Text Books:	
1.	Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020. (Unit 1)
2.	Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017. (Unit 2)
3.	Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)

Reference Books:	
1.	Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2.	Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.
3.	Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Understand the fundamentals of exploratory data analysis.	Understand
CO2	Implement the data visualization using Matplotlib.	Create
CO3	Perform univariate data exploration and analysis.	Apply
CO4	Apply bivariate data exploration and analysis.	Apply
CO5	Use Data exploration and visualization techniques for multivariate and time series data	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	3	3	-	-	-	2	2	3	2	2	2
CO 2	2	2	2	3	3	-	-	-	3	2	2	2	2	2
CO 3	2	3	2	2	3	-	-	-	2	2	2	1	2	2
CO 4	2	2	2	2	3	-	-	-	3	2	2	1	2	2
CO 5	2	2	3	2	1	-	-	-	1	2	2	1	2	2
Avg	**2.2**	**2.2**	**2.4**	**2.4**	**2.6**	**-**	**-**	**-**	**2.2**	**2**	**2.2**	**1.4**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH102	RECOMMENDER SYSTEMS				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the foundations of the recommender system.
2	To learn the significance of machine learning and data mining algorithms for Recommender systems
3	To learn about collaborative filtering
4	To make students design and implement a recommender system.
5	To learn collaborative filtering

UNIT I	INTRODUCTION	9	0	0	9

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

Suggested Activities:

- Practical learning – Implement Data similarity measures.
- External Learning – Singular Value Decomposition (SVD) applications

Suggested Evaluation Methods:

- Quiz on Recommender systems.
- Quiz of python tools available for implementing Recommender systems

UNIT II	CONTENT-BASED RECOMMENDATION SYSTEMS	9	0	0	9

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

Suggested Activities:

- Assignment on content-based recommendation systems
- Assignment of learning user profiles

Suggested Evaluation Methods:

- Quiz on similarity-based retrieval.
- Quiz of content-based filtering

UNIT III	COLLABORATIVE FILTERING	9	0	0	9

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection.

Suggested Activities:

- Practical learning – Implement collaborative filtering concepts
- Assignment of security aspects of recommender systems

Suggested Evaluation Methods:

- Quiz on collaborative filtering
- Seminar on security measures of recommender systems
-

UNIT IV	ATTACK-RESISTANT RECOMMENDER SYSTEMS	9	0	0	9

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

Suggested Activities:

- Group Discussion on attacks and their mitigation
- Study of the impact of group attacks
- External Learning – Use of CAPTCHAs

Suggested Evaluation Methods:

- Quiz on attacks on recommender systems
- Seminar on preventing attacks using the CAPTCHAs

UNIT V	EVALUATING RECOMMENDER SYSTEMS	9	0	0	9

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures.

Suggested Activities:

- Group Discussion on goals of evaluation design
- Study of accuracy metrics

Suggested Evaluation Methods:

- Quiz on evaluation design
- Problems on accuracy measures

Total (45 L) =45 Periods

Text Books:

1	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2	Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3	Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011)
4	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of recommender systems.	Understand
CO2	Implement machine-learning and data-mining algorithms in recommender systems data sets.	Apply
CO3	Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.	Apply
CO4	Design and implement a simple recommender system.	Create
CO5	Learn about advanced topics of recommender systems	Understand
CO6	Learn about advanced topics of recommender systems applications	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	1	2	1	-	-	-	1	-	-	1	2	2
CO 2	1	2	-	-	1	-	-	-	-	-	-	1	2	2
CO 3	2	3	1	-	1	-	-	-	**2**	-	-	-	2	2
CO 4	3	2	2	2	1	-	-	-	**2**	-	-	2	2	2
CO 5	1	1	-	2	1	-	-	-	-	-	-	1	2	2
CO 6	2	2	1	1	1	-	-	-	-	-	-	1	2	2
Avg	**1.83**	**2**	**1.3**	**1.8**	**1**	**-**	**-**	**-**	**1.7**	**-**	**-**	**1.2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH103	NEURAL NETWORKS AND DEEP LEARNING				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics in deep neural networks
2	To understand the basics of associative memory and unsupervised learning networks
3	To apply CNN architectures of deep neural networks
4	To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
5	To apply autoencoders and generative models for suitable applications.

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

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.

UNIT II	**ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS**	**9**	**0**	**0**	**9**

Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.

UNIT III	**THIRD-GENERATION NEURAL NETWORKS**	**9**	**0**	**0**	**9**

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuro scientific Basis – Applications: Computer Vision, Image Generation, Image Compression.

UNIT IV	**DEEP FEEDFORWARD NETWORKS**	**9**	**0**	**0**	**9**

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Back propagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT V	**RECURRENT NEURAL NETWORKS**	**9**	**0**	**0**	**9**

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Auto encoder, Stochastic Encoders and Decoders, Contractive Encoders.

Total (45L) = 45 Periods

Text Books:

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2	Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications,2021.

Reference Books:

1	Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly,2018.
2	Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media,2017.
3	Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.

4	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6	Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
7	S Rajasekaran, G A Vijayalakshmi Pai, "Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications", PHI Learning, 2017.
8	Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9	James A Freeman, David M S Kapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Apply Convolution Neural Network for image processing.	Apply
CO2	Understand the basics of associative memory and unsupervised learning networks.	Understand
CO3	Apply CNN and its variants for suitable applications.	Apply
CO4	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.	Analyze
CO5	Apply autoencoders and generative models for suitable applications.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	2	3	1	-	-	2	1	-	-	1	2
CO 2	3	1	2	1	-	-	-	-	-	1	2	2	2	2
CO 3	3	3	3	3	3	1	-	-	2	1	-	-	2	2
CO 4	3	3	3	3	3	-	-	-	2	-	2	3	2	2
CO 5	1	1	3	2	3	-	-	-	2	-	-	-	2	2
Avg	**2.6**	**2**	**2.8**	**2.2**	**3**	**1**			**2**	**1**	**2**	**2.5**	**1.8**	**2**

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

22ALH104	TEXT AND SPEECH ANALYSIS				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	Understand natural language processing basics
2	Apply classification algorithms to text documents
3	Build question-answering and dialogue systems
4	Develop a speech recognition system
5	Develop a speech synthesizer

UNIT I	NATURAL LANGUAGE BASICS	9	0	0	9

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs

UNIT II	TEXT CLASSIFICATION	9	0	0	9

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model –FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

- Assignment on above topics
- Quiz on RNN, Transformers
- Implementing NLP with RNN and Transformers

UNIT III	QUESTION ANSWERING AND DIALOGUE SYSTEMS	9	0	0	9

Information retrieval – IR-based question answering – knowledge-based question answering –language models for QA – classic QA models – chatbots – Design of dialogue systems –evaluating dialogue systems

Suggested Activities

- Flipped classroom on language models for QA
- Developing a knowledge-based question-answering system
- Classic QA model development

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on knowledge-based question answering system
- Development of simple chatbots

UNIT IV	TEXT-TO-SPEECH SYNTHESIS	9	0	0	9

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

Suggested Activities

- Flipped classroom on Speech signal processing
- Exploring Text normalization
- Data collection
- Implementation of TTS systems

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on wavenet, deep learning-based TTS systems
- Finding accuracy with different TTS systems

UNIT V	AUTOMATIC SPEECH RECOGNITION	9	0	0	9

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Suggested Activities

- Flipped classroom on Speech recognition.
- Exploring Feature extraction

Suggested Evaluation Methods

- Assignment on the above topics
- Quiz on acoustic modelling

Total (45L) = 45 Periods

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

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	1	3	-	-	-	1	2	1	2	2	2
CO 2	3	1	2	1	2	-	-	-	2	2	1	3	2	2
CO 3	2	2	1	3	1	-	-	-	3	3	1	2	2	2
CO 4	2	1	1	1	2	-	-	-	2	1	2	2	2	2
CO 5	1	3	2	2	1	-	-	-	3	2	1	1	2	2
Avg	**2.2**	**1.8**	**1.8**	**1.6**	**2**	**-**	**-**	**-**	**2.2**	**2**	**1.2**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH105	BUSINESS ANALYTICS				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the Analytics Life Cycle.
2	To comprehend the process of acquiring Business Intelligence
3	To understand various types of analytics for Business Forecasting
4	To model the supply chain management for Analytics.
5	To apply analytics for different functions of a business

UNIT I	**INTRODUCTION TO BUSINESS ANALYTICS**	**9**	**0**	**0**	**9**

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II	**BUSINESS INTELLIGENCE**	**9**	**0**	**0**	**9**

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions .

UNIT III	**BUSINESS FORECASTING**	**9**	**0**	**0**	**9**

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV	**HR & SUPPLY CHAIN ANALYTICS**	**9**	**0**	**0**	**9**

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V	**MARKETING & SALES ANALYTICS**	**9**	**0**	**0**	**9**

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

Total (45L) = 45 Periods

Text Books:

1	R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5	Mahadevan B, “Operations Management -Theory and Practice”,3rd Edition, Pearson Education,2018.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the real world business problems and model with analytical solutions.	Understand
CO2	Identify the business processes for extracting Business Intelligence	Apply
CO3	Apply predictive analytics for business fore-casting	Apply
CO4	Apply analytics for supply chain and logistics management	Apply
CO5	Use analytics for marketing and sales.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	1	1	-	-	-	1	2	1	1	2	2
CO 2	3	3	3	2	3	-	-	-	1	2	2	2	2	2
CO 3	2	2	3	3	2	-	-	-	3	1	1	3	2	2
CO 4	2	1	1	2	2	-	-	-	3	3	2	1	2	2
CO 5	2	3	2	3	2	-	-	-	3	3	1	3	2	2
Avg	**2.2**	**2.2**	**2.4**	**2.2**	**2**	**-**	**-**	**-**	**2.2**	**2.2**	**1.4**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH106	IMAGE AND VIDEO ANALYTICS					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics of image processing techniques for computer vision.
2	To learn the techniques used for image pre-processing.
3	To discuss the various object detection techniques.
4	To understand the various Object recognition mechanisms.
5	To elaborate on the video analytics techniques.

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

Computer Vision – Image representation and image analysis tasks - Image representations –digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT II	**IMAGE PRE-PROCESSING**	**9**	**0**	**0**	**9**

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multisperalct images - Local pre-processing in the frequency domain - Line detection by local preprocessing operators - Image restoration.

UNIT III	**OBJECT DETECTION USING MACHINE LEARNING**	**9**	**0**	**0**	**9**

Object detection– Object detection methods – Deep Learning framework for Object detection–bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT IV	**FACE RECOGNITION AND GESTURE RECOGNITION**	**9**	**0**	**0**	**9**

Face Recognition-Introduction-Applications of Face Recognition-Process of Face RecognitionDeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNetGesture Recognition

UNIT V	**VIDEO ANALYTICS**	**9**	**0**	**0**	**9**

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problemRestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architectureImprovement in Inception v2-Video analytics-RestNet and Inception v3.

Total (45 L) =45 Periods

Text Books:

1	Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4nd edition, Thomson Learning, 2013.
2	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architecture with Python and Keras,Apress 2021(UNIT-III,IV and V)

Reference Books:

1	VSRichard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited,2011.
2	Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.
3	D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
4	E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basics of image processing techniques for computer vision and video analysis.	Understand
CO2	Explain the techniques used for image pre-processing.	Understand
CO3	Develop various object detection techniques.	Create
CO4	Understand the various face recognition mechanisms.	Understand
CO5	Elaborate on deep learning-based video analytics.	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	2	2	2	-	-	-	3	3	2	1	2	2
CO 2	2	2	3	3	3	-	-	-	3	2	1	1	2	2
CO 3	1	2	2	2	3	-	-	-	1	2	1	2	2	2
CO 4	1	2	3	2	3	-	-	-	2	2	2	3	2	2
CO 5	3	2	1	3	2	-	-	-	2	1	1	3	2	2
Avg	**2**	**1.8**	**2.2**	**2.4**	**2.6**	**-**	**-**	**-**	**2.2**	**2**	**1.4**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH107	DATA VISUALIZATION					
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
NIL		**Hours/week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the fundamental concepts and components used in the data visualization
2.	To apply effective data visualizations to provide new insights

UNIT I	INTRODUCTION TO DATA VISUALIZATION	9	0	0	9

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

UNIT II	DATA VISUALIZATION METHODS	9	0	0	9

Mapping - Time series - Connections and correlations – Indicator-Area Chart-Pivot table- Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods-Hierarchies and Recursion - Networks and Graphs -Matrix representation for graphs- Info graphics

UNIT III	DATA VISUALIZATION PROCESS	9	0	0	9

Acquiring data, - Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Parsing data - Levels of Effort, Tools for Gathering Clues, Text Markup Languages, Regular Expressions (regexps), Vectors and Geometry, Binary Data Formats.

UNIT IV	INTERACTIVE DATA VISUALIZATION	9	0	0	9

Technology Fundamentals- Setting up D3- Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – T3 JavaScript Framework- Tableau

UNIT V	SECURITY DATA VISUALIZATION	9	0	0	9

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating security visualization system.

Total (45 L)= 45 Periods

Text Books:

1.	Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008
2.	Scott Murray, “Interactive data visualization for the web”, O’Reilly Media, Inc., Second Edition, 2017.
3.	Greg Conti, “Security Data Visualization: Graphical Techniques for Network Analysis”, No Starch Press Inc, 2007

Reference Books:

1.	Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2nd edition,A K Peters, Ltd 2015.
2.	Tamara Munzner,Visualization Analysis & Design ,1st edition,AK Peters Visualization Series 2014
3.	Scott Murray,Interactive Data Visualization for the Web ,2nd Edition, 2017

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the representation of complex and voluminous data.	Understand
CO2	Infer the various methodologies used in data visualization.	Analyze
CO3	Represent the various process and tools used for data visualization.	Apply
CO4	Implement the interactive data visualization to make inferences from the data	Analyze
CO5	Apply the security measures in data visualization.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1		2								2	1
CO2	2	2	2		3								2	1
CO3	2	3	2										2	1
CO4	1		1		2								2	1
CO5	2	2	2		3								2	1
Avg	**1.8**	**2**	**1.6**		**2.5**								**2**	**1**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH108	BIG DATA ANALYTICS					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand big data
2	To learn and use NoSQL big data management.
3	To learn map reduce analytics using Hadoop and related tools.
4	To work with map reduce applications
5	To understand the usage of Hadoop related tools for Big Data Analytics

UNIT I	**UNDERSTANDING BIG DATA**	**9**	**0**	**0**	**9**

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.

UNIT II	**NOSQL DATA MANAGEMENT**	**9**	**0**	**0**	**9**

Introduction to NoSQL – aggregate data models – key-value and document data models –relationships – graph databases – schemaless databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients

UNIT III	**MAP REDUCE APPLICATIONS**	**9**	**0**	**0**	**9**

Map Reduce workflows – unit tests with MR Unit – test data and local tests – anatomy of Map Reduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – Map Reduce types – input formats – output formats.

UNIT IV	**BASICS OF HADOOP**	**9**	**0**	**0**	**9**

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow –Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures -Cassandra – Hadoop integration.

UNIT V	**HADOOP RELATED TOOLS**	**9**	**0**	**0**	**9**

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis.
Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts.
Hive – data types and file formats – Hive QL data definition – Hive QL data manipulation – Hive QL queries.

Total (45 L) =45 Periods

Text Books:

1	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2	Eric Sammer, "Hadoop Operations", O'Reilley, 2012
3	Sadalage, Pramod J. “NoSQL distilled”, 2013

Reference Books:	
1	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4	Alan Gates, "Programming Pig", O'Reilley, 2011.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe big data and use cases from selected business domains. .	Remember
CO2	Explain NoSQL big data management	Understand
CO3	Install, configure, and run Hadoop and HDFS.	Apply
CO4	Perform map-reduce analytics using Hadoop	Apply
CO5	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	3	3	-	-	-	2	2	3	1	2	2
CO 2	3	3	2	3	2	-	-	-	2	2	3	3	2	2
CO 3	3	3	3	2	3	-	-	-	2	2	1	2	2	2
CO 4	2	3	3	3	3	-	-	-	2	2	3	2	2	2
CO 5	3	3	3	3	3	-	-	-	3	1	3	2	2	2
Avg	**2.8**	**3**	**2.8**	**2.8**	**2.8**	**-**	**-**	**-**	**2.2**	**1.8**	**2.6**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH201	FULL STACK WEB APPLICATION DEVELOPMENT				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Develop TypeScript Application
2	Develop Single Page Application (SPA)
3	Able to communicate with a server over the HTTP protocol
4	Learning all the tools need to start building applications with Node.js
5	Implement the Full Stack Development using MEAN Stack

UNIT I	**FUNDAMENTALS & TYPESCRIPT LANGUAGE**	**9**	**0**	**0**	**9**

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.

UNIT II	**ANGULAR**	**9**	**0**	**0**	**9**

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. Http Client. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.

UNIT III	**NODE.js**	**9**	**0**	**0**	**9**

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Call back functions. call back errors. Abstracting call backs. Chaining call backs. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Call back API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and Typed Arrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.

UNIT IV	**EXPRESS.Js**	**9**	**0**	**0**	**9**

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router. route(path). Router Class. Request Object. Response Object. Error Handling.

UNIT V	**MONGODB**	**9**	**0**	**0**	**9**

Introduction to Mongo DB. Documents. Collections. Sub collections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

Total (45 L) =45 Periods

Text Books:	
1	Adam Freeman, Essential TypeScript, Apress, 2019
2	Mark Clow, Angular Projects, Apress, 2018
3	Alex R. Young, Marc Harter,Node.js in Practice, Manning Publication, 2014
4	Pro Express.js, Azat Mardan, Apress, 2015
5	MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, Manning Publication, Second edition, 2016

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop basic programming skills using Javascript .	Create
CO2	Implement a front-end web application using Angular.	Apply
CO3	Create modules to organise the server	Create
CO4	Build RESTful APIs with Node, Express and MongoDB with confidence.	Create
CO5	Will learn to Store complex, relational data in MongoDB using Mongoose .	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	3	3	3	-	-	-	1	3	3	1	2	2
CO 2	2	2	2	1	2	-	-	-	2	2	1	3	2	2
CO 3	1	1	3	2	3	-	-	-	1	2	1	1	2	2
CO 4	2	3	3	1	2	-	-	-	3	1	2	2	2	2
CO 5	1	2	3	2	2	-	-	-	2	1	3	1	2	2
Avg	**1.8**	**2**	**2.8**	**1.8**	**2.4**	**-**	**-**	**-**	**1.8**	**1.8**	**2**	**1.6**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH202	APP DEVELOPMENT					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To learn development of native applications with basic GUI Components
2	To develop cross-platform applications with event handling
3	To develop applications with location and data storage capabilities
4	To develop web applications with database access

UNIT I	**FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT**	**9**	**0**	**0**	**9**

Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design

UNIT II	**NATIVE APP DEVELOPMENT USING JAVA**	**9**	**0**	**0**	**9**

Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Dev elopment Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props

UNIT III	**HYBRID APP DEVELOPMENT**	**9**	**0**	**0**	**9**

Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova

UNIT IV	**CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE**	**9**	**0**	**0**	**9**

What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Crossplatform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props

UNIT V	**NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS**	**9**	**0**	**0**	**9**

Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability

Total (45 L) =45 Periods

Text Books:

1	Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2	Apache Cordova in Action, Raymond K. Camden, Manning. 2015
3	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing

Reference Books:

1	Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2	Native Mobile Development by Shaun Lewis, Mike Dunn
3	Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras
4	Apache Cordova 4 Programming, John M Wargo, 2015
5	React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop Native applications with GUI Components. .	Create
CO2	Develop hybrid applications with basic event handling.	Create
CO3	Implement cross-platform applications with location and data storage capabilities.	Apply
CO4	Implement cross platform applications with basic GUI and event handling.	Apply
CO5	Develop web applications with cloud database access.	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	1	2	3	-	-	-	1	1	2	1	2	2
CO 2	2	1	3	2	2	-	-	-	3	2	2	3	2	2
CO 3	2	2	2	1	2	-	-	-	1	1	1	1	2	2
CO 4	1	3	1	1	3	-	-	-	1	1	3	2	2	2
CO 5	1	1	3	1	3	-	-	-	1	1	2	1	2	2
Avg	**1.6**	**1.8**	**2**	**1.4**	**2.6**	**-**	**-**	**-**	**1.4**	**1.2**	**2**	**1.6**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH203	SERVICE ORIENTED ARCHITECTURE				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To provide an overview of XML Technology and modeling databases in XML
2	To provide an Basics concepts of Service Oriented Architecture
3	To provide an Basics concepts of Service Oriented Architecture
4	To introduce Security solutions in XML and Web Services and to introduce Security standards for Web Services
5	To provide concepts about Big data and SOA with its Business case analysis.

UNIT I	**XML TECHNOLOGY**	**9**	**0**	**0**	**9**

XML – XML and Web - Name Spaces – XML Document Structure - Structuring with Schemas and DTD - Modeling Databases in XML – XQuery.

UNIT II	**SOA BASICS**	**9**	**0**	**0**	**9**

Service Oriented Architecture (SOA) – Comparing SOA with Client-Server and Distributed architectures - Characteristics of SOA – Benefits of SOA -- Principles of Service orientation – Service layers - Business Process management

UNIT III	**WEB SERVICES**	**9**	**0**	**0**	**9**

SOA and Web Services – Web Services Protocol Stack – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI. Service-Level Interaction patterns – XML and Web Services - Enterprise Service Bus - .NET and J2EE Interoperability.

UNIT IV	**WS TECHNOLOGIES AND STANDARDS**	**9**	**0**	**0**	**9**

Web Services Technologies - JAX-RPC, JAX-WS. Web Service Standards – WS-RM, WSAddressing, WS-Policy. Service Orchestration and Choreography – Composition Standards - BPEL. Service Oriented Analysis and Design.

UNIT V	**BIG DATA AND SOA**	**9**	**0**	**0**	**9**

Big Data and SOA: Concepts, Big Data and its characteristics, Technologies for Big Data, Service-orientation for Big Data Solutions.
Business Case for SOA: Stakeholder Objectives, Benefits of SOA, Cost Savings, Return on Investment (ROI), Build a Case for SOA

Total (45 L) =45 Periods

Text Books:

1	Ron Schmelzer et al. “XML and Web Services”, Pearson Education, 2008. (Unit 1 and 3)
2	Thomas Erl, “ Service Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005 (Unit 2, 3, 4, and 5)
3	Frank P.Coyle, “XML, Web Services and the Data Revolution”, Pearson Education, 2002 (Unit 5)
4	Shankar Kambhampaty; Service - Oriented Architecture & Microservices Architecture: For Enterprise, Cloud, Big Data and Mobile; Wiley; 3rd Edition; 2018; ISBN: 9788126564064.

Reference Books:	
1	Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", Addison Wesley, 2005.
2	James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, "Java Web Services Architecture", Elsevier, 2011.
3	Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the basics of XML	Understand
CO2	Describe the concepts of SOA	Remember
CO3	Apply the Web services, some of the prevailing standards and technologies of Web Services	Apply
CO4	Design approaches for providing security for XML documents as well as messages exchanged among Web Services	Create
CO5	Explain the concepts about Big data and SOA with its Business case analysis	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	1	1	1	-	-	-	2	1	3	2	2	2
CO 2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO 3	1	1	3	1	3	-	-	-	3	3	1	1	2	2
CO 4	1	1	1	2	3	-	-	-	2	3	3	1	2	2
CO 5	1	3	3	2	2	-	-	-	1	3	1	2	2	2
Avg	**1.8**	**1.8**	**2**	**1.8**	**2.2**	**-**	**-**	**-**	**1.8**	**2.4**	**2.2**	**1.4**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH204	UI AND UX DESIGN				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To provide a sound knowledge in UI & UX
2	To understand the need for UI and UX
3	To understand the various Research Methods used in Design
4	To explore the various Tools used in UI & UX
5	Creating a wireframe and prototype

UNIT I	**FOUNDATIONS OF DESIGN**	**9**	**0**	**0**	**9**

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy.

UNIT II	**FOUNDATIONS OF UI DESIGN**	**9**	**0**	**0**	**9**

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides

UNIT III	**FOUNDATIONS OF UX DESIGN**	**9**	**0**	**0**	**9**

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

UNIT IV	**WIREFRAMING, PROTOTYPING AND TESTING**	**9**	**0**	**0**	**9**

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

UNIT V	**RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE**	**9**	**0**	**0**	**9**

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

Total (45L) = 45 Periods

Text Books:

1	Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2	Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021

Reference Books:

1	Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2	Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3	Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
4	https://www.nngroup.com/articles/
5	https://www.interaction-design.org/literature

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Build UI for user Applications	Create
CO2	Evaluate UX design of any product or application	Evaluate
CO3	Demonstrate UX Skills in product development	Remember
CO4	Implement Sketching principles	Apply
CO5	Create Wireframe and Prototype	Create

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	1	3	1	-	-	-	3	3	2	1	2	2
CO 2	2	3	1	3	2	-	-	-	1	2	2	2	2	2
CO 3	1	3	3	2	2	-	-	-	2	3	1	2	2	2
CO 4	1	2	3	3	1	-	-	-	3	2	1	3	2	2
CO 5	1	2	3	2	1	-	-	-	2	1	1	1	2	2
Avg	**1.6**	**2.2**	**2.2**	**2.6**	**1.4**	**-**	**-**	**-**	**2.2**	**2.2**	**1.4**	**1.8**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH205	SOFTWARE TESTING AND AUTOMATION				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics of software testing
2	To learn how to do the testing and planning effectively
3	To build test cases and execute them
4	To focus on wide aspects of testing and understanding multiple facets of testing
5	To get an insight about test automation and the tools used for test automation

UNIT I	**FOUNDATIONS OF SOFTWARE TESTING**	**9**	**0**	**0**	**9**

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT II	**TEST PLANNING**	**9**	**0**	**0**	**9**

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III	**TEST DESIGN AND EXECUTION**	**9**	**0**	**0**	**9**

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV	**ADVANCED TESTING CONCEPTS**	**9**	**0**	**0**	**9**

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT V	**TEST AUTOMATION AND TOOLS**	**9**	**0**	**0**	**9**

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

Total (45 L) =45 Periods

Text Books:

1	Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2	Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018

Reference Books:

1	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc
2	Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3	Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Fourth Edition, 2014, Taylor & Francis Group.

4	Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
5	Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc
6	Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing
7	Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of software testing and the need for software testing	Understand
CO2	Design Test planning and different activities involved in test planning	Create
CO3	Design effective test cases that can uncover critical defects in the application	Create
CO4	Carry out advanced types of testing	Understand
CO5	Automate the software testing using Selenium and TestNG	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	1	2	-	-	-	1	1	3	2	2	2
CO 2	2	3	1	1	1	-	-	-	2	2	1	2	2	2
CO 3	2	2	1	3	1	-	-	-	1	3	1	2	2	2
CO 4	2	1	3	2	1	-	-	-	1	1	1	2	2	2
CO 5	2	2	1	3	1	-	-	-	1	3	2	1	2	2
Avg	**2.2**	**2.2**	**1.6**	**2**	**1.2**	**-**	**-**	**-**	**1.2**	**2**	**1.6**	**1.8**	**2**	**2**

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

22ALH206	WEB APPLICATION SECURITY				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the fundamentals of web application security
2	To focus on wide aspects of secure development and deployment of web applications
3	To learn how to build secure APIs
4	To learn the basics of vulnerability assessment and penetration testing
5	To get an insight about Hacking techniques and Tools

UNIT I	**FUNDAMENTALS OF WEB APPLICATION SECURITY**	**9**	**0**	**0**	**9**

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II	**SECURE DEVELOPMENT AND DEPLOYMENT**	**9**	**0**	**0**	**9**

Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III	**SECURE API DEVELOPMENT**	**9**	**0**	**0**	**9**

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV	**VULNERABILITY ASSESSMENT AND PENETRATION TESTING**	**9**	**0**	**0**	**9**

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Databasebased vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V	**HACKING TECHNIQUES AND TOOLS**	**9**	**0**	**0**	**9**

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

Total (45 L) =45 Periods

Text Books:

1	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGrawHill Companies.
3	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA

Reference Books:	
1	Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc
2	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4	Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understanding the basic concepts of web application security and the need for it	Understand
CO2	Be acquainted with the process for secure development and deployment of web applications	Understand
CO3	Acquire the skill to design and develop Secure Web Applications that use Secure APIs	Understand
CO4	Be able to get the importance of carrying out vulnerability assessment and penetration testing	Understand
CO5	Acquire the skill to think like a hacker and to use hackers tool sets	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	2	1	3	-	-	-	-	-	-	1	2	2
CO 2	2	1	2	1	3	-	-	-	-	-	-	-	2	2
CO 3	1	1	1	2	3	-	-	-	-	-	-	1	2	2
CO 4	1	2	1	1	2	-	-	-	-	-	-	-	2	2
CO 5	1	2	2	2	2	-	-	-	-	-	-	1	2	2
Avg	**1.2**	**1.6**	**1.6**	**1.4**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH207	DEVOPS				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To introduce DevOps terminology, definition & concepts
2	To understand the different Version control tools like Git, Mercurial
3	To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4	To understand Configuration management using Ansible
5	Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I	**INTRODUCTION TO DEVOPS**	**9**	**0**	**0**	**9**

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II	**COMPILE AND BUILD USING MAVEN & GRADLE**	**9**	**0**	**0**	**9**

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle

UNIT III	**CONTINUOUS INTEGRATION USING JENKINS**	**9**	**0**	**0**	**9**

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV	**CONFIGURATION MANAGEMENT USING ANSIBLE**	**9**	**0**	**0**	**9**

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V	**BUILDING DEVOPS PIPELINES USING AZURE**	**9**	**0**	**0**	**9**

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines. yaml file

Total (45L) = 45 Periods

Text Books:

1	Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2	Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014.

Reference Books:

1	Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
2	Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.

3	David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016..
4	Mariot Tsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
5	https://www.jenkins.io/user-handbook.pd
6	https://maven.apache.org/guides/getting-started/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand different actions performed through Version control tools like Git.	Understand
CO2	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.	Apply
CO3	Ability to Perform Automated Continuous Deployment	Apply
CO4	Ability to do configuration management using Ansible	Apply
CO5	Understand to leverage Cloud-based DevOps tools using Azure DevOps	Understand

COURSE ARTICULATION MATRIX

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

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

22ALH208	PRINCIPLES OF PROGRAMMING LANGUAGES				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To understand and describe syntax and semantics of programming languages
2	To understand data, data types, and basic statements
3	To understand call-return architecture and ways of implementing them
4	To understand object-orientation, concurrency, and event handling in programming languages
5	To develop programs in non-procedural programming paradigms

UNIT I	**SYNTAX AND SEMANTICS**	**9**	**0**	**0**	**9**

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing

UNIT II	**DATA, DATA TYPES, AND BASIC STATEMENTS**	**9**	**0**	**0**	**9**

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT III	**SUBPROGRAMS AND IMPLEMENTATIONS**	**9**	**0**	**0**	**9**

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping.

UNIT IV	**OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING**	**9**	**0**	**0**	**9**

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling

UNIT V	**FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES**	**9**	**0**	**0**	**9**

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

Total (45 L) =45 Periods

Text Books:

1	Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.
2	Michael L. Scott, “Programming Language Pragmatics”, Fourth Edition, Elsevier, 2018
3	R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, Prentice Hall, 2011.
4	Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Pearson, 1997.
5	W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe syntax and semantics of programming languages	Remember
CO2	Explain data, data types, and basic statements of programming languages	Understand
CO3	Design and implement subprogram constructs	Apply
CO4	Apply object-oriented, concurrency, and event handling programming constructs and Develop programs in Scheme, ML, and Prolog	Apply
CO5	Understand and adopt new programming languages	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	2	1	-	-	-	-	-	-	3	2	2
CO 2	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO 3	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO 4	3	3	3	3	2	2	-	-	-	-	-	-	2	2
CO 5	3	3	3	3	3	3	2	2	1	3	1	3	2	2
Avg	**2.8**	**2.8**	**3**	**2.4**	**2**	**2.5**	**2**	**2**	**1**	**3**	**1**	**3**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH301	CLOUD COMPUTING					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To understand the principles of cloud architecture, models and infrastructure.
2	To understand the concepts of virtualization and virtual machines.
3	To gain knowledge about virtualization Infrastructure
4	To explore and experiment with various Cloud deployment environments.
5	To learn about the security issues in the cloud environment.

UNIT I	**CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE**	**9**	**0**	**0**	**9**
Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges					
UNIT II	**VIRTUALIZATION BASICS**	**9**	**0**	**0**	**9**
Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.					
UNIT III	**VIRTUALIZATION INFRASTRUCTURE AND DOCKER**	**9**	**0**	**0**	**9**
Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.					
UNIT IV	**CLOUD DEPLOYMENT ENVIRONMENT**	**9**	**0**	**0**	**9**
Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.					
UNIT V	**CLOUD SECURITY**	**9**	**0**	**0**	**9**
Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.					
Total (45 L) =45 Periods					

Text Books:	
1	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2	James Turnbull, "The Docker Book", O'Reilly Publishers, 2014
3	Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

Reference Books:	
1	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the design challenges in the cloud.	Understand
CO2	Apply the concept of virtualization and its types	Apply
CO3	Experiment with virtualization of hardware resources and Docker	Apply
CO4	Develop and deploy services on the cloud and set up a cloud environment.	Create
CO5	Explain security challenges in the cloud environment	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	2	1	1	1	-	-	-	2	3	1	3	2	2
CO 2	3	1	2	2	1	-	-	-	1	2	1	3	2	2
CO 3	2	3	2	3	1	-	-	-	3	1	1	3	2	2
CO 4	1	2	3	3	3	-	-	-	3	3	1	2	2	2
CO 5	2	3	3	1	3	-	-	-	2	2	1	2	2	2
Avg	**2.2**	**2.2**	**2.2**	**2**	**1.8**	**-**	**-**	**-**	**2.2**	**2.2**	**1**	**2.6**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH302	VIRTUALIZATION				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To Learn the basics and types of Virtualization
2	To understand the Hypervisors and its types.
3	To Explore the Virtualization Solutions
4	To Experiment the virtualization platforms

UNIT I	**INTRODUCTION TO VIRTUALIZATION**	**9**	**0**	**0**	**9**

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisor

UNIT II	**SERVER AND DESKTOP VIRTUALIZATION**	**9**	**0**	**0**	**9**

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform- Desktop Virtualization-Types of Desktop Virtualization

UNIT III	**NETWORK VIRTUALIZATION**	**9**	**0**	**0**	**9**

Introduction to Network Virtualization-Advantages- Functions-Tools for Network VirtualizationVLAN-WAN Architecture-WAN Virtualization

UNIT IV	**STORAGE VIRTUALIZATION**	**9**	**0**	**0**	**9**

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID.

UNIT V	**VIRTUALIZATION TOOLS**	**9**	**0**	**0**	**9**

VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.

Total (45 L) =45 Periods

Text Books:

1	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3	David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
4	Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.
5	James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
6	David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Analyse the virtualization concepts and Hypervisor	Analyze
CO2	Apply the Virtualization for real-world applications	Apply
CO3	Install & Configure the different VM platforms	Apply
CO4	Experiment with the VM with various software	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	3	1	3	2	-	-	-	1	1	3	1	2	2
CO 2	3	2	2	1	2	-	-	-	1	2	2	3	2	2
CO 3	3	2	1	3	1	-	-	-	2	2	1	3	2	2
CO 4	1	1	2	3	3	-	-	-	3	3	1	1	2	2
CO 5	1	3	2	3	1	-	-	-	2	1	3	3	2	2
Avg	**1.8**	**2.2**	**1.6**	**2.6**	**1.8**	**-**	**-**	**-**	**1.8**	**1.8**	**2**	**2.2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH303	CLOUD SERVICES MANAGEMENT				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Introduce Cloud Service Management terminology, definition & concepts
2	Compare and contrast cloud service management with traditional IT service management
3	Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
4	Select appropriate structures for designing, deploying and running cloud-based services in a business environment
5	Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

UNIT I	**CLOUD SERVICE MANAGEMENT FUNDAMENTALS**	**9**	**0**	**0**	**9**

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

UNIT II	**CLOUD SERVICES STRATEGY**	**9**	**0**	**0**	**9**

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III	**CLOUD SERVICE MANAGEMENT**	**9**	**0**	**0**	**9**

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT IV	**CLOUD SERVICE ECONOMICS**	**9**	**0**	**0**	**9**

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT V	**CLOUD SERVICE GOVERNANCE & VALUE**	**9**	**0**	**0**	**9**

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

Total (45 L) =45 Periods

Text Books:

1	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

Reference Books:

1	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.	Remember
CO2	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services	Understand
CO3	Solve the real world problems using Cloud services and technologies	Apply
CO4	Understand the pricing model of cloud.	Understand
CO5	Understand the Cloud service Governance and value	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	1	1	1	-	-	-	2	1	3	2	2	2
CO 2	3	1	2	3	2	-	-	-	1	2	3	1	2	2
CO 3	1	1	3	1	3	-	-	-	3	3	1	1	2	2
CO 4	1	1	1	2	3	-	-	-	2	3	3	1	2	2
CO 5	1	3	3	2	2	-	-	-	1	3	1	2	2	2
Avg	**1.8**	**1.8**	**2**	**1.8**	**2.2**	**-**	**-**	**-**	**1.8**	**2.4**	**2.2**	**1.4**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH304	DATA WAREHOUSING				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To know the details of data warehouse Architecture
2	To understand the OLAP Technology
3	To understand the partitioning strategy
4	To differentiate various schema
5	To understand the roles of process manager & system manager

UNIT I	INTRODUCTION TO DATA WAREHOUSE	9	0	0	9

Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse

UNIT II	ETL AND OLAP TECHNOLOGY	9	0	0	9

What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP

UNIT III	META DATA, DATA MART AND PARTITION STRATEGY	9	0	0	9

Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition

UNIT IV	DIMENSIONAL MODELING AND SCHEMA	9	0	0	9

Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools

UNIT V	SYSTEM & PROCESS MANAGERS	9	0	0	9

Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing

Total (45 L) =45 Periods

Text Books:

1	Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2	Ralph Kimball, “The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling”, Third edition, 2013

Reference Books:

1	Paul Raj Ponniah, “Data warehousing fundamentals for IT Professionals”, 2012.
2	K.P. Soman, ShyamDiwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Design data warehouse architecture for various Problems	Create
CO2	Apply the OLAP Technology	Apply
CO3	Analyse the partitioning strategy	Analyze
CO4	Critically analyze the differentiation of various schema for given problem	Analyze
CO5	Frame roles of process manager & system manager	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	2	2	-	-	-	3	-	-	3	2	2
CO 2	3	2	2	2	3	-	-	-	2	-	2	2	2	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	3	2	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	3	2	2
CO 5	3	2	2	2	-	2	-	-	-	-	2	2	2	2
Avg	**3**	**2.6**	**2.6**	**1.2**	**2.5**	**2**	**-**	**-**	**2.5**	**-**	**2**	**2.6**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH305	STORAGE TECHNOLOGIES				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Characterize the functionalities of logical and physical components of storage
2	Describe various storage networking technologies
3	Identify different storage virtualization technologies
4	Discuss the different backup and recovery strategies
5	Understand common storage management activities and solutions

UNIT I	**STORAGE SYSTEMS**	**9**	**0**	**0**	**9**

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT II	**INTELLIGENT STORAGE SYSTEMS AND RAID**	**9**	**0**	**0**	**9**

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scaleout storage Architecture.

UNIT III	**STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION**	**9**	**0**	**0**	**9**

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT IV	**BACKUP, ARCHIVE AND REPLICATION**	**9**	**0**	**0**	**9**

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V	**SECURING STORAGE INFRASTRUCTURE**	**9**	**0**	**0**	**9**

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

Total (45 L) =45 Periods

Text Books:

1	EMC Corporation, Information Storage and Management, Wiley, India
2	Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017
3	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein ,Storage Networks Explained, Second Edition, Wiley, 2009

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment	Remember
CO2	Illustrate the usage of advanced intelligent storage systems and RAID	Apply
CO3	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization	Analyze
CO4	Examine the different role in providing disaster recovery and remote replication technologies	Analyze
CO5	Infer the security needs and security measures to be employed in information storage management	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	1	3	3	-	-	-	1	1	1	3	2	2
CO 2	3	1	2	3	3	-	-	-	3	2	3	2	2	2
CO 3	1	1	3	2	2	-	-	-	3	1	1	2	2	2
CO 4	3	2	1	2	2	-	-	-	1	1	3	1	2	2
CO 5	1	3	2	1	2	-	-	-	1	2	3	1	2	2
Avg	**1.8**	**1.8**	**1.8**	**2.2**	**2.4**	**-**	**-**	**-**	**1.8**	**1.4**	**2.2**	**1.8**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH306	SOFTWARE DEFINED NETWORKS					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the need for SDN and its data plane operations
2	To understand the functions of control plane
3	To comprehend the migration of networking functions to SDN environment
4	To explore various techniques of network function virtualization
5	To comprehend the concepts behind network virtualization

UNIT I	**SDN: INTRODUCTION**	**9**	**0**	**0**	**9**

Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane

UNIT II	**SDN DATA PLANE AND CONTROL PLANE**	**9**	**0**	**0**	**9**

Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers.

UNIT III	**SDN APPLICATIONS**	**9**	**0**	**0**	**9**

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking

UNIT IV	**NETWORK FUNCTION VIRTUALIZATION**	**9**	**0**	**0**	**9**

Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture

UNIT V	**NFV FUNCTIONALITY**	**9**	**0**	**0**	**9**

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV

Total (45 L) =45 Periods

Text Books:

1	William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1 Edition, 2015.

Reference Books:

1	Ken Gray, Thomas D. Nadeau, “Network Function Virtualization”, Morgan Kauffman, 2016
2	Thomas D Nadeau, Ken Gray, “SDN: Software Defined Networks”, O’Reilly Media, 2013.
3	Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, 1st Edition, CRC Press, 2014.
4	Paul Goransson, Chuck Black Timothy Culver, “Software Defined Networks: A Comprehensive Approach”, 2nd Edition, Morgan Kaufmann Press, 2016
5	Oswald Coker, Siamak Azodolmolky, “Software-Defined Networking with OpenFlow”, 2nd Edition, O’Reilly Media, 2017.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Describe the motivation behind SDN	Remember
CO2	Identify the functions of the data plane and control plane	Apply
CO3	Design and develop network applications using SDN	Create
CO4	Orchestrate network services using NFV	Analyze
CO5	Explain various use cases of SDN and NFV	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	1	2	3	1	3	-	-	-	2	3	1	3	2	2
CO 2	2	1	2	2	3	-	-	-	2	2	2	2	2	2
CO 3	2	2	2	3	3	-	-	-	3	1	1	2	2	2
CO 4	2	2	2	3	1	-	-	-	1	3	1	2	2	2
CO 5	3	3	1	1	3	-	-	-	1	2	1	2	2	2
Avg	**2**	**2**	**2**	**2**	**2.6**	**-**	**-**	**-**	**1.8**	**2.2**	**1.2**	**2.2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH307	STREAM PROCESSING				
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
3	Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing

Reference Books:	
1	https://spark.apache.org/docs/latest/streaming-programming-guide.html
2	Kafka.apache.org

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the applicability and utility of different streaming algorithms.	Understand
CO2	Describe and apply current research trends in data-stream processing.	Remember
CO3	Analyze the suitability of stream mining algorithms for data stream systems.	Analyze
CO4	Program and build stream processing systems, services and applications.	Create
CO5	Solve problems in real-world applications that process data streams.	Analyze

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	3	1	-	-	-	2	3	1	2	2	2
CO 2	2	1	1	2	2	-	-	-	3	2	2	3	2	2
CO 3	3	1	2	3	3	-	-	-	2	2	1	1	2	2
CO 4	2	1	3	3	3	-	-	-	3	3	1	1	2	2
CO 5	3	3	1	2	2	-	-	-	3	3	2	3	2	2
Avg	**2.6**	**1.8**	**1.8**	**2.6**	**2.2**	**-**	**-**	**-**	**2.6**	**2.6**	**1.4**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH308	SECURITY AND PRIVACY IN CLOUD				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To Introduce Cloud Computing terminology, definition & concepts
2	To understand the security design and architectural considerations for Cloud
3	To understand the Identity, Access control in Cloud
4	To follow best practices for Cloud security using various design patterns
5	To be able to monitor and audit cloud applications for security

UNIT I	**FUNDAMENTALS OF CLOUD SECURITY CONCEPTS**	**9**	**0**	**0**	**9**
Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures					
UNIT II	**SECURITY DESIGN AND ARCHITECTURE FOR CLOUD**	**9**	**0**	**0**	**9**
Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key					
UNIT III	**ACCESS CONTROL AND IDENTITY MANAGEMENT**	**9**	**0**	**0**	**9**
Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention					
UNIT IV	**CLOUD SECURITY DESIGN PATTERNS**	**9**	**0**	**0**	**9**
Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud					
UNIT V	**MONITORING, AUDITING AND MANAGEMENT**	**9**	**0**	**0**	**9**
Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management					
Total (45 L) =45 Periods					

Text Books:	
1	Raj Kumar Buyya , James Broberg, andrzejGoscinski, “Cloud Computing:‖, Wiley 2013
2	Dave shackleford, “Virtualization Security‖, SYBEX a wiley Brand 2013.
3	Mather, Kumaraswamy and Latif, “Cloud Security and Privacy‖, OREILLY 2011
Reference Books:	
1	Mark C. Chu-Carroll “Code in the Cloud‖,CRC Press, 2011
2	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the cloud concepts and fundamentals.	Understand
CO2	Explain the security challenges in the cloud.	Understand
CO3	Define cloud policy and Identity and Access Management.	Remember
CO4	Understand various risks and audit and monitoring mechanisms in the cloud.	Understand
CO5	Define the various architectural and design considerations for security in the cloud.	Remember

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	1	2	-	-	-	1	1	1	3	2	2
CO 2	1	3	2	3	1	-	-	-	2	2	3	2	2	2
CO 3	3	2	2	3	2	-	-	-	3	1	1	2	2	2
CO 4	2	1	2	3	3	-	-	-	3	2	3	3	2	2
CO 5	1	3	3	1	1	-	-	-	2	3	3	2	2	2
Avg	**2**	**2.4**	**2.4**	**2.2**	**1.8**	**-**	**-**	**-**	**2.2**	**1.8**	**2.2**	**2.4**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH401	CYBER PHYSICAL SYSTEMS					
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			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.	Apply
CO2	Present solution to automated systems to make life easier.	Understand
CO3	Apply concepts of embedded systems and microcontroller to enhance existing systems	Apply
CO4	Ability to develop concepts, logics towards solving a unknown problem in research and industry..	Understand
CO5	Describe cyber physical systems applications	Remember

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	2	1	-	-	-	1	2	2	1	2	2
CO 2	1	2	1	2	1	-	-	-	2	2	1	1	2	2
CO 3	2	2	3	3	1	-	-	-	1	2	1	2	2	2
CO 4	2	1	1	2	1	-	-	-	1	3	3	3	2	2
CO 5	2	3	1	1	2	-	-	-	2	1	1	1	2	2
Avg	**1.8**	**2**	**1.8**	**2**	**1.2**	**-**	**-**	**-**	**1.4**	**2**	**1.6**	**1.6**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH402	ETHICAL HACKING				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics of computer based vulnerabilities.
2	To explore different foot printing, reconnaissance and scanning methods.
3	To expose the enumeration and vulnerability analysis methods.
4	To understand hacking options available in Web and wireless applications
5	To explore the options for network protection.
6	To practice tools to perform ethical hacking to expose the vulnerabilities.

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

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware – Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

UNIT II	**FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS**	**9**	**0**	**0**	**9**

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT III	**ENUMERATION AND VULNERABILITY ANALYSIS**	**9**	**0**	**0**	**9**

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

UNIT IV	**SYSTEM HACKING**	**9**	**0**	**0**	**9**

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade

UNIT V	**NETWORK PROTECTION SYSTEMS**	**9**	**0**	**0**	**9**

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

Total (45 L) =45 Periods

Text Books:

1	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

Reference Books:

1	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Express knowledge on basics of computer based vulnerabilities.	Remember
CO2	Gain understanding on different foot printing, reconnaissance and scanning methods	Understand
CO3	Demonstrate the enumeration and vulnerability analysis methods.	Remember
CO4	Gain knowledge on hacking options available in Web and wireless applications.	Understand
CO5	Acquire knowledge on the options for network protection	Remember
CO6	Use tools to perform ethical hacking to expose the vulnerabilities	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	2	3	2	1	-	-	-	1	2	2	1	2	2
CO 2	1	2	1	2	1	-	-	-	2	2	1	1	2	2
CO 3	2	2	3	3	1	-	-	-	1	2	1	2	2	2
CO 4	2	1	1	2	1	-	-	-	1	3	3	3	2	2
CO 5	2	3	1	1	2	-	-	-	2	1	1	1	2	2
Avg	**1.8**	**2**	**1.8**	**2**	**1.2**	**-**	**-**	**-**	**1.4**	**2**	**1.6**	**1.6**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH403	DIGITAL AND MOBILE FORENSICS				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand basic digital forensics and techniques..
2	To understand digital crime and investigation.
3	To understand how to be prepared for digital forensic readiness.
4	To understand and use forensics tools for iOS devices
5	To understand and use forensics tools for Android devices.

UNIT I	**INTRODUCTION TO DIGITAL FORENSICS**	**9**	**0**	**0**	**9**

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase

UNIT II	**DIGITAL CRIME AND INVESTIGATION**	**9**	**0**	**0**	**9**

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence

UNIT III	**DIGITAL FORENSIC READINESS**	**9**	**0**	**0**	**9**

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics

UNIT IV	**iOS FORENSICS**	**9**	**0**	**0**	**9**

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud

UNIT V	**ANDROID FORENSICS**	**9**	**0**	**0**	**9**

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling

Total (45L) = 45 Periods

Text Books:

1	Andre Arnes, “Digital Forensics”, Wiley, 2018.
2	Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.

Reference Books:

1	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

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

COURSE ARTICULATION MATRIX

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

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

22ALH404	SOCIAL NETWORK SECURITY				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To develop semantic web related simple applications
2	To explain Privacy and Security issues in Social Networking
3	To explain the data extraction and mining of social networks
4	To discuss the prediction of human behavior in social communities
5	To describe the Access Control, Privacy and Security management of social networks.

UNIT I	**FUNDAMENTALS OF SOCIAL NETWORKING**	**9**	**0**	**0**	**9**

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security

UNIT II	**SECURITY ISSUES IN SOCIAL NETWORKS**	**9**	**0**	**0**	**9**

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world

UNIT III	**EXTRACTION AND MINING IN SOCIAL NETWORKING DATA**	**9**	**0**	**0**	**9**

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy

UNIT IV	**PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES**	**9**	**0**	**0**	**9**

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties.

UNIT V	**ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT**	**9**	**0**	**0**	**9**

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network,Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning

Total (45 L) =45 Periods

Text Books:

1	Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2	BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3	Learning Neo4j 3.x Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing
4	David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World, First Edition, Cambridge University Press, 2010.

Reference Books:	
1	Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World, Cambridge University Press, 2010
2	Jackson, Matthew O., Social and Economic Networks, Princeton University Press, 2008.
3	GuandongXu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
4	Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
5	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling, IGI Global Snippet, 2009
6	John G. Breslin, Alexander Passant and Stefan Decker, The Social Semantic Web, Springer, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop semantic web related simple applications	Apply
CO2	Address Privacy and Security issues in Social Networking	Remember
CO3	Explain the data extraction and mining of social networks	Understand
CO4	Discuss the prediction of human behavior in social communities	Understand
CO5	Describe the applications of social networks	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	1	2	3	2	-	-	-	3	2	1	2	2	2
CO 2	2	2	2	3	3	-	-	-	1	2	2	3	2	2
CO 3	2	1	1	3	2	-	-	-	1	2	1	1	2	2
CO 4	3	3	3	3	3	-	-	-	1	1	1	1	2	2
CO 5	1	3	2	2	2	-	-	-	1	1	3	1	2	2
Avg	**2.2**	**2**	**2**	**2.8**	**2.2**	**-**	**-**	**-**	**1.4**	**1.6**	**1.6**	**1.6**	**2**	**2**

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

22ALH405	MODERN CRYPTOGRAPHY				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	To learn about Modern Cryptography
2	To focus on how cryptographic algorithms and protocols work and how to use them.
3	To build a Pseudorandom permutation.
4	To construct Basic cryptanalytic techniques.
5	To provide instruction on how to use the concepts of block ciphers and message authentication codes.

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

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II	**FORMAL NOTIONS OF ATTACKS**	**9**	**0**	**0**	**9**

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NMCCA2, Inter-relations among the attack model

UNIT III	**RANDOM ORACLES**	**9**	**0**	**0**	**9**

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)

UNIT IV	**BUILDING A PSEUDORANDOM PERMUTATION**	**9**	**0**	**0**	**9**

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT V	**MESSAGE AUTHENTICATION CODES**	**9**	**0**	**0**	**9**

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.

Total (45 L) =45 Periods

Text Books:

1	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)

Reference Books:

1	ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2	OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3	William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd Edition, 2006.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Interpret the basic principles of cryptography and general cryptanalysis.	Understand
CO2	Determine the concepts of symmetric encryption and authentication.	Remember
CO3	Identify the use of public key encryption, digital signatures, and key establishment.	Apply
CO4	Articulate the cryptographic algorithms to compose build and analyze simple cryptographic solutions.	Understand
CO5	Express the use of Message Authentication Codes	Understand

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	3	1	-	-	-	2	1	1	2	2	2
CO 2	1	3	2	1	2	-	-	-	3	2	2	2	2	2
CO 3	1	1	2	3	2	-	-	-	1	1	1	3	2	2
CO 4	3	1	2	1	3	-	-	-	3	2	1	2	2	2
CO 5	2	3	3	3	3	-	-	-	3	1	1	1	2	2
Avg	**2**	**2.2**	**2.4**	**2.2**	**2.2**	**-**	**-**	**-**	**2.4**	**1.4**	**1.2**	**2**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH406	ENGINEERING SECURE SOFTWARE SYSTEMS				
PREREQUISITES	**Category**	**PE**	**Credit**		**3**
	Hours/Week	**L**	**T**	**P**	**TH**
		3	**0**	**0**	**3**

Course Learning Objectives

1	Know the importance and need for software security.
2	Know about various attacks.
3	Learn about secure software design.
4	Understand risk management in secure software development.
5	Know the working of tools related to software security.

UNIT I	NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS	9	0	0	9

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory- Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

UNIT II	SECURE SOFTWARE DESIGN	9	0	0	9

Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UNIT III	SECURITY RISK MANAGEMENT	9	0	0	9

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV	SECURITY TESTING	9	0	0	9

Traditional Software Testing – Comparison - Secure Software Development Life Cycle – Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT V	SECURE PROJECT MANAGEMENT	9	0	0	9

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

Total (45 L) =45 Periods

Text Books:

1	Julia H. Allen, “Software Security Engineering”, Pearson Education, 2008.
2	Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011
3	Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006

Reference Books:	
1	Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional 2005.
2	Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3	Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4	Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012
5	Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012
6	Jason Grembi, "Developing Secure Software"

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Identify various vulnerabilities related to memory attacks	Apply
CO2	Apply security principles in software development	Apply
CO3	Evaluate the extent of risks. .	Evaluate
CO4	Involve selection of testing techniques related to software security in the testing phase of software development. .	Understand
CO5	Use tools for securing software.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	2	3	2	3	2	-	-	-	2	1	2	2	2	2
CO 2	2	2	2	3	3	-	-	-	2	1	2	2	2	2
CO 3	1	2	2	2	1	-	-	-	1	1	2	1	2	2
CO 4	2	3	2	2	2	-	-	-	2	1	2	2	2	2
CO 5	2	1	2	2	3	-	-	-	2	1	1	2	2	2
Avg	**1.8**	**2.2**	**2**	**2.4**	**2.2**	**-**	**-**	**-**	**1.8**	**1**	**1.8**	**1.8**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														

22ALH407	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics of Blockchain
2	To learn Different protocols and consensus algorithms in Blockchain
3	To learn the Blockchain implementation frameworks.
4	To understand the Blockchain Applications
5	To experiment the Hyperledger Fabric, Ethereum networks

UNIT I	**INTRODUCTION TO BLOCKCHAIN**	**9**	**0**	**0**	**9**

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic –Hash Function, Properties of a hash function-Hash pointer and Merkle tree

UNIT II	**BITCOIN AND CRYPTOCURRENCY**	**9**	**0**	**0**	**9**

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT III	**BITCOIN CONSENSUS**	**9**	**0**	**0**	**9**

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

UNIT IV	**HYPERLEDGER FABRIC & ETHEREUM**	**9**	**0**	**0**	**9**

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V	**BLOCKCHAIN APPLICATIONS**	**9**	**0**	**0**	**9**

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

Total (45 L) =45 Periods

Text Books:

1	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2	Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

Reference Books:

1	Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.
2	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3	Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015

4	Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing
5	Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand emerging abstract models for Blockchain Technology	Understand
CO2	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.	Apply
CO3	Provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.	Understand
CO4	Apply hyper ledger Fabric and Ethereum platform to implement the Block chain Application.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	2	1	-	-	-	1	-	-	2	2	2
CO 2	3	3	3	3	1	-	-	-	2	-	-	2	2	2
CO 3	3	3	3	3	2	-	-	-	3	-	-	2	2	2
CO 4	3	2	3	2	3	-	-	-	3	-	-	2	2	2
Avg	**3**	**2.75**	**2.75**	**2.5**	**1.75**	**-**	**-**	**-**	**2.25**	**-**	**-**	**2**	**2**	**2**

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

22ALH408	CYBER SECURITY				
PREREQUISITES		**Category**	**PE**	**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To Learn the basics of computer forensics
2	To be familiar with forensics tools
3	To Learn to analyze and validate forensics data.
4	To Expose how to evaluate the security and how to identify vulnerabilities in systems.
5	To learn how to detect a cyb er attack.

UNIT I	**INTRODUCTION TO COMPUTER FORENSICS**	**9**	**0**	**0**	**9**

Introduction to Traditional Computer Crime-Traditional problems associated with Computer Crime-Introduction to Identity Theft & Identity Fraud- Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II	**EVIDENCE COLLECTION AND FORENSICS TOOLS**	**9**	**0**	**0**	**9**

Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT III	**ANALYSIS AND VALIDATION**	**9**	**0**	**0**	**9**

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

UNIT IV	**ETHICAL HACKING**	**9**	**0**	**0**	**9**

Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing

UNIT V	**INTRUSION DETECTION**	**9**	**0**	**0**	**9**

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

Total (45L) = 45 Periods

Text Books:

1	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2	Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021
3	CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015

Reference Books:

1	John R.Vacca, ―Computer Forensics‖, Cengage Learning, 2005
2	MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3	William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015
4	AnkitFadia ― Ethical Hacking‖ Second Edition, Macmillan India Ltd, 2006
5	Kenneth C.Brancik ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group– 2008.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the basic concepts of computer forensics	Understand
CO2	Apply a number of different computer forensic tools for various crime and incident scenes	Apply
CO3	Choose appropriate technique to validate forensics data	Understand
CO4	Identify the vulnerabilities in a given network infrastructure and the role of ethical hacking	Apply
CO5	Apply intrusion techniques to detect intrusion.	Apply

COURSE ARTICULATION MATRIX														
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	2	2	2	-	-	-	2	1	2	1	2	2
CO 2	1	1	3	2	2	-	-	-	2	2	1	1	2	2
CO 3	1	2	1	1	2	-	-	-	3	3	1	3	2	2
CO 4	2	2	3	2	3	-	-	-	3	3	2	1	2	2
CO 5	2	1	3	2	2	-	-	-	2	1	1	3	2	2
Avg	**1.8**	**1.8**	**2.4**	**1.8**	**2.2**	**-**	**-**	**-**	**2.4**	**2**	**1.4**	**1.8**	**2**	**2**
3 / 2 /1 - indicates strength of correlation (3- High, 2- Medium, 1- Low)														