PSN College of Engineering and Technology

B.E. - Computer Science and Engineering (Artificial Intelligence and Machine Learning)

R 2022- Curriculum and Syllabus (I to VIII Semester)

PSN COLLEGE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution Recognised by AICTE, New Delhi
and Affiliated to Anna University, Chennai)
Accredited with A+ Grade by NAAC. An ISO 9001:2015 Certified Institution
Melathediyoor, Tirunelveli – 627 152

REGULATIONS – R2022 (Full Time)

B.E CSE (Artificial Intelligence and Machine Learning)

INDEX

Vision and Mission of the Institute

Vision

Emerge as a pioneer institute inculcating engineering education and skills, research, values and ethics.

Mission

- **To achieve greater heights of excellence in technical knowledge and skill development through innovative teaching and learning practices.**
- **To develop the state of art infrastructure to meet the demands of technological revolution.**
- **To improve and foster research in all dimensions for betterment of society.**
- **To develop individual competencies to enhance innovation, employability and entrepreneurship among students.**
- **To instill higher standards of discipline among students, inculcating ethical and moral values for societal harmony and peace**

Vision and Mission of the Department

Vision

To provide High-quality technical education that empowers professional to meet and overcome global technological challenges in the field of Artificial Intelligence and Machine Learning

Mission

1. To impart quality education and hands-on training in Artificial Intelligence and Machine Learning through innovative teaching, research, and industry collaboration.
2. To foster creativity ,ethical values , and lifelong learning among students to address global technological and societal challenges
3. To develop globally competent professionals equipped with the knowledge and skills necessary for sustainable technological advancement and national development

Program Outcomes (POs)

PO's No	KNOWLEDGE	STATEMENTS
1	Engineering Knowledge:	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem Analysis:	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design / Development of Solutions:	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct Investigations of Complex Problems:	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	Modern Tool usage:	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an UN 2 of the limitations.
6	The Engineer and Society:	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	Environment and Sustainability:	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics:	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and Team Work:	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication:	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project Management and Finance:	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long Learning:	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

S.No	Topic	PEOs
PEO1	**Core Competence and Technical Expertise**	Graduates will apply advanced mathematical and computational principles to **design, develop, and deploy intelligent systems** using emerging technologies across multidisciplinary domains.
PEO2	**Innovation, Research, and Lifelong Learning**	Graduates will engage in **innovation, research, and continuous learning**, adapting to the **evolving trends in AI, data science, and automation**, while contributing to **knowledge creation and Interdisciplinary Collaboration**.
PEO3	**Societal Impact and Entrepreneurship**	Graduates will leverage AI and ML knowledge to **address societal challenges, promote sustainability**, and demonstrate **entrepreneurial and leadership capabilities** that foster innovation, community well-being and global changes

Program Specific Outcomes (PSOs)

Graduating student shall be able to:

PSO1	Graduates will be able to **design and implement intelligent systems** using core Artificial Intelligence concepts- such as **knowledge representation, reasoning, search techniques, intelligent agents, and AI-based decision-making** to develop smart applications in areas like automation, smart cities, robotics, and healthcare
PSO2	Graduates will be able to **build, train, evaluate, and optimize Machine Learning models** using **supervised, unsupervised, and deep learning techniques**, apply statistical and data analytics methods, and deploy ML solutions for predictive analysis, pattern recognition, and real-world problem-solving.
PSO3	Graduates will be able to **apply strong computer science fundamentals-** including **programming, data structures, algorithms, operating systems, databases, computer networks, and software engineering principles** to develop **secure, scalable, and efficient software systems** that support AI–ML applications

PSN COLLEGE OF ENGINEERING AND TECHNOLOGY

BE-CSE(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

III To VIII SEMESTER

(Applicable to students those who are admitted from AY 2024-25)

Sl.No	Course code	Course Name	Category		L	T	P	C
1	IC610001	Professional English I	ICC	Theory	2	0	0	2
2	IC610002	Matrices and Calculus	ICC	Theory	2	1	0	3
3	IC610003	Engineering Physics	ICC	Theory	3	0	0	3
4	IC610004	Engineering Chemistry	ICC	Theory	3	0	0	3
5	CS610005	Problem Solving and 'C' Programming	ICC	Theory	3	0	0	3
6	ME610006	Engineering Graphics with CAD	ICC	Theory with Practical Component	2	0	2	3
7	IP610101	Physics & Chemistry Laboratory	ICC	Practical	0	0	3	1.5
8	IP610102	Programming in 'C' Laboratory	ICC	Practical	0	0	3	1.5
9		NCC/NSS/NSO *	IMC	Institute Mandatory	1*	0	0	0
10	IC610007	Tamil marabu/Heritage of Tamil	ICC	Theory	1	0	0	1
		Total			16	1	8	21

SEMESTER-II

11	IC620008	Professional English II	ICC	Theory with Practical Component	2	0	2	3
12	IC620009	Transforms & Partial Differential Equations	ICC	Theory	2	1	0	3
13	IC620010	Engineering Materials (for Non Circuit Branches)	ICC	Theory	3	0	0	3
	IC620011	Semiconductor Physics(for Circuit Branches)			3	0	0	
14	ME620012	Engineering Mechanics(for Non Circuit Branches)	PCC	Theory	3	0	0	3
	CS620013	Fundamentals of Artificial Intelligence (for Circuit Branches)			3	0	0	

15	CS620014	Python Programming	ICC	Theory	3	0	0	3
16	EE620015	Basic Engineering	ICC	Theory	3	0	0	3
17	IP620103	Python Laboratory	ICC	Practical	0	0	3	1.5
18	IP620104	Engineering practice laboratory	ICC	Practical	0	0	3	1.5
19	IM610401	Environmental Studies	IMC	Institute Mandatory	2*	0	0	0
20	IC620016	Tamils and technology	ICC	Theory	1	0	0	1
		Total			17	1	8	22

SEMESTER-III

Sl. No	Course code	Course Name	Classifi cation		L	T	P	C
21	IC630017	Numerical Methods and Statistics	IC	Theory	3	0	0	3
22	AM630201	Introduction to Analysis of Algorithms	PC	Theory	3	0	0	3
23	CS630202	Data Structures using C++	PC	Theory	3	0	0	3
24	CS630203	Database Management Systems	PC	Theory	3	0	0	3
25	CS630204	Operating Systems	PC	Theory with Practic al Component	2	0	2	3
26	CS606401	Introduction to Internet of Things (Professional elective-1)	PE	Theory	3	0	0	3
27	CS630301	Data Structures using C++ laboratory	PC	Practical	0	0	3	1.5
28	CS630302	Database Management System laboratory	PC	Practical	0	0	3	1.5
29	CS630501	Integrated Aptitude Skills - I (Lower)	EEC	Skill Based Cours e	0	0	1*	0.5
30	IM630402	Universal Human Values	IM	Institute Mandator y	2*	0	0	0
		Total			17	0	8	21
	SEMESTER-IV							
31	IC640018	Boundary value problems and probability distributions	IC	Theory	3	0	0	3
32	AM640202	Data Science Essentials	PC	Theory	3	0	0	3
33	CS640205	Object Oriented Programming using JAVA	PC	Theory	3	0	0	3
34	AM640203	Artificial Intelligence and Reasoning	PC	Theory with Practical Component	2	0	2	3

35		Professional elective-2	PE	Practical	3	0	0	3
36		Institute elective -1	IE	Theory	3	0	0	3
37	CS640303	Java Programming laboratory	PC	Practical	0	0	3	1.5
38	AM640301	Data Science Laboratory	PC	Practical	0	0	3	1.5
39	CS640502	Integrated Aptitude Skills - II (Lower)	EEC	Skill Based Course	0	0	1*	0.5
40		Implant Training (2 Weeks)	IM	Institute Mandatory	2*	0	0	0
		Total			17	0	8	21
	SEMESTER-V							
41	CS650207	Computer Networks and Management	PC	Theory with Practical Component	2	0	0	3
42	AM650204	Artificial Intelligence Technique	PC	Theory	3	0	0	3
43	AD650208	Data Warehousing and Data Mining	PC	Theory	3	0	0	3
44		Institute elective -2	IE	Theory	3	0	0	3
45		Professional elective-3	PE	Theory	3	0	0	3
46		Professional elective-4	PE	Theory	3	0	0	3
47	AM650302	Artificial Intelligence Techniques Lab	PC	Practical	0	0	3	1.5
48	AD650305	Data Warehousing and Data Mining lab	PC	Practical	0	0	3	1.5
49	CS650503	Integrated Aptitude Skills - I (Higher)	EEC	Skill Based Course	0	0	2	1
50	CS650801A	Introduction to Quantum Computing	PM	Programme Mandatory	2*	0	0	0
		Total			17	0	8	21
	SEMESTER-VI							
51	AD660212	Mongo DB	PC	Theory with Practical Component	2	0	4	3
52	AM660205	Data Analytics	PC	Theory	3	0	0	3
53	CS660212	Machine Learning	PC	Theory	3	0	0	3
54		Institute elective -3	IE	Theory	3	0	0	3
55		Professional elective-5	PE	Theory	3	0	0	3
56		Professional elective-6	PE	Theory	3	0	0	3
57	AM660303	Data Analytics Laboratory	PC	Practical	0	0	3	1.5
58	CS660308	Machine Learning Laboratory	PC	Practical	0	0	3	1.5

59	AD660504	Training with AI Tools	EEC	Skill Based Course	0	0	2	1
60	IM660403	Professional Ethics	IM	Institute Mandatory	2*	0	0	0
61		Internship	IM	Institute Mandatory				0
		Total			17	0	8	21

SEMESTER-VII

62	AM670206	Data Visualization and Automation	PC	Theory	3	0	0	3
63	AD670213	Deep Learning	PC	Theory	3	0	0	3
64	AM670207	Computer Vision	PC	Theory with Practical	2	0	2	3
65		Institute elective -3	IE	Theory	3	0	0	3
66		Professional elective-7	PE	Theory	3	0	0	3
67		Professional elective-8	PE	Theory	3	0	0	3
68	AM670304	Data Visualization and Automation Laboratory	PC	Practical	0	0	3	1.5
69	AD670308	Deep Learning laboratory	PC	Practical	0	0	3	1.5
70	MG670019	Innovation Entrepreneurship and Startups	IC	Theory	3	0	0	3
71	CS670505	Advanced career development	EEC	Skill Based Course	0	0	2*	1
		Total			20	0	8	24
	SEMESTER-VIII							
72	AM660501	Project Work	EEC	Practical	0	0	20	10
		Total			0	0	20	10

LIST OF ELECTIVES

Sl. No	Subject Code	Subject Name	L	T	P	C
VERTICAL –I (Full Stack Development)						
1	CS606101	Design and Analysis of Algorithms (NPTEL)	3	0	0	3
2	CS606102	App Development	3	0	0	3
3	CS606103	PHP Programming	3	0	0	3
4	CS606104	UI and UX Design	3	0	0	3
5	CS606105	Software Testing (NPTEL)	3	0	0	3
6	CS606106	Web Application Security	3	0	0	3
7	CS606107	Dev-ops	3	0	0	3
8	CS606108	Principles of Programming Languages	3	0	0	3
9	CS606109	Social Networks (NPTEL)	3	0	0	3
10	CS606110	Multimedia Technology	3	0	0	3
VERTICAL –II (Cloud and Data Science)						
1	CS606201	Cloud Computing (NPTEL)	3	0	0	3
2	CS606202	Virtualization	3	0	0	3
3	CS606203	Cloud Computing and Distributed Systems (NPTEL)	3	0	0	3
4	CS606204	Data Warehousing	3	0	0	3
5	CS606205	Storage Technologies	3	0	0	3
6	CS606206	Software Defined Networks	3	0	0	3
7	CS606207	Grid Computing	3	0	0	3
8	CS606208	Security and Privacy in Cloud	3	0	0	3
9	CS606209	IoT and Cloud	3	0	0	3
10	CS606210	Google Cloud Computing Foundations (NPTEL)	3	0	0	3

VERTICAL –III (Cyber Security)						
1	CS606301	Ethical Hacking (NPTEL)	3	0	0	3
2	CS606302	Digital and Mobile Forensics	3	0	0	3
3	CS606303	Systems and Usable Security (NPTEL)	3	0	0	3
4	CS606304	Modern Cryptography	3	0	0	3
5	CS606305	Engineering Secure software systems	3	0	0	3
6	CS606306	Crypto currency and Block chain Technologies	3	0	0	3
7	CS606307	Cryptography and Network Security (NPTEL)	3	0	0	3
8	CS606308	Network Management	3	0	0	3
9	CS606309	Cyber Crime and Laws	3	0	0	3
10	CS606310	Design of Network Router	3	0	0	3
VERTICAL –IV(Internet Of Things)						
1	CS606401	Introduction To Internet of Things (NPTEL)	3	0	0	3
2	CS606402	IoT Architecture and Framework	3	0	0	3
3	CS606403	Communication Protocols for IoT	3	0	0	3
4	CS606404	Cloud Services for IoT	3	0	0	3
5	CS606405	Computer Networks and Internet Protocol (NPTEL)	3	0	0	3
6	CS606406	Privacy and Security In IoT	3	0	0	3
7	CS606407	IoT Platform for Smart City Planning	3	0	0	3
8	CS606408	IoT for Smart Grids	3	0	0	3
9	CS606409	IoT and its Applications	3	0	0	3
10	CS606410	Introduction to Industry 4.0 And Industrial Internet of Things (NPTEL)	3	0	0	3

VERTICAL –V(Block chain)						
1	CS606501	Foundations of Cryptography (NPTEL)	3	0	0	3
2	CS606502	Blockchain And Its Applications (NPTEL)	3	0	0	3
3	CS606503	Blockchain Technologies	3	0	0	3
4	CS606504	Blockchain Architecture Design and Use Cases (NPTEL)	3	0	0	3
5	CS606505	Blockchain Platforms	3	0	0	3
6	CS606506	Blockchain Forensics	3	0	0	3
7	CS606507	Robot Manipulator Control	3	0	0	3
8	CS606508	Computer Vision with Open cv	3	0	0	3
9	CS606509	Internet Security	3	0	0	3
10	CS606510	Intelligent Transport Systems	3	0	0	3
VERTICAL –VI(Diversified Courses)						
1	AD606601	Hardware Security (NPTEL)	3	0	0	3
2	CS606602	Problem Solving Using Python	3	0	0	3
3	AD606602	Model Checking (NPTEL)	3	0	0	3
4	CS606604	Database Design (NPTEL)	3	0	0	3
5	CS606605	Matlab Programming for Engineers	3	0	0	3
6	CS606606	Robotics and Its Applications	3	0	0	3
7	CS606607	Adhoc Networks	3	0	0	3
8	CS606608	Principles of Distributed Systems	3	0	0	3
9	CS606609	Python Scripting	3	0	0	3
10	CS606610	Implement Rust	3	0	0	3

VERTICAL –VII (Deep Learning)						
1	AD606701	NLP Tools and Applications (NPTEL)	3	0	0	3
2	AD606702	Neural Networks and Deep Learning	3	0	0	3
3	AD606703	Text and Speech Analysis	3	0	0	3
4	AD606704	Drone technology	3	0	0	3
5	AD606705	Image and video analytics	3	0	0	3
6	AD606706	Big Data Analytics (NPTEL)	3	0	0	3
7	AD606707	Data Mining Using R	3	0	0	3
8	AM606701	Deep Learning Using Tensor Flow	3	0	0	3
9	AM606702	Python and R Programming for Biotechnologists	3	0	0	3
10	AM606703	Neural Networks and Deep Learning (NPTEL)	3	0	0	3

INSTITUTE ELECTIVES -1

S.No	Course code	Course Name	Dept	Classification		L	T	P	C
1	AM607104	Introduction to data structure	AI & ML	IE	Theory	3	0	0	3
2	AM607105	Introduction to Algorithms	AI & ML	IE	Theory	3	0	0	3

INSTITUTE ELECTIVES -II

S.No	Course code	Course Name	Dept	Classification		L	T	P	C
1	AM607201	Software Engineering	AI & ML	IE	Theory	3	0	0	3
2	AM607202	Basics of Software Testing	AI & ML	IE	Theory	3	0	0	3

INSTITUTE ELECTIVES -III

S.No	Course code	Course Name	Dept	Classification		L	T	P	C
1	AM607301	Foundation of Big Data Analytics	AI & ML	IE	Theory	3	0	0	3
2	AM607301	Foundation of Deep Learning	AI & ML	IE	Theory	3	0	0	3

INSTITUTE ELECTIVES -IV

S.No	Course code	Course Name	Dept	Classification		L	T	P	C
1	AM607401	Computer Vision Basics	AI & ML	IE	Theory	3	0	0	3
2	AM607402	Machine Learning Fundamentals	AI & ML	IE	Theory	3	0	0	3

PSN COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

CURRICULUM – R 2022

B.E Computer Science and Engineering (Artificial Intelligence and Machine Learning)

SUMMARY SHEET

SEMESTER	I	II	III	IV	V	VI	VII	VIII	TOTAL
CREDITS	21	22	21	21	21	21	24	10	**161**

Chairman
Board of Studies
PSNCET

SEMESTER I

Course Code	PROFESSIONAL ENGLISH - I	L	T	P	C
IC610001		2	0	0	2
Course Category: *Industrial Core*		Course Type: *Theory*			

Course Objective(s):

The objective of this course is to make the learners to communicate effectively and appropriately in real life situation. It helps to improve the student's vocabulary and to develop strong conversation and role play skills. It will make them to grasp the substance and central idea from their communication skills.

Course Outcomes: (COs)

At the end of the course, students will be able to

CO 1	Write and speak clearly, read perceptively and think critically.
CO 2	Understand the correct usage of English grammar in writing and speaking.
CO 3	Write academic papers, essays and summaries using the process approach.
CO4	Read fluently through extensive reading.
CO 5	**S**peak in English both in terms of fluency and comprehensibility.

UNIT I - INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION **6**

Technical English: Definition, Interpersonal, Intrapersonal, Verbal and Non-Verbal Communication. Speaking: Self-Introduction; Introducing a friend; Conversation – politeness strategies; Telephone Conversation. Reading: Reading longer technical texts. Writing: Paragraph writing Short Report on an event (fieldtrip etc.).

UNIT II - GRAMMATICAL COMPONENTS 6

Subject-Verb Agreement; Correct Usage: Noun; Pronoun; Modifiers; Articles; Prepositions; Prefixes and Suffixes, One Word Substations, Relative Pronouns, Sentence Structures, Phrase & Clause, Words and Phrases.

UNIT III - FORMS OF TECHNICAL WRITING 6

Letters: Complaint Letter, Placing an Order, Quotation, Enquiry letter, Agenda, Minutes of Meeting, Letter to the Editor, Technical Proposal: Writing of Proposal.

UNIT IV - FORMS OF TECHNICAL READING 6

Developing Efficient Reading Skills - Types- Skimming, Scanning, Extensive reading, Intensive reading – predicting content – Interpretation – Inference from text - Implications- Critical reading, reading technical articles, advertisements and editorial of newspaper.

UNIT V - PRESENTATION STRATEGIES **6**

Defining purpose, Audience & Locale, Organizing Contents, Preparing Audio-Video Aids, Body Language, Intonation: Stress & Rhythm, Presentation Techniques, Oral Presentation.

TEXT BOOKS:

1. Lakshminarayan K. R, Murugavel. T. Managing Soft skills, New Delhi SCITECH Publication, (India) Pvt Ltd.,2010.
2. Ried Alison. Spoken English. Goodwill publishing house; First edition. 2019.
3. V.N.Arora and Laxmi Chandra, Improve Your Writing. Oxford Univ.Press, New Delhi. 2013.
4. Carnegie Dale, The Quick and easy way to Effective Listening. Rupa; First edition. 2016.

REFERENCES:

1. Business Correspondence and Report Writing by Prof.R.C.Sharma & Krishna Mohan,TataMcGraw Hill & Co. Ltd., New Delhi. 2017.
2. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub & Distributors; Delhi. Marcg 2015.

WEB REFERENCES:

1. **https://www.education.com/resources/grammar/**
2. **https://literacyideas.com**
3. **https://www.readingrockets.org**
4. **https://eslgold.com**
5. **https://basicenglishspeaking.com**

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	1				2		2	2		3
CO2	2	2	1				2		2	2		3
CO3	2	2	2				2		2	2		3
CO4	2	2	1				2		2	2		3
CO5	1	1	1				1		1	1		3

Course Code	MATRICES AND CALCULUS	L	T	P	C
IC610002		2	1	0	3
Course Category: *Industrial Core*		Course Type: *Theory*			

Course Objective(s):

The objective of this course is to familiarize the students with basic elements of mathematics. It acquaints the students with standard concepts and tools that will serve as building blocks towards tackling more advanced level of mathematics that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector. This is specially designed for students to help them bring to speed with other students who have already had some training in mathematics at the higher secondary level.

Course Outcomes: (COs)

At the end of the course, students will be able to

CO 1:	Find the Eigen values, Eigen vectors, canonical form and nature of the quadratic form by matrix method.
CO 2:	Apply ordinary differentiation in maxima and minima and to Solve ordinary differential equations by various methods.
CO 3:	Find the Jacobian and application of Partial differential equations in Lagrange's method to find maxima and minima
CO 4:	Apply the concepts of integration and applications of indefinite integral by single Integration.
CO 5:	Use the change of variables in multiple Integration.

UNIT I - MATRICES **12**

Matrices – Types of Matrices and operation including elementary row and column operation – Determinants (rules of computation) - Cayley-Hamilton theorem – Finding Inverse of a matrix using Cayley - Hamilton theorem – Eigen values and Eigen vectors – Diagonalization of matrix by Orthogonal transformation – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. Applications: Stretching of an elastic membrane and electrical networks.

UNIT II - DIFFERENTIAL CALCULUS **12**

Limits and Continuity – Concept of a derivative – Standard rules of differentiation – elementary trigonometric, logarithmic, and exponential differentiation – Implicit function differentiation – Taylors series expansion - Maxima and Minima for one variable. Application: Maxima and Minima of one variable.

UNIT III - FUNCTIONS OF SEVERAL VARIABLES **12**

Partial differentiation – Homogenous functions – Euler's theorem – chain rule - Total derivatives – change of variable – Jacobians– Properties of Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables. Applications: Maxima and Minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV - INTEGRAL CALCULUS **12**

Integration – definite and indefinite integral – standard rules of Integration –Integration by parts – Trigonometric integrals, inverse, Trigonometric substitution – Integration of rational function by partial fraction – Improper Integrals. Applications: Moments and Centers of mass.

UNIT V- MULTIPLE INTEGRALS **12**

Double Integration - Change of order of Integration – Area enclosed by plane curves – Triple Integrals – Volume of Solids – Change of variables in double and triple Integrals. Applications: Moments and Centers of mass, Moment of inertia.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi,2016. 2. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.

3. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV – Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 – 7.4 and 7.8].

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", NarosaPublications NewDelhi. 5th Edition, 2016.
3. Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

WEB RESOURCES:

1. https://www.matrixres.com/en
2. https://www.youtube.com/watch?v=dksu5SZZ80A
3. https://www.youtube.com/watch?v=nfx0pdwsrLI
4. https://www.youtube.com/watch?v=kfv9h3c46CI
5. https://www.youtube.com/watch?v=gQ-u_HlSKNk

Course Code	ENGINEERING PHYSICS	L	T	P	C
IC610003		3	0	0	3
Course Category: *Industrial Core*		Course Type: *Theory*			

Course Objective(s):

To impart a strong foundation in the principles of Physics and make the students to apply them for engineering problems.

Course Outcomes: (COs)

At the end of the Course the students will be able to

CO 1	Apply and gain the knowledge to explain the elastic properties of matter.
CO 2	Understand the knowledge on thermal conductivity of the materials and its significance.
CO 3	Understand the basics of electrostatics, current electricity and the production of electromagnetic waves.
CO 4	Understand the basic concept in quantum mechanics.
CO 5	Understand the fundamental concepts of Optics and Laser for engineering applications

UNIT I - ELASTIC PROPERTIES OF MATTER 9

Elasticity – Hooke's law – stress-strain diagram – elastic modulus – Poisson's ratio – torsional stress and deformations – twisting couple; applications: Torsion pendulum (theory and experiment) – bending of beams – bending moment – cantilever – determination of Young's modulus by uniform and non-uniform bending (qualitative).

UNIT II – THERMAL PHYSICS 9

Heat Transfer -Conduction, Convection and Radiation(qualitative), Kinetic Theory of gases – distribution of velocities: Maxwell-Boltzmann law of distribution of velocities in an ideal gas, Mean, RMS and most probable speeds; degrees of freedom, Law ofequipartition of energy (No proof required), Specific heats of gases; Thermal conductivity and diffusion, application: Lee's Disc method (Theory and experiment) - Brownian motion and its significance.Introduction to thermo-electricity – Seebeck Effect, Peltier Effect, Thermoelectric devices, Thermistor, Newton's law of cooling.

UNIT III - ELECTROMAGNETISM 9

Coulomb's Law, Forces between charges, Electric field, Non-steady currents and charges, Faraday's laws of electromagnetic induction, concept of dipole, Ampere's circuital law, current loop as a dipole, torque on a dipole, Maxwell's field equations (derivation), Equation of continuity, displacement current. Electromagnetic wave equation (Derivation), Properties of plane electromagnetic waves: Poynting vector (derivation), production of electromagnetic waves, Applications: Hertz experiment.

UNIT IV QUANTUM MECHANICS 9

Concept of de Broglie's Matter waves – Derivation of wavelength of matter waves in different forms– Heisenberg's Uncertainty principle, Concept of Phase velocity and Group velocity (qualitative); Schrodinger's Time independent and dependent equation (derivation), Applications: Schrodinger's equation (qualitative treatment) – a) Particle in one dimensional rigid box b) Potential Barrier.

UNIT V LASERS AND FIBRE OPTICS 9

Laser and its characteristics, Einstein's Coefficients (derivation), population inversion, meta stable state, types of pumping, lasing action, construction and working of He-Ne laser, CO_2 laser, Nd-YAG laser – Applications. Introduction to optical fiber, construction and working principle of an optical fiber, acceptance angle and numerical aperture, types of optical fibers – mode and propagation through step and graded index fibers, attenuation, Engineering, industrial and medical applications of optical fiber.

TEXT BOOKS:

1. R.K. Gaur and S. L. Gupta, Engineering Physics (2009)DhanbatRai Publication
2. E. Clark, Physics Electricity Magnetism& Waves, CBS Publishers & Distributors (2005).
3. R. Murugeshan and KiruthikaSivaprasath, Modern Physics, S. Chand Publishers, 18th Edition(2019)

REFERENCE BOOKS:

1. Arthur Beiser, Shobit Mahajan and S. Rai Choudhury, Concepts of Modern Physics, 7thedition,McGraw Hill (2017)
2. D.K. BhattacharyaPoonamTandon, Engineering physics, Oxford University Press (2015)
3. DattuprasadRamanlal Joshi, Engineering Physics, Tata McGraw Hill Education Private Limited, (2010).
4. B N Sankar, S O Pillai, Engineering Physics**,New Age International private limited,(2015)**

Course Outcomes	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**
CO 1	3	2	2					2			3	2
CO 2	3	2	2	1								2
CO 3	3	2	2	1								2
CO 4	3	2	2	1				2			2	2
CO 5	3	2	2	1				2				2

Course Code	ENGINEERING CHEMISTRY	L	T	P	C
IC610004		3	0	0	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

To impart a strong foundation in the principles of chemistry and make the students to apply them for engineering problems.

Course Outcomes: (COs)

At the end of the course, the students will be able to

CO 1	Apply the knowledge in chemical industries in the manufacture of chemicals.
CO 2	Differentiate the various sources of energy and its applications.
CO 3	Understand about corrosion and its protection techniques.
CO 4	Knowusage of analytical devices for industrial processes.
CO 5	Understand the basic concepts of phase rule in the manufacture of alloys and its applications.

UNIT I - INDUSTRIAL CHEMICALS **9**

Introduction – Preparation and industrial applications of ammonium chloride, ammonium nitrate, ammonium sulfate, chromic acid, acrylonitrile, caprolactam, cellulose acetate, diethyl ether, glycerin, melamine (from urea). Rocket propellants: Definition, characteristics of good propellants, classification and advantages of propellants.

UNIT II - ENERGY SCIENCES **9**

Battery technology – Fundamentals of primary cells, rechargeable batteries, Ni-Cd battery, Ag_2O-Zn alkaline battery, lead-acid storage cells; Fuel cells – hydrogen–oxygen fuel cell, Solid oxide fuel cells (SOFC): principles, applications, advantages/disadvantages. Conventional Fuels – Types of fuels, calorific value, processing and refining of petroleum, liquid fuels - synthesis of petrol by Bergius process - Knocking and anti-knocking agents, Octane and Cetane values, cracking of crude oil - catalytic cracking, Nuclear Energy - nuclear reactor – working principle (conventional energy), Non - conventional sources of energy: Solar energy (principles), Wind energy- Applications

UNIT III - CORROSION **9**

Definition, dry (or chemical) corrosion, wet (or electrochemical) corrosion and their mechanisms; Types of electrochemical corrosion, (differential aeration, galvanic). Typical electrochemical corrosion like pitting, inter-granular, soil, and waterline corrosion. Factors affecting corrosion. Protection of corrosion – Sacrificial Anodic Protection (SAP) method and Impressed Current Cathodic Protection method (ICCP). Protective coatings – Paints: constituents and function.

UNIT IV - INSTRUMENTAL TECHNIQUES **9**

Beer-Lambert's law–Flame photometry – principle – instrumentation (block diagram only) – Estimation of sodium by flame photometry – Atomic Absorption Spectroscopy (AAS) – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy. Thermal methods of analysis: Thermogravimetric analysis (TGA) - principles, instrumentation (block diagram only), application of TGA to decomposition of calcium oxalate system, Differential thermal analysis (DTA) - principles, instrumentation (block diagram only), endothermic curves,exothermic curves, DTA thermogram analysis of pure sulfur.

UNIT V - PHASE RULE AND ALLOYS **9**

Phase Rule: Phase, component, degree of freedom, phase rule applications to one component system-water system. Condensed phase rule, two component system: lead-silver system. Alloys: Importance of making alloys, types of alloys: ferrous and nonferrous alloys. Nichrome, carbon steel, duralumin, monel

metal. Powder metallurgy, Heat treatment of alloys.

TEXT BOOKS:

1. Vairam and Suba Ramesh, Engineering Chemistry-I, Wiley India Pvt. Ltd, 2014.
2. Shashi Chawla, A Text Book of Engineering Chemistry, Dhanpat Rai & Co., 2015.
3. C. V. Agarwal, C. P. Murthy, A. Naidu, "Chemistry of Engineering Materials", Wiley India, 5th Edition, 2013.
4. Engineering Chemistry by Prasanth Rath, Cengage Learning, 2015 edition.

REFERENCES:

1.Puri, Sharma, Pathania, *Principles of Physical Chemistry*, Vishal Publishing Co.,2015.

2. B. Siva Shankar, "Engineering Chemistry", Tata Mc Graw Hill Publishing Limited, 3rd Edition, 2015.

3. P.Mani,K.N.Mishra,"Chemistryof Engineering Materials", Cengage Learning,3rdEdition, 2015.

WEB REFERENCES:

1. https://www.studocu.com/in/document/sardar-patel-university/industrial chemistry/industrialchemistry-lecture-notes-1-18/20483178.
2. http://www.freebookcentre.net/chemical-books-download/Energy-Engineering-LectureNotes.html
3. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003251903229434ranvijay_Corrosion_Science.pdf
4. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/SCY2.pdf
5. https://ccsuniversity.ac.in/bridge-library/pdf/Engg-AG-Engg-Chem-2nd-sem-subodh-Lecture-5.pdf

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	1			3				2	2
CO 2	3	2	2	1			3					2
CO 3	3	2	2	1			3					2
CO 4	3	2	2	1			3					2
CO 5	3	2	2	1			3				2	2

Course Code	PROBLEM SOLVING AND 'C' PROGRAMMING	L	T	P	C
CS610005		3	0	0	3
Course Category: *Industrial Core*		Course Type: *Theory*			

Course Objective(s):

1. To understand the basics of algorithmic problem solving.
2. To develop C Programs using basic programming constructs
3. To develop C programs using arrays and strings.
4. To develop modular applications in C using functions and pointers
5. To develop applications in C using structures and union

Course Outcomes: (COs)

At the end of the course, the students will be able to

CO 1	Develop algorithmic solutions to simple computational problems.
CO 2	Develop simple applications in C using basic constructs.
CO 3	Design and implement applications using arrays and strings.
CO 4	Develop and implement modular applications in C using functions and pointers.
CO 5	Develop applications in C using structures and union.

UNIT I - COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Software and its types – Software Life Cycle - Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops. Imperative languages: Introduction to imperative language; syntax and constructs of a specific language (ANSI C).

UNIT II - BASICS OF C PROGRAMMING 9

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements-Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process.

UNIT III - ARRAYS AND STRINGS 9

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT IV - FUNCTIONS AND POINTERS 9

Functions- Defining function- Accessing a function- Function prototypes- Passing arguments to a functions- Passing arrays to a function- Passing Pointers to function- Recursion – Dynamic memory allocation - malloc, calloc, realloc-Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers..

.UNIT V - STRUCTURES AND UNION 9

Structures – Declaration –Nested Structures- Structures and Functions – Arrays of Structures – Pointers to structures – Typedef - Unions – Bit-fields.

Case Studies:

1. Print Characters without using format specifiers
2. Check the given IP address is valid or not
3. Storage management using Structure and Union

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.

2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and programming”, 1st Edition, BCS Learning & Development Limited, 2017.
3. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
4. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.

REFERENCES:

2. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.
3. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
4. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press.2021
5. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
6. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.
7. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGraw-Hill Education, 1996.
8. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=reUOojtbU3A
2. https://www.youtube.com/watch?v=3QiItmIWmOM
3. https://www.youtube.com/watch?v=3ZgDx-0oGQQ
4. https://www.youtube.com/watch?v=qaszuaFXRTA
5. https://www.youtube.com/watch?v=jjNs_x7rlQk

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3											
CO 2	3	2										
CO 3		2	3		3							
CO 4		2	3		3							2
CO 5		2	3	3								2

Course Code	ENGINEERING GRAPHICS WITH CAD	L	T	P	C
ME610006		2	0	2	3
Course Category: *Industrial Core*	Course Type: *Theory*				

Course Objective(s):

To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings and computer aided drafting.

Course Outcomes: (COs)

On successful completion of this course, the student will be able to

CO 1	Illustrate the fundamentals of engineering drawing and draw orthographic projections of points and lines.
CO 2	Draw the orthographic projections of planes and simple solids.
CO 3	Draw the orthographic projections of sectioned solid and development of surfaces.
CO 4	Sketch the isometric view of simple solids.
CO 5	Determine to determine the features of CAD Software

CONCEPTS AND CONVENTIONS (Not for Examination) **2**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I- ORTHOGRAPHIC PROJECTION 12

Introduction to orthographic projection, drawing orthographic views of objects from their isometric views. Orthographic projections of points lying in four quadrants. Orthographic projection of lines parallel and inclined to one and both the planes.

UNIT II-PROJECTION OF PLANES AND SOLIDS 12

Orthographic projection of planes inclined to any one of the plane. Projections of simple solids - axis perpendicular to HP, axis perpendicular to VP and axis inclined to horizontal planes only.

UNITIII-PROJECTIONOFSECTIONEDSOLIDS& DEVELOPMENT OF SURFACES 12

Introduction to sectioning of solids - Section planes perpendicular to one plane and parallel to another plane, section plane inclined to horizontal plane. Introduction to development of surfaces - Development of prisms, pyramids and cylindrical & conical surfaces.

UNIT IV- ISOMETRIC PROJECTION 12

Introduction to Isometric projection and isometric views of different planes and simple solids - Introduction to perspective projection.

UNIT V INTRODUCTION TO COMPUTER AIDED DRAFTING 10

Computer screen, layout of the software, standard tool bar / menu and description of most commonly used tool bars, and navigational tools. Co-ordinate system and reference planes HP, VP, RPP & LPP of 2D/3D environment. Selection of drawing sheet size and scale. Commands and creation of Lines, coordinate points, axes, poly-lines, square, rectangle, polygons, circle, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz., tangency, parallelism, inclination and perpendicularity.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House 53rd Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

REFERENCES:

1. Basant Agarwal and Agarwal C.M.,"Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27thEdition, 2017.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International Publishers; Fifteenth edition (1 July 2018)

WEB RESOURCES:

1. https://www.youtube.com/watch?v=ANEvQyt3PnU
2. https://www.youtube.com/watch?v=-W7tH49dBLw&t=36s

CO -PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2									2
CO 2	3	2	2									2
CO 3	3	3	2									2
CO 4	3	3	3									2
CO 5	3	3	3		3							2

Course Code	PHYSICS & CHEMISTRY LABORATORY	L	T	P	C
IP610101		0	0	3	1.5
	Course Type: *Practical*				

PHYSICS LABORATORY

Course Objective(s):

To familiarize the student's knowledge about fundamentals of physics and train them to handle the instruments.

Course Outcomes: (COs)

At the end of this course, the student will be able to

CO 1	Measure the Wavelength of laser light
CO 2	Study the properties of ultrasonic waves
CO 3	Find the mechanical properties of materials
CO 4	Analyse the thermal properties of materials
CO 5	Find the magnetic properties of matereials

LIST OF EXPERIMENTS IN PHYSICS

1. Laser parameter, particle size and acceptance angle
2. Velocity of ultrasonic waves – Ultrasonic Interferometer
3. Young's Modulus of the material – Uniform and Non-Uniform bending
4. Thermal conductivity of bad conductor – Lee's disc method
5. Hysteresis – Magnetometer method
6. Bandgap determination of a semiconductor – P.O Box Method

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3	1	2			2			3			2
CO 2	3	1	2			2			3			2
CO 3	3	1	2			2			3			2
CO 4	3	1	2			2			3			2
CO 5	3	1	2			2			3			2

CHEMISTRY LABORATORY

Course Objective(s):

To familiarize the student's knowledge about fundamentals of chemistry and train them to handle the chemicals.

Course Outcomes: (COs)

At the end of this course, the student will be able to

CO 1	Estimate the amount of total hardness in the given sample of hard water by EDTA method.
CO 2	Estimate the carbonate and non-carbonate hardness in the given sample of hard water byEDTA method.
CO 3	Determine the amount of dissolved oxygen in the given water sample by winklers method.
CO 4	Determine the amount of dissolved oxygen in the given water sample by winklers method.
CO 5	Determine the amount of barium chloride present in the given solution by conductometric

LIST OF EXPERIMENTS IN CHEMISTRY

1. Determination of total hardness in water sample using EDTA.
2. Estimation of carbonate and non-carbonate hardness of water.
3. Determination of Dissolved Oxygen in Water
4. Conductometric Precipitation Titration.
5. Potentiometric Titration (Redox).
6. Estimation of copper in brass by EDTA method.

CO-PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2				1		3			2
CO 2	3	2	2				1		3			2
CO 3	3	2	2				1		3			2
CO 4	3	2	2				1		3			2
CO 5	3	2	2				1		3			2

Course Code	PROGRAMMING IN 'C' LABORATORY	L	T	P	C
IP610102		0	0	3	1.5
	Course Type: *Practical*				

Course Objective(s):

1.To learn and execute the simple programs in C' language
2.To be familiar with looping and branching concepts in C' Programming
3.To be familiar with array in C' Programming
4.To learn the concept of functions in C' Language
5.To study about the concept of Structures and Unions

Course Outcomes: (COs)

At the end of this course, the student will be able to

CO 1	Solve simple problems using C' Language.
CO 2	Execute the programs using control statements.
CO 3	Handle arrays in C' Programs.
CO 4	Write functions and to solve some complicated problems in C.
CO 5	Handle structure and unions in C' Programs.

LIST OF EXPERIMENTS

1. Write a 'C' Program to generate first 'n' terms of the Fibonacci sequence
2. Write a 'C' Program to generate prime numbers between 1 and 'n'
3. Write a 'C' Program to find the Factorial using recursion and non-recursion
4. Write a 'C' Program to find the GCD of two given positive numbers
5. Write a 'C' Program to perform the arithmetic operations on two numbers using switch statement
6. Write a 'C' Program to find the sum of series ($1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!$)
7. Write a 'C' Program to implement the addition of 'n' numbers in an array
8. Write a'C' program to find both the largest and smallest number in a list of integers after arranging them in ascending order
9. Write a 'C' Program to merge two sorted arrays
10. Write a 'C' Program to find the given string is Palindrome or not.
11. Write a 'C' program to find string handling mechanism 12. Write a 'C' Program that uses the concept of function
13. Write a 'C' program to calculate an array of pointers.
14. Write a 'C' program to read and print an employee's details using structure
15. Write a 'C' program to find size of the union

Hardware / Software Required for a Batch of 30 Students Hardware

- Standalone PCs – 30 Nos.

Software

- Operating System – Windows
- Compiler – C

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3											
CO 2	3	2										
CO 3		2	3									
CO 4		2	3									2
CO 5		2	3	3								2

INSTITUTE MANDATORY COURSE

NATIONAL CADET CORPS(NCC)/NATIONAL SERVICESCHEME (NSS)/NATIONAL SPORTSORGANIZATION (NSO)

Course Objective(s):

To enable the students to gain knowledge about NCC/NSS/NSO and put the same into practice

Course Outcomes: (COs)

At the end of this course, the students will be able to Imbibe in their minds related to the concepts and benefits of NCC/NSS/NSO and make them practice the same.

NATIONAL CADET CORPS (NCC):

Any student enrolling as a member of National Cadet Core (NCC)will have to attend sixteen parades out of twenty parades each offour periods over a span of academic year.Attending eight parades in first semester will qualify a student toearn the credits specified in the curriculum. Grading shall be done based on punctuality, regularity in attending the parades and theextent of active involvement.

NATIONAL SERVICE SCHEME (NSS):

A student enrolling as member of NSS will have to complete 60hours of training / social service to be eligible to earn the creditsspecified in the curriculum.Grading shall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and theextent of active involvement.

NATIONAL SPORTS ORGANIZATION (NSO):

Each student must select one of the following games/sports eventsand practice for one hour per week. An attendance of 75% iscompulsory to earn the credits specified in the curriculum. Gradingshall be done by the faculty member handling the course based on punctuality, regularity in attending the classes and the extent of active involvement. List of games/sports:Basket Ball, Football, Volley Ball, Ball Badminton, Cricket, Throw- ball, Track events, Field events or any other game with the approval of faculty member.

SEMESTER II

Course Code	PROFESSIONAL ENGLISH II	L	T	P	C
IC620008		2	0	2	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

The objective of the course is to make the students to possess the basic workplace skills. It makes the students to empower the learners of Engineering and Technology to attain the key employability skills.

Course Outcomes: (COs)

At the end of the course, students will be able to

CO 1	Improve their employability skills and to develop their competence and competitiveness.
CO 2	Solve the problems in communicative contexts using analytical thinking skills.
CO 3	Create formal reports and proposals cohesively, creatively and flawlessly.
CO 4	Think in innovative ways to solve issues in the work place by enhancing the creativity of the students.
CO 5	Improve their competence in the use of English with particular reference to the workplace situations.

UNIT I - MAKING COMPARISONS **6**

Listening: Listening and Responding to complaints, Listening to problem, Evaluating listening: Advertisement, Product/Description, Listening and Filling a form. **Speaking:** Offering solution, Group Discussion **Reading:** Reading aloud, Reading Advertisements, User Manuals. **Writing:** Professional Emails, Writing a paragraph on Motivational ideas.

UNIT II - PERSUASIVE COMMUNICATION **6**

Listening: Listening to famous speeches, Listening to a product launch, Watching movie scenes or documentaries, Depicting a technical problem. **Speaking:** Making a Short Speeches- Formal: Welcome Speech and Vote of Thanks, Informal: Farewell Speech, Graduation Speech. **Reading:** Stress and Intonation-Voice Modulation. **Writing:** Dialogue writing, writing opinion pieces (book review, Food review, Film review).

UNIT III - DIGITAL COMPETENCE **6**

Listening: Listening to Interview, Gap Filling exercises, Listening to Panel Discussions. **Speaking:** Interview with subject specialists, participating in a meeting: Face to Face and Online, Creating Vlogs (subject related). **Reading:** Excerpts from literary Texts, News Reports, **Writing:** Preparing first draft of short assignments, Checklists.

UNIT IV - CREATIVITY AND IMAGINATION **6**

Listening: Listening comparison based on news reports, Documentaries. **Speaking:** Interviewing, Presenting on Oral Report, Mini presentation on selected topics. **Reading**: Essays on creativity and imagination (subject based). **Writing:** Recommendation, Reports and Technical and Scientific Articles.

UNIT V - WORKPLACE COMMUNICATION AND BASIC ACADEMIC WRITING **6**

Listening: Listening to the Presentation, Formal Job Interview, Informal Interview for feature writing, Short videos (conference meeting). **Speaking:** Short academic presentation using powerpoint presentation, Debate. **Reading:** Product profiles, Circulars, Scripts reading. **Writing:** Writing an introduction, Paraphrasing and Job Application: Cover Letter and Resume.

TOTAL HOURS: 30

TEXT BOOKS:

1. English for Engineers and Technologist (2020 edition). Orient Blackswan Pvt. Ltd, Department of English Anna University.
2. English for Science and Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadharshini, Dr. Deepa Mary Francis, Dr. KN. Sobha and Dr. Lourdes Joevani, Department of English Anna University.

REFERENCE BOOKS:

1. Raman, Meenatchi, Sharma. Sangeetha. Professional English. Oxford University press. New Delhi. 2019.

2. Communication skills for professionals and students by Dr. Amitabh Dwivedi, Notion Press, 1st Edition. 2019.

WEB REFERENCES:

1. **https://literacyideas.com**
2. **https://www.readingrockets.org** 3. **https://eslgold.com**

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	1				2		2	2		3
CO2	2	2	1				2		2	2		3
CO3	2	2	2				2		2	2		3
CO4	2	2	1				2		2	2		3
CO5	1	1	1				1		1	1		3

Course Code	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
IC620009		2	1	0	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

The objective of this course is to familiarize the students with basic elements of mathematics. It acquaints the students with standard concepts and tools that will serve as building blocks towards tackling more advanced level of mathematics portion in public or private sector. This is specially designed for students to help them bring to speed with other students who have already had some training in mathematics at the higher secondary level.

Course Outcomes: (COs)

At the end of the course the student will be able to

CO 1	Have a fundamental knowledge of the Fourier series.
CO 2	Apply PDE Engineering.
CO 3	Have a well-founded knowledge of Laplace transform which can describe real life phenomena.
CO 4	Have a fundamental knowledge of the Fourier transforms.
CO 5	Have a fundamental knowledge of the Z-Transforms

UNIT I - FOURIER SERIES **12**

Fourier series – Dirichlet's conditions – General Fourier series –Fourier series of periodic functions with different periods - Fourier series of Odd functions – Fourier series of even functions – Half range Fourier sine series – Half range Fourier cosine series – Root mean square value - Parseval's identity – Harmonic Analysis

UNIT II - PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS **12**

Formation of partial differential equations – the four standard forms – Equations of the form f(p,q) = 0 Clairaut's equation - Solution of Lagrange's linear partial differential equations Pp+Qq = R. Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction(Insulated edges excluded).

UNIT III - LAPLACE TRANSFORM **12**

Laplace transform – Conditions for existence – Transform of elementary functions –Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions. Definition of Inverse Laplace transform as contour integral – Convolution theorem(excluding proof) – Application of Laplace transformation.

UNIT IV - FOURIER TRANSFORMS **12**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem– Parseval's identity- Application of Fourier transforms.

UNIT V - Z -TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem -Formation of difference equations – Application of Z-transforms.

TEXT BOOKS:

1. Grewal, B.S, 'Higher Engineering Mathematics' 47th Edition, Khanna publishers Delhi, (2016)
2. Bali.N.P and Manish Goyal 'Transforms and partial differential Equations', Second Edition, Laxmi Publications(P) Ltd. (2011) (For units 2,3,4,5)

REFERENCES:

1. Ramana.B.V. 'Higher Engineering Mathematics' Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
2. Glyn James, 'Advanced Modern Engineering Mathematics', Third edition-Pearson Education (2007).

3. Erwin Kreyszig ’Advanced Engineering Mathematics’, Eighth edition - Wiley India(2007).
4. T.Veerarajan, “Engineering Mathematics”, Tata-Mc Graw Hill Publishing Pvt. Ltd., New Delhi (2008).

WEB RESOURCES:

1. https://blogs.ed.ac.uk/mnaylor/2020/10/13/web-resources-on-fourier-transforms/
2. https://www.youtube.com/watch?v=jo8EO2KxLmw
3. https://www.youtube.com/watch?v=KqokoYr_h1A
4. https://www.youtube.com/watch?v=3pBumhfj7MY
5. https://www.youtube.com/watch?v=CrhhKz3-9hI

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	1								3
CO2	3	2	2	2								3
CO3	3	2	2	2	1							3
CO4	3	2	2	2	1							3
CO5	3	2	2	2	1							3

Course Code	ENGINEERING MATERIALS (for non circuit branches)	L	T	P	C
IC620010		3	0	0	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

To provide exposure and knowledge in the Physics of materials especially in engineering applications and to introduce the characterization of materials related to it.

Course Outcomes: (COs)

At the end of the course the students will be able to,

CO 1	Apply the knowledge gained to identify crystal structures and synthesize crystals
CO 2	Equipe the knowledge on different types of electron theory and the basics of superconductors
CO 3	Understand to distinguish conductors, insulators and semiconductors; analyze and evaluate the performance of electronic devices.
CO 4	Familiarize the students with the theory and applications of magnetic materials and applications of nanotechnology
CO 5	Understand the fundamentals of composite and Bio materials.

UNIT I - SOLID STATE MATERIALS **9**

Crystal systems – classification - Simple cubic (SC), Body Centered cubic (BCC), Face centered cubic (FCC) - Atomic radius – Packing factor –polymorphism and allotropy–Nucleation: Homogeneous and heterogeneous; - Crystal growth: solution growth - Czochralski, Bridgman - Sol-gel; Applications: Bragg'slaw, Powder X-ray diffractometer.

UNIT II - CONDUCTING AND SUPER CONDUCTING MATERIALS **9**

Electrons in a metal - Density of energy states – effect of temperature on Fermi energy – carrier concentration in metals: Hall Effect – determination of carrier concentration and mobility. Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors; Applications: Magnetic levitation, Josephson Effect – SQUIDS, cryotron.

UNIT III - SEMICONDUCTING AND ELECTRONIC MATERIALS **9**

Introduction, Energy and sin solids, band gap formation. Intrinsic semiconductors, Extrinsic semiconductors, carrier concentration and Fermi level variations (n type and p type) and conductivity. Metal- semiconductor junction– PN junction – PN junction under bias– Junctionbreakdown– heterojunction–transistorsandMOSFETs–Optoelectronicdevices; Applications: LED, Laser, Photodetectors.

UNIT IV - MAGNETIC MATERIALS AND NANO TECHNOLOGY **9**

Classification of magnetic materials: Dia, Para, ferro, Antiferro and ferrimagnetism–Hard and soft Magnetic materials, Weiss theory of ferromagnetism, Application: hysteresis, Nanoparticles – Nanoclusters – Nanostructures – surface to volume ratio – size and dimensionalityeffects– carbonnanotubes– applicationsofcarbonnanotubes–quantumnanostructures–preparation of quantum nanostructures – applications of quantum nanostructures–photolithography– working principle of scanning electron microscope (SEM), tunneling electron microscope (TEM) and atomic for cemicroscopy (AFM).

UNIT V - COMPOSITE MATERIALS **9**

Introduction and overview of composite materials and their need, Enhancement of properties, classification of composites, Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC), Application of composites.Recent developments in

Composites: Self healing composites, Molecular composites, Micro and Nano composites, Bio composites, Left handed composites, Stiffer than stiff composites, Carbon / carbon composites (Advantages and limitations of carbon matrix)

TEXT BOOKS:

1. V.Raghavan, Materials science and Engineering: A First Course, (2015).
2. Kumar. J, MoorthyBabu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, (2006).

REFERENCES:

1. Sergio M Resande, Introduction to Electronic Materials and Devices (e-book), Springer Link ,First Edition (2022).
2. Arthur Beiser, ShobitMahajan and S. RaiChoudhury, Concepts of Modern Physics, 7thedition,McGraw Hill (2017)
3. Lev I.Berger ,Semiconductor Materials,(2020)
4. Dilip Kumar Roy,Electronics Materials and Semiconductor Devices ,(2013).
5. J.PingLiu,EricFullerton,OliverGutfleisch ,Nanoscale Magnetic Materials and Applications,(2022)

WEB RESOURCES:

1. https://physics.uiowa.edu/research/condensed-matter-and-materials-physics
2. https://www.cambridge.org/core/series/solid-statematerials/1152B348C4C7AF23BC28FC2535B9E2BA
3. https://physicstoday.scitation.org/doi/10.1063/PT.3.4751
4. https://www.iop.org/explore-physics/big-ideas-physics/nanotechnology2d-materials
5. https://physicsworld.com/a/materials-and-nanotechnology-highlights-of-2021/
6. https://www.nde-ed.org/Physics/Materials/Introduction/composites.xhtml
7. https://www.science.org.au/curious/technology-future/composite-materials

CO-PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	1							3	3
CO 2	3	2	2	1								3
CO 3	3	2	2	1								3
CO 4	3	2	2	1								3
CO 5	3	2	2	1							2	3

Course Code	SEMI CONDUCTOR PHYSICS (for circuit branches)	L	T	P	C
IC620011		3	0	0	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

To provide exposure and knowledge in the Semiconductor Physics for circuit branches.

Course Outcomes: (COs)

At the end of the Course the students will be able to,

CO 1	Apply the knowledge gained to identify crystal structures and the significance of crystal effects.
CO 2	Differentiate the types of electronic materials and the origin of bands.
CO 3	Apply the sound knowledge gained on semiconductor Physics towards optoelectronic devices
CO 4	Understand the various measurement techniques for engineering applications
CO 5	Understand the working parameters of a solar cell and the technologies that are used to harness the power of solar energy

UNIT I – CRYSTAL STRUCTURE **9**

Crystal– classification-calculation of number of atoms per unit cell–atomic radius coordination number–packing factor for simple cubic (SC), Body Centered cubic(BCC), Face centered cubic (FCC) and Hexagonal closed packed(HCP)structures –polymorphism and allotropy–crystal defects: point, line and surface defects; Applications: Bragg's law, Powder X-ray diffractometer.

UNIT II - ELECTRONIC MATERIALS **9**

Free electron theory, Density of states and energy band diagrams, Kronig-Penny model to introduce origin of band gap, Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass, Phonons.

UNIT III – SEMICONDUCTORS **9**

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices: transistors and MOSFETs– LED, Laser, Photodetectors.

UNIT IV - MEASUREMENTS & ENGINEERED SEMICONDUCTOR MATERIALS **9**

Four-point probe and van der Pauw measurements for carrier density, resistivity, and hall mobility; Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics, Deep Level Transient Spectroscopy (DLTS), band gap by UV-Vis spectroscopy, absorption/transmission. Density of states in 2D, 1D and 0D (qualitatively), Practical examples of low-dimensional systems (quantum wells, wires, and dots).

UNIT V - INTRODUCTION TO SOLARCELLS: **9**

Solarradiation–solarspectrum–solarenergy–photovoltaiceffect–fundamentalsofsolarcells– current–voltagecharacteristics– conversion efficiencyand power.Types of solar cells – silicon solar cells – thin film solar cells – dye sensitized solar cells.CelltoModule–Applications: Fabricationof solar panels–solarwater heating– solarconcentrators.

TEXTBOOKS:

1. Joachim Piprek, Semiconductor Optoelectronic devices, Introduction to Physics and simulation,(2013).
2. R. Murugeshan and KiruthikaSivaprasath, Modern Physics, S. Chand Publishers, 18th Edition(2019) 3. Arvind Shah, Solar Cells and modules (2020).

REFERENCES:

1. Sergio M Resande, Introduction to Electronic Materials and Devices (e-book), Springer Link, First Edition (2022).
2. Arthur Beiser, Shobit Mahajan and S. Rai Choudhury, Concepts of Modern Physics, 7th edition, McGraw Hill (2017)
3. Fundamentals of Solar Astronomy by Arvind Bhatnagar and William Livingston, latest edition, World scientific.
4. Roberto Fornari, Single Crytals of Electronic Materials: Growth and Properties, (2018)
5. YuriyPoplavko, Electronic Materials: Principles and Applied Science, (2018)
6. Atul Tiwari, Rabah Boukherroub, Maheshwar Sharon,Solar Cell Nanotechnology,(2013).

WEB REFERENCES:

1. **https://en.wikipedia.org/wiki/Crystal_structure**
2. **http://che.uri.edu/course/che333/Structure.pdf**
3. **http://che.uri.edu/course/che333/Structure.pdf**
4. **https://byjus.com/jee/semiconductors/#:~:text=What%20are%20Semiconductors%3F,such%20as%20germanium%20or%20silicon**.
5. **https://ggnindia.dronacharya.info/CSE-AIML/Downloads/SubInfo/IstYear/Physics/Unit_4.pdf**
6. **https://metsolar.eu/blog/introduction-photovoltaics-solar-cells/**

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2								3	3
CO 2	3	2	2	1								3
CO 3	3	2	2	1								3
CO 4	3	2	2	1								3
CO 5	3	2	2	1							2	3

Course Code	ENGINEERING MECHANICS (for non circuit branches)	L	T	P	C
ME620012		3	0	0	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

To Learn the use scalar and vector analytical techniques for analyzing forces in statically determinate structures, introduce the equilibrium of rigid bodies, free body diagram, learn the principles of friction, forces, determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems and develop basic dynamics concepts – force, momentum, work and energy;

Course Outcomes: (COs)

On successful completion of this course, the student will be able to

CO 1	Illustrate the vectorial and scalar representation of forces and moments and analyze the equilibrium of particles, bodies and trusses
CO 2	Evaluate the properties of surfaces and solids
CO 3	Determine the friction and the effects by the laws of friction
CO 4	Explain the various types of motion and Calculate velocity, acceleration for various types of motion.
CO 5	Calculate the dynamic forces exerted in rigid body

UNIT I-BASIC CONCEPTS & STATICS ` **9**

Introduction: idealizations of mechanics, vector and scalar quantities, equality and equivalence of vectors, laws of mechanics, elements of vector algebra. Important vector quantities: position vector, moment of a force about a point, the couple and couple moment, moment of a couple about a line.Equivalent force systems: translation of a force to a parallel position, resultant of a force system. Equations of equilibrium: free - body diagram, problems of equilibrium.
Applications of equations of equilibrium for Trusses.

UNIT II-PROPERTIES OF SURFACES **9**

Introduction to properties of surfaces: first moment and centroid of plane area by integration method, second moments and product of area for a plane area, polar moment of area, principal axes. Method of virtual work: principles of virtual work for rigid bodies and its applications.

UNIT III- FRICTION **9**

Introduction to friction, Friction forces: laws of Coulomb friction, simple contact friction problems; Cables and chains. Ladder friction.

UNIT IV- KINEMATICS OF A PARTICLE **9**

Introduction, general notions, differentiation of a vector with respect to time, velocity and acceleration calculations in rectangular coordinates, velocity and acceleration in terms of path variables and cylindrical coordinates, simple kinematical relations and applications.

UNIT V- DYNAMICS OF A PARTICLE **9**

Introduction, Newton's law for rectangular coordinates, rectilinear translation, Newton's law for cylindrical coordinates, Newton's law for path variables, energy and momentum methods: Introduction to conservation of mechanical energy, Work - energy equation, impulse and momentum relations, Impact on Elastic Bodies

TEXTBOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

WEB REFERENCES:

- www.digimat.in/nptel/courses/video/112106180/L20.html
- https://archive.nptel.ac.in/courses/112/103/112103109/
- https://www.youtube.com/watch?v=LF9POom6uto
- https://www.youtube.com/watch?v=RGT1g_lu440
- https://www.youtube.com/watch?v=yuLpPoxj_48
- https://www.youtube.com/watch?v=hvSAVJ64Z4k

CO -PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	1								2
CO 2	3	2	2	1								2
CO 3	3	2	3	1								2
CO 4	3	2	3	1								2
CO 5	3	2	3	1								2

Course Code	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE (for circuit branches)	L	T	P	C
CS620013		3	0	0	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems To understand the different ways of designing software agents
- To know about the various applications of AI.

Course Outcomes: (COs)

At the end of this course, the students will be able to

CO 1	Use appropriate search algorithms for any AI problem
CO 2	Represent a problem using first order and predicate logic
CO 3	Provide the apt agent strategy to solve a given problem
CO 4	Design software agents to solve a problem
CO 5	Design applications for NLP that use Artificial Intelligence

UNIT I - INTRODUCTION **9**

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems – Machine Learning and its contribution in AI

UNIT II - PROBLEM SOLVING METHODS **9**

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game
Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games

UNIT III - KNOWLEDGE REPRESENTATION **9**

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

UNIT IV- SOFTWARE AGENTS **9**

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

UNIT V- APPLICATIONS **9**

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware –
Perception – Planning – Moving

TEXT BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition,2009.

2. I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008

2. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.

3. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.

4. Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013.

5. David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

WEB RESOURCES:

https://www.youtube.com/watch?v=61RbzGBpBIs

https://www.youtube.com/watch?v=CXtN2fik8L0

https://www.youtube.com/watch?v=2iHaSVEadiI

https://www.youtube.com/watch?v=Oth_jnB5lOA

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P12**
CO 1	1	1								1		1
CO 2	1	2										1
CO 3	1	1										1
CO 4	2	1								1		2
CO 5	2									2		2

Course Code	Python Programming	L	T	P	C
CS620014		3	0	0	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

1.To read and write simple Python programs.
2.To develop Python programs with conditionals and loops.
3.To define Python functions and call them.
4.To use Python data structures –- lists, tuples, dictionaries.
5.To understand the concepts of Files, Modules and Package

Course Outcomes: (COs)

At the end of this course, the students will be able to

CO 1	Apply the Demo Read, write, execute by hand simple Python programs.
CO 2	Analyze the structure, simple Python programs for solving problems.
CO 3	Understand the Decomposition of a Python program into functions.
CO 4	Apply the Representation of compound data using Python lists, tuples and dictionaries.
CO 5	Understand Read and write data from/to files in Python Programs

UNIT I –INTRODUCTION **9**

Introduction to Python, Demo of Interactive and script mode, Tokens in Python – Variables, Keywords, Comments, Literals, Data types, Indentation, Operators and its precedence, Expressions, Input and Print functions.

UNIT II - CONTROL FLOW **9**

Conditionals: Boolean values and operators, Selective statements – if, if-else, nested if, if –elif ladder statements ,Iteration: state, while, for, break, continue, pass , Illustrative programs: square root, gcd, exponentiation, sum an array of numbers.

UNIT III - FUNCTIONS AND STRINGS **9**

Functions: Types of Functions, Fruitful functions: return values, parameters, local and global scope, function composition, recursion,Strings: Formatting, Comparison, Slicing, Splitting, Stripping, Negative indices, String functions.

UNIT IV - LISTS TUPLES AND DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value, Dictionary: Create, add, and replace values, operations on dictionaries. Sets: Create and operations on set.

UNIT V - FILES,MODULES AND PACKAGES **9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016. (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, “Introduction to Computation and Programming Using Python’’, Revised and expanded Edition, MIT Press , 2013.
3. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013

CO PO MAPPING:

Course Outcomes	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	1		2									
CO 2	1	1			2							
CO 3	2		3									
CO 4	2	1										
CO 5	2				2							2

Course Code	BASIC ENGINEERING	L	T	P	C
EE620015		3	0	0	3
Course Category: *Industrial Core*	**Course Type:** *Theory*				

Course Objective(s):

Giving the knowledge about basic construction materials, surveying, electrical, manufacturing processes and computer generations.

Course Outcomes: (COs)

At the end of this course, the student will be able to

CO 1	Explain the usage of construction material , proper selection of construction materials and also measure distances and area by surveying
CO 2	Understand about Engineering Materials and IC Engines
CO 3	Compute electric circuit parameter for simple problems
CO 4	Understand the working principle of electronic devices such as diodes and zener diodes.
CO 5	Understand the concepts of generation of computers and its applications

UNIT I - CONSTRUCTION MATERIALS & SURVEYING **9**

Construction Materials – Properties, Types and uses of Stone, Bricks, Sand, Cement, Steel. Stone Masonry - Brick Masonry – Types. Types and Uses of Beam, Column, Lintels, Flooring, Roofing. Foundation – Footings – Types. Basic Requirements of Building – Planning – Criteria. Surveying - Object of Surveying – Classification of Surveying – Instruments used for Chain surveying – Calculation of Areas. Leveling – Principle of leveling – Types – Plane Table Surveying.

UNIT II -MANUFACTURING PROCESS AND IC ENGINES **9**

Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Meta Forming: Extrusion, Forging, Rolling, Drawing, IC Engines: 2 - Stroke and 4 – Stroke Engines, S.I. Engine and C.I. Engine: Differences

UNIT III - ELECTRICAL CIRCUITS **9**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT IV - BASIC ELECTRONICS **9**

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode CharacteristicsRectifier circuits-Wave shaping circuit.

UNIT V- BASIC COMPUTER APPLICATIONS **9**

Generation of Computers – Applications of 5 th generation computers – Basic concept of Networking – Server & Client - Network Topologies Internet, World Wide Web: Introduction to Internet, Internet Access, Internet Basics-World Wide Web (WWW), Web Pages. E-mail: Introduction to e-mail, Mailing basics.

TEXT BOOKS:

1. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2015
2. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, 2014.
3. Sadhu Singh, Basic Mechanical Engineering, S. Chand Publishing, 2009.

REFERENCE BOOKS:

1. SeetharamanS.,“Basic Civil Engineering”,Anuradha Agencies,2005.
2. Pravinkumar, Basic Mechanical Engineering, Pearson Education; Second edition (30 May 2018) 3. R. K. Rajput, Basic Mechanical EngineeringLaxmi Publications; Fourth edition (1 January 2007).
4. Thomas L. Floyd, ‘Electronic Devices’, 10th Edition, Pearson Education, 2018.
5. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017

WEB RESOURCE:

1. https://www.youtube.com/watch?v=ehi_hkLlutw
2. https://archive.nptel.ac.in/courses/112/103/112103262/

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P12**
CO 1	1	2	1				2		2	2	1	2
CO 2	2	2	1				2		2	2	2	2
CO 3	2	3	2	3							1	1
CO 4	2	3	3	3	3	1	-	1	1	-	1	3
CO 5	1	1	1				1		1	1	1	3

Course Code	PYTHON PROGRAMMING LABORATORY	L	T	P	C
IP620103		0	0	3	1.5
	Course Type: *Practical*				

Course Objective(s):

1. To write, test, and debug simple Python programs
2. To implement Python programs with conditionals and loops
3. Use functions for structuring Python programs
4. Represent compound data using Python lists, tuples, dictionaries
5. Read and write data from/to files in Python

Course Outcomes: (COs)

At the end of this course, the students will be able to

CO 1	Write, test, and debug simple Python programs
CO 2	Implement Python programs with conditionals and loops.
CO 3	Develop Python programs step-wise by defining functions and calling them.
CO 4	Use Python lists, tuples, dictionaries for representing compound data.
CO 5	Read and write data from/to files in Python.

LIST OF EXPERIMENTS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO 1	1	1	1									2
CO 2					2						1	2
CO 3						2					2	2
CO 4	2	3	3								2	2
CO 5	2	2	2								2	2

Course Code	ENGINEERING PRACTICE LABORATORY	L	T	P	C
IP620104		0	0	3	1.5
	Course Type:*Practical*				

Course Objective(s):

To provide hands on training in Sawing, planning, making joints in wood materials used in common household wood work, drawing pipe line plan; laying and connecting various pipe fittings used in common, household plumbing work, making a tray out of metal sheet using sheet metal work, wiring various electrical joints in common household electrical wire work and Soldering and testing simple electronic circuits, house wiring system, measurement of electrical quantities, and handling electrical equipment.

Course Outcomes: (COs)

At the end of this course, the students will be able to:

CO 1	Draw pipe line layout and connect various pipe fittings used in common household plumbing work
CO 2	Make a tray out of metal sheet using sheet metal work and join the components using Screws, bolts and rivets.
CO 3	Design House wiring system and measure the various electrical quantities in a circuit
CO 4	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
CO 5	Set IP address, Connecting two computers and verify data transmission.

EXERCISES

CIVIL:

Carpentry& Plumbing: 9

1. Wood sizing exercise in planning, marking, sawing, chiseling and grooving to make; Tee Joint and Dovetail Joint.
2. Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
3. Laying pipe connection to the suction side of a pump

4. Laying pipe connection to the delivery side of a pump.
5. Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

MECHANICAL:

Sheet Metal & Fasteners: 9

1. Fabrication of Dust Pan
2. Fabrication of Square tray.
3. Making bolted joints, screw joints and riveted joints.

ELECTRICALS: 9

1. Residential House wiring using switches, fuse, indicator, lamp and Energy meter
2. Different Types of wiring (Staircase and Fluorescent Lamp wiring)
3. Verification of Ohm's law
4. Measurement of Electrical quantities (Voltage, current, power and power factor in RLC series circuit)
5. Calculation of Magnetic flux in an electrical circuit.

ELECTRONICS: 9

1. Characteristics of PN junction diode
2. Characteristics of Zener diode
3. Half wave and full wave Rectifiers
4. Application of Zener diode as shunt regulator.
5. Characteristics of BJT and JFET

COMPUTER SCIENCE: 9

1. Setting IP address to the client system
2. Network cable crimping and Installation
3. Connecting two computers and verify data transmission
4. Folders and peripherals sharing
5. Creating mail ID

CO PO MAPPING:

Course Outcomes	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3	3	1			1	1		3			
CO 2	3	3	1			1	1		3			
CO 3	2	2	2	3	1	-	-	-	1	2	2	1
CO 4	2	1	3	1					2	1	2	2
CO 5	3	1	2	2					1	2	1	1

INSTITUTE MANDATORY COURSE

Course Code	ENVIRONMENTAL STUDIES	L	T	P	C
IM610401		2	0	0	0
Course Category: *Institute Mandatory*	**Course Type:***Theory*				

Course Objective(s):

The course deals with the fundamentals of environmental engineering and its application in pollution control. It is intended to impart the fundamental knowledge of environmental engineering along with the design aspect of some pollution control equipment. It will also help the young scientific professionals to keep their knowledge upgraded with the current thoughts and newer technology options along with their advances in the field of the environmental/industrial pollution abatement.

Course Outcomes: (COs)

At the end of this course, the students will be able to

CO 1	Identify the sources and effects of pollutants to the environment
CO 2	Understand the various treatment technologies for industrial wastewater
CO 3	Understand the development and applications of various unit operation to control the toxic Elements.
CO 4	Identify the effect of the behavior of air& noise pollutants on the environment.
CO 5	Create awareness about environmental impact assessment (EIA)&Sustainable Development.

UNIT I - INTRODUCTION **4**

Man and environment, types of pollution, pollution controls aspects, Industrial pollution, pollution monitoring and analysis of pollutants, Indian pollution regulations Environmental quality and degradation, Industrial scenario in India.

UNIT II - INDUSTRIAL WASTEWATER TREATMENT **6**

Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts. Regulatory requirements for treatment of industrial wastewater. Industrial Wastewater Treatment method-MembraneTechnologies

UNIT III - SOLID WASTE MANAGEMENT: **6**

Type of waste collection systems, analysis of collection system –alternative techniques for collection system. Separation and Processing and Transformation of Solid Waste: unit operations user for separation and processing, Landfills**:** Site selection, design and operation, drainage and leachate collection systems –E waste - sources, collection, treatment and reuse management., Hazardous waste treatment technologies (Management & Handling) Rules,

UNIT IV - AIR & NOISE POLLUTION **8**

Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, Equipments for control of pollution, air quality standards and limits. Noise Pollution: Types of noise, Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution Effects on human being.

UNIT V - ENVIRONMENTAL LAWS& SUSTAINABLE DEVELOPMENT **8**

Environmental regulations and policies; Environmental protection laws and acts; Corporate and international charters and protocols; Standards and Guidelines, Historical development of Environmental Impact Assessment; Towards Sustainable Future:Concept of Sustainable

Development, Life cycle assessment; Environmental auditing; Eco-labelling of products; Environmental management systems particularly IS 14000 series.Concept of Green Computing.

TEXT BOOKS:

1.M.N. Rao, "Air Pollution", Tata McGraw Hill, 2018
2.Jeffrey Pierce J, "Environmental pollution and control", Butterworth-Heinemann,1998
3. Nicholas P. Cheremisinoff, Handbook of Air Pollution Prevention and Control. ButterworthHeinemann, 2002
4. Noel de Nevers, Air Pollution Control Engg., McGraw-Hill, New York, 2012
5. N.K.Uberoi, Environmental Management, Excel Books, 2006
5. Singal, S.P., Noise Pollution and Control Strategy, Narosa Publishing House,,2005

REFERENCES:

1. Westlake, K, Landfill Waste pollution and Control, Albion Publishing Ltd., England,1995.
2. Garg, S.K., "Environmental Engineering Vol. I & II", Khanna Publishers, New Delhi2012
3. Modi, P.N., "Environmental Engineering Vol. I & II", Standard Book House, Delhi 2013
4. Canter, W.L., Environmental Impact Assessment, McGraw-Hill Inc., 1992
5. Rau, J.G and Wooten, D.C., Environmental Impact Analysis Handbook, McGraw-Hill, 2015.
7. UNEP/IED Technical Report Serial No.2., Environmental Auditing, 1990.
8.. Metcalf &Eddy., Wastewater Engineering – Treatment and Reuse, Tata Mc. Graw-Hill Company, 2019

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/106/105106056/
2. https://nptel.ac.in/courses/105105178
3. MEVE-001: Environmental Impact Assessment for Environmental Health - Course (swayam2.ac.in)
4. https://moef.gov.in/wp-content/uploads/wssd/doc2/ch2.html
5. https://nptel.ac.in/courses/120108004

CO PO MAPPING:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	2	1	2			2	2					2
CO 2	3	2	2	2		2	2					2
CO 3	3	2	2	2		2	3					2
CO 4	3	2	2	1		2	2					2
CO 5	3	1	2			2	2	2	2	2	2	2

SEMESTER III

IC630017 - **NUMERICAL METHODS AND STATISTICS**

Course Category: Institute Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

The objective of this course is to computing a value and being aware of two or more comparable values. When data series are organised as columns, interpolation occasionally aims to predict the future and should be representative in order for researchers to draw conclusions about the larger population and to approximate a bigger population on factors pertinent to the research subject.

UNIT 1: SOLUTION OF EQUATION AND EIGNVALUE PROBLEM **9**

Solution of linear system of equation – Bijection method – fixed point Iteration method – Newton Raphson Method – Ragula Falsi method – Decomposition Method – Gauss Elimination Method – Gauss Jordan Method – Gauss Jacobi Method –Finding largest eigen value- Inverse of matrix by Jordan Method.

UNIT 2: INTERPOLATION AND APPROXIMATING POLYNOMIALS **9**

Lagrangian polynomials – Divided difference formulae for equal intervals and unequal intervals – Interpolating with a cubic spline – Newton's forward and backward difference formulas – Stirlings formula.

UNIT 3: NUMERICAL DIFFERENTIATION AND INTEGRATION **9**

Differentiation using interpolation formulae – Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rule – Romberg's Method – Double integrals using trapezoidal and Simpson's rules.

UNIT 4: THEORY OF ESTIMATION **9**

Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.

UNIT 5: TESTING OF HYPOTHESIS **9**

Sampling distributions – Testing of hypothesis for mean – variance –proportions and differences using Normal–'t'–Chi-square and F-distributions–Tests for independence of distributions of attributes and goodness of fit

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Compute the solutions of the variables using iterative methods.

CO2: Understand and apply methods to find interpolating and approximating polynomials.

CO3: Solve complicated differentiation and integration by numerical methods.

CO4: Identify the type of estimations for small samples and large samples.

CO5: Solve the physical problems by small and large sampling theory.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation
TEXT BOOKS:
1. M.K. JAIN, S.R.K. IYENGAR and R.K. JAIN "Numerical methods: for scientific and engineering computation" 2013. 6th ed.,
2. DEVORE, J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning , New Delhi, 8th Edition, 2014.
3. S.C. GUPTA AND V.K. KAPOOR "*Fundamentals of mathematical statistics*" Elevanth thoroughly revised ed., Sultan Chand & Sons educational publishers, New Delhi (June 2003)
4. T. VEERARAJAN, "*Probability, Statistics and Random Processes"* Tata McGraw-Hill Publishing Company Limited, New Delhi(2006)
REFERENCE BOOKS:
1. SANKARARAO.K " Numerical Methods for Scientists and Engineers" -3rd edition Printice Hall of India Private Ltd. New Delhi-(2007).
2. WALPOLE, R.E., MYERS, R.H., MYERS, S.L. and YE. K., "Probability and Statistics For Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010
3. VEERARAJAN.T AND RAMACHANDRAN. T " Numerical Methods with Programming in C" second Ed., Tata Mc. Graw Hill Publishing. Co. Ltd (2007)

AM630201-INTRODUCTION TO ANALYSIS OF ALGORITHMS						
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- Learn the algorithm analysis techniques.
- Become familiar with the different algorithm design techniques.
- Understand the limitations of Algorithm power.

UNIT 1: INTRODUCTION	**9**
Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework – Asymptotic Notations and its properties – Mathematical analysis for Recursive and Non-recursive algorithms	
UNIT 2: BRUTE FORCE AND DIVIDE-AND-CONQUER	**9**
Brute Force - Closest-Pair -Exhaustive Search - Traveling Salesman Problem - Knapsack Problem - Assignment problem. Divide and conquer methodology – Merge sort – Quick sort – Binary search – Multiplication of Large Integers – Strassen's Matrix Multiplication	
UNIT 3: DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE	**9**
Dynamic Programming – Warshall's and Floyd' algorithm – Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique– Prim's algorithm- Kruskal's Algorithm-Dijkstra's Algorithm-Huffman Trees.	
UNIT 4: LIMITATIONS OF ALGORITHM POWER	**9**
Lower-Bound Arguments - Decision Trees- P, NP and NP-Complete Problems--Coping with the Limitations –– Hard Problems – Approximation Algorithms for NP : Traveling Salesman problem – Knapsack problem.	
UNIT 5: BACTRACKING AND BRANCH AND BOUND	**9**
Backtracking – n-Queens problem – Hamiltonian Circuit Problem – Subset Sum Problem-Branch and Bound – Assignment problem – Knapsack Problem – Traveling Salesman Problem	
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Design algorithms for computing problems and analyze the time and space complexity of algorithms.

CO2: Design algorithms to solve problems using brute force approach and divide and conquer approach.

CO3: Design algorithms to solve problems using greedy strategy and dynamic programming approach.

CO4: Design algorithms to solve approximation problems and understand the concept of Lower bound arguments, P,NP and NP Complete Problems.

CO5: Design algorithms to solve problems using backtracking and branch bound approach.

TEXT BOOKS:

1.Bhasin, H., " Algorithms: Design and Analysis", India: Oxford University Press, 2015.

2.Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.

REFERENCE BOOKS:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2009.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
3. Donald E. Knuth, “The Art of Computer Programming”, Volumes 1& 3 Pearson Education, 2009.
4. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008.

CS630202-Data Structures using C++

Course Category: Programme Core	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of OOPS and basic constructs in C++
- To learn how to define classes, objects, statements and constructors in C++
- To understand the concepts of operator overloading and inheritance in C++
- To understand the concepts of linear data structures and sorting
- To understand the basic concepts of related to operating systems and computer networks

UNIT 1: INTRODUCTION TO OOPS AND C++ **9**

Object oriented programming paradigm – Basic concepts of object oriented programming – Benefits of OOP – A simple C++ program - Basics of C++**:** Tokens – Keywords – Identifiers and constants – Basic data types - Declaration of variables – Operators in C++ – Scope resolution operator – Operator precedence.

UNIT 2: CONTROL STRUCTURES AND STATEMENTS IN C++ **9**

Control structures in C++: if statement – switch statement – do-while statement – while statement – else statement - for statement - Functions in C++: Introduction - The main function – Function prototyping – Call by reference – Return by reference – Inline functions - Method overloading – friend and virtual functions – Math library functions.

UNIT 3: BASIC OOPS CONCEPTS IN C++ **9**

Specifying a class – Defining member functions – A C++ program with class – Parameterized constructors – Multiple constructors in a class – Constructors with default arguments – Copy constructor – Destructors - Operator overloading – Inheritance - Single inheritance – Multilevel inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance.

UNIT 4: BASIC DATA STRUCTURES AND SORTING **9**

Algorithm – Analysis – List ADT – Stack ADT – Queue ADT – Priority Queue – Stack implementation – Basic operations on stack – Application of stack – Queue: Introduction – Definition of Queue – implementation of Queue – Operation on a Queue – Applications of Queue – Sorting : bubble sort-Insertion sort - Merge sort - Quick sort-Searching - hashing

UNIT 5: GRAPH AND TREES **9**

Trees: Introduction – Tree – Basic elements of a tree – Binary tree – Representation of binary tree – Operations on binary tree – AVL Tcree – Operations on AVL Tree - Graph: Representation - Shortest path algorithm: Dijikstra's algorithm - Minimum spanning tree: Prim's Algorithm

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1:Understand the difference between object-oriented programming and procedural oriented language and data types in C++
CO2:Implement C++ programs with features such as composition of objects, Polymorphism.
CO3: Implement C++ programs with features such as Operator overloading and inheritance
CO4: Choose an appropriate data structure for a particular problem
CO5:Simulate problems in the subjects like Operating system, Computer networks and also real-world problems in C++
TEXT BOOKS:
1. E. Balagurusamy, "Object Oriented Programming with C++", Fifth Edition, Tata McGraw Hill, 2011 (Unit I, II and III) 2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Third edition, Pearson Education Asia, 2010. (Unit IVand V)
REFERENCE BOOKS:
1. M.T. Somashekara, Programming In C++, PHI Pvt. Ltd., 2008
2. B.Trivedi, Programming with ANSI C++, Oxford University Press, 2007

CS630203-Database Management Systems

Course Category: Programme Core	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the basic organization of a Database Management System.
- To study about Relational Database Management Structure
- To study about the design issues of a Database
- To study about transaction management of the database
- To study about various implementation techniques

UNIT 1: INTRODUCTION	**9**

Purpose of Database System - Files versus database systems – View of Data – Database Language - Database Architecture – Database users and administrators – History of Database System - E-R model – Constraints- E-R Diagram

UNIT 2: RELATIONAL MODEL	**9**

Relational Model – Structure of Relational Databases – Relational Algebra Operations – Null Values – Modification of Relational Databases- SQL – Advanced SQL- Integrity Constraints – Authorization – Embedded SQL – Dynamic SQL- The Tuple Relational Calculus – The Domain Relational Calculus - QBE – Triggers.

UNIT 3: DATABASE DESIGN	**9**

Functional Dependencies – Non-loss Decomposition – Functional Dependencies – 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 4: TRANSACTIONS	**9**

Transaction Concepts - Transaction Recovery – ACID Properties – System Recovery – Media Recovery – Two Phase Commit - Save Points – SQL Facilities for recovery – Concurrency – Need for Concurrency – Locking Protocols – Two Phase Locking – Intent Locking – Deadlock- Serializability – Recovery Isolation Levels – SQL Facilities for Concurrency.

UNIT 5: IMPLEMENTATION TECHNIQUES	**9**

Physical Storage Media – Magnetic Disks – RAID – Tertiary storage – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static and Dynamic Hashing – Query Processing Overview – Catalog Information for Cost Estimation – Selection Operation – Sorting – Join Operation – Web Technology and DBMS – Web as a Database Application Platform

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1:Understand the major objectives of database technology

CO2:Understand the relational model for databases

CO3: Design issues of Database
CO4: Identify the problems in Transaction
CO5:Analyze the issues involved in Implementation
TEXT BOOKS:
1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011 (Unit I and Unit-V). 2. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.(Unit II, III and IV)
REFERENCE BOOKS:
1. M.T. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition , Pearson / Addisionwesley, 2007. 2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003., "Programming In C++", PHI Pvt. Ltd., 2008

CS630204-Operating Systems

Course Category: Programme Core	Course Type: Theory with Practical Component	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To gain knowledge about various advanced techniques and concepts involved in operating systems
- To incorporate knowledge to processes and threads
- To know the concept of semaphore and deadlock
- To study about the various storage strategies
- To study about the concepts of I/O systems

UNIT 1: OPERATING SYSTEMS OVERVIEW	**6**
Operating system – Main frame systems – Desktop systems – Multiprocessor systems – Distributed systems – Clustered systems – Real-time systems – Handheld systems – Operating System structures: System components – Operating system services - System calls – System programs – System structure	
UNIT 2: PROCESSES AND THREADS	**6**
Process: Process concept – Process scheduling – Operations on processes – Cooperating processes – Interprocess communication – Communication in client-server systems - Threads: Overview - Multithreading models – Threading issues – Pthreads - CPU Scheduling: Basic concepts - Scheduling criteria – Scheduling algorithms – Multiple-processor scheduling – Real time scheduling.	
UNIT 3: PROCESS MANAGEMENT	**6**
Process synchronization: The critical-section problem – Synchronization hardware – Semaphores – Classic problems of synchronization – Critical regions – Monitors –Deadlocks: System model – Deadlock characterization – Methods for handling deadlocks – Recovery from deadlock	
UNIT 4: STORAGE MANAGEMENT	**6**
Memory Management: Background -Swapping – Contiguous memory allocation – Paging – Segmentation – Segmentation with paging - Virtual Memory: Background – Demand paging – Process creation – Page replacement – Allocation of frames – Thrashing	
UNIT 5: I/O SYSTEMS	**6**
File-system interface: File concept – Access methods – Directory structure – File-system mounting – File sharing - Protection – File-system implementation: Directory implementation – Allocation methods – Free-space management – Mass storage structure: Disk structure - Disk scheduling – Disk management – Swap-space management	

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1:Understand the fundamental concepts of operating system

CO2:Understand the concept of processes and threads scheduling

CO3: Analyze the various semaphores techniques and the deadlock handling mechanism

CO4:Analyze the different storage management strategies

CO5:Understand the concept of I/O systems

List of Exercises:

1. Create new processes and do communicate using pipe
2. Make communication between the processes using shared memory and message queue
3. Simulate the following CPU scheduling algorithms a) FIFO b) SJF c) Priority d) Round Robin
4. Implement Peterson's solution using semaphore
5. Implement dinning philosopher problem using semaphore
6. Simulate Bankers Algorithm for Dead Lock Avoidance
7. Simulate Bankers Algorithm for Dead Lock Prevention
8. Simulate all File Organization Techniques a) Single level directory b) Two level c) Hierarchical d) DAG
9. Simulate Paging Technique of memory management
10. Simulate all page replacement algorithms a) FIFO b) LRU c) LFU

TOTAL: 30+15=45 PERIODS

TEXT BOOKS:

1. Silberschatz, Galvin and Gagne, "Operating System Concepts", Eighth Edition, John Wiley & Sons Inc., Reprint 2011

REFERENCE BOOKS:

1. William Stallings, " Operating Systems: Internals and Design Principles" Seventh Edition ,Pearson Education, 2011
2. H M Deital, P J Deital and D R Choffnes, "Operating Systems", Pearson Education, 2004.
3. Pramod Chandra P Bhatt, "An Introduction to Operating Systems : Concepts and Practice", PHI Learning Pvt. Ltd.,2010

CS630301-Data Structures using C++ laboratory

Course Category: Programme Core	Course Type: Practical	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To understand the basic concepts of OOPS, Basic constructs in C++
- To learn how to define classes, objects, statements, operator overloading, inheritance and constructors in C++
- To understand the concepts of linear data structures (arrays, stacks, queues) and sorting
- To understand the usage of graph structures and spanning trees.
- To learn about Huffman Coding

Pre-requisites, if any: Basic Knowledge about Data Structures

LIST OF EXPERIMENTS:

1. Develop a program for finding the sum of individual digits of a given number by using looping statements.
2. Implement a program that uses a function to find the factorial of a given number.
3. Find both the largest and smallest number in a list of integers after arranging them in ascending order by using Array concept.
4. Develop a C++ program that uses to find prime numbers.
5. Implement a program using overloaded constructors
6. Implement a program that illustrates how Single inheritance is supported.
7. Implement a program that illustrate how Multi level inheritance is supported
8. Develop a C++ program for Stack implementation using arrays
9. Implementing an Queue by using arrays
10. Implementing queue ADT using linked list
11. Design and implementing Binary tree traversals
12. Design a C++ program for sorting N numbers using Insertion Sort
13. Design a C++ program for sorting N numbers using Quick Sort
14. Design a C++ program for sorting N numbers using Merge Sort
15. Develop a C++ program for implementing Prim's Algorithm

TOTAL: 30 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand the difference between object oriented programming and procedural oriented language and data types in C++

CO2: Implement C++ programs with features such as composition of objects, Polymorphism.

CO3: Implement C++ programs with features such as Operator overloading and inheritance

CO4: Choose an appropriate data structure for a particular problem

CO5: Simulate problems in the subjects like Operating system, Computer networks and also real world problems in C++

Hardware Requirements:

- l Desktop Systems - Pentium IV with 2 GB RAM
- 160 GB HARD Disk
- Monitor 1024 x 768 color

Software Requirements:

- Windows Operating System.
- Dev C++/C/Equivalent Compiler.
- JDK 1.8

TEXT BOOKS:

1. S.Sridhar, “Design and Analysis of Algorithms”, Oxford University Press, 1st Edition, 2014.
2. Adam Drozdex, “Data Structures and algorithms in C++”, Cengage Learning, 4th Edition, 2013.
3. Ellis Horowitz, SartajShani, SanguthevarRajasekaran, “Fundamentals Of Computer Algorithms”. India, Misc, 2010.

REFERENCE BOOKS:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", Second Edition, Prentice Hall of India Ltd
2. Mark Allen Weiss, “Data Structures and Algorithms in C++”, Pearson Education, 3rd Edition, 2009

CS630302-Database Management System laboratory						
Course Category: Programme Core	**Course Type: Practical**	**L**	**T**	**P**	**C**	
		0	**0**	**3**	**1.5**	

COURSE OBJECTIVES:

- To create and manipulate their own database
- To use SQL Commands for accessing the Database
- To design a small application with backend
- To design a form for various applications
- To implement a mini Project

LIST OF EXPERIMENTS:

1. Design and Develop Schema
2. Create Queries for DDL and DML Commands like Insert, Select Commands, Update & Delete Commands.
3. Develop tables using Nested Queries & Join Queries
4. Develop tables using Views
5. Developing various programs using Control structures, Procedures and Functions.
6. Design various User Interfaces as Front end tools
7. Connecting databases with Front end interfaces
8. Form Designing for various applications
9. Menu Design for some simple real time applications
10. Generating reports
11. Database Design and implementation (Mini Project).

TOTAL: 30 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1:Create and manipulate their own databases

CO2:Understand various SQL commands for accessing the database

CO3: Implement a small application with database accessing

CO4:Design a form for various applications

CO5:Implement a mini Project

Hardware Requirements:

30 Personal Computers

Software Requirements:

Front end : VB/VC ++/JAVA

Back end: Oracle 11g, my SQL, DB2

Platform: Windows 2000 Professional/XP

Oracle server could be loaded and can be connected from individual PCs.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011 (Unit I and Unit-V)
2. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.(Unit II, III and IV)

REFERENCE BOOKS:

1. M.T. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition , Pearson / Addisionwesley, 2007

2. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003., "Programming In C++", PHI Pvt. Ltd., 2008

CS630501: **Integrated Aptitude Skills – I (Lower)**

QUANTITATIVE APTITUDE	LOGICAL REASONING	VERBAL ABILITY
1. Numbers – Number Systems, Types of Numbers, Series (Arithmetic Progression, Geometric Progression) 2. Problem on Ages 3. HCF & LCM 4. Profit & Loss 5. Problems on Trains, Boats& Stream 6. Calendar & Clocks 7. Time & Work 8. Speed & Distance (Or) Time & Distance 9. Decimal Fractions, Simplification (Including Expression & Evaluation) 10. Square Root, Cubic Root 11. Average 12. Surds & Indices 13. Odd Man Out & Series	1. Series completion 2. Analogy 3. Classification 4. Coding-Decoding 5. Blood Relation 6. Puzzle test 7. Sequential Output Tracing 8. Direction sense test 9. Logical Venn Diagram 10. Alphabet Test 11. Alpha-numeric sequence Puzzle 12. Number, Ranking and Time sequence Test 13. Mathematical Operations 14. Logical Sequence of words 15. Arithmetical Reasoning 16. Inserting the mission character 17. Data Sufficiency 18. Eligibility test 19. Assertions and Reasoning 20. Situation Reaction Test 21. Verification of truth of the statement	1. Vocabulary Based - Synonyms 2. Vocabulary Based - Antonyms 3. Spotting Errors 4. Spelling 5. Jumbled words 6. One word substitution 7. Sentence Correction 8. Idioms & Phrases. 9. Commonly confusing words 10. Statement and Conclusion 11. Change of Voice 12. Facts/Inferences and Judgment.

Text Books:

1. Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, First Edition1989, Reprint, 2016
2. Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1994, Reprint, 2016
3. Agarwal R.S, "Objective General English," S.Chand and Company Pvt. Ltd.,New Delhi, FirstEdition 1997, Reprint, 2016

Reference Books:

1. Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd., New Delhi, Edition, 2016
2. Arun Sharma, "How to Prepare for Logical Reasoning," Tata-McGraw Hill Education Series. NewDelhi, First Edition 2016
3. Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers. First Edition 1995,Reprint, 2016
4. The Princeton Review, "Cracking the GRE", Random House Publisher, Premium Edition 2016.
5. Mark Alan Steward, J D,"30 days to the GMAT CAT", Arco Publishers, 2nd Edition 2016.

IM630402 - **UNIVERSAL HUMAN VALUES**						
Course Category: Institute Mandatory	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		2	**0**	**0**	**0**	

COURSE OBJECTIVES:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

UNIT 1: COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION	**6**
Need for Value Education, basic guidelines, content and process for Value - the basic requirements for fulfillment of aspirations of every human being with their correct priority. Right Understanding, relationship and Physical Facility. Happiness and Prosperity correctly-understanding and living in harmony at various levels. Process of Value Education – Selfexploration	
UNIT 2: UNDERSTANDING HARMONY IN THE HUMAN BEING	**6**
Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. 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 Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Swasthya	
UNIT 3: UNDERSTANDING HARMONY IN THE FAMILY	**6**
Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human-human relationship - the foundational values of relationship. Difference between intention and competence. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship.	
UNIT 4: UNDERSTANDING THE HARMONY IN THE SOCIETY	**6**
Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals. Health and self regulation. Harmony from Family Order to World Family Order – Process of Development of a Child – In an environment of Relationship.	
UNIT 5: UNDERSTANDING HARMONY IN THE NATURE	**6**
Understanding the harmony in the Nature. Interconnectedness, Self-regulation and Mutual Fulfilment among the Four. Realizing Existence as Co-existence at All Levels. Holistic perception of harmony at all levels of existence.	
TOTAL: 30 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand the significance of value inputs in a classroom and start applying them in their life and profession

CO2: Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO3: Understand the value of harmonious relationship based on trust and respect in their life and profession
CO4: Understand the role of a human being in ensuring harmony in society and nature.
CO5: Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.
TEXT BOOKS:
1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
REFERENCE BOOKS:
1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. AICTE, FDP –Course material

SEMESTER - IV

IC640018 - **BOUNDARY VALUE PROBLEMS AND PROBABILITY DISTRIBUTION**

Course Category: Institute Core	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

Objective of the subject is to provide a venue for the promotion, encouragement, and interdisciplinary collaboration of various fields using the theory, techniques, and applications of boundary value problems and Make predictions about the likelihood of specific events using the probability distribution for discrete random variables (general, binomial,). Students will use the normal distribution's fundamentals to calculate probability. Implement a normal distribution. Check out a normal distribution.

UNIT 1: INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	**9**

Single Step Methods: Taylor Series Method – Euler Method for First Order Equation – Fourth Order Runge – Kutta Method for Solving First and Second Order Equations – Multistep Methods: Milne's and Adam's Predictor and Corrector Methods.

UNIT 2: BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS	**9**

Finite Difference Solution of Second Order Ordinary Differential Equation – Finite Difference Solution of One Dimensional Heat Equation by Explicit and Implicit Methods – One Dimensional Wave Equation and Two Dimensional Laplace and Poisson Equations

UNIT 3: PROBABILITY AND RANDOM VARIABLES	**9**

Random experiment – sample space – concept of probability Axioms of Probability – conditional probability –Total probability - Baye's theorem - Discrete and continuous type of random variables - Moments - Moment generating functions and their properties

UNIT 4: STANDARD DISTRIBUTIONS	**9**

Discrete distributions: Binomial, Poisson, Geometric, Negative Binomial – Continuous distributions - Uniform, Normal, Exponential, Gamma, and Weibull distributions – Mean and variance of distribution – Method of finding Mean and variance using MGF

UNIT 5: TWO DIMENSIONAL RANDOM VARIABLES	**9**

Joint distributions - Marginal and conditional distributions -Independent random variables - Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem with its applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Apply the method of finding numerical solution for differential equation by initial value problems and terminal problem

CO2: Apply the method of finding numerical solution for differential equation by boundary value problems and with their application.

CO3: Gain knowledge about conditional probability and applications of Baye's theorem.

CO4: Identify the different types of distribution and apply in real life.

CO5: Apply the discrete data to analyse the correlation and regression.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. M.K. JAIN, S.R.K. IYENGAR and R.K. JAIN "Numerical methods: for scientific and engineering computation" 2013. 6th ed.,

2. DEVORE, J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning , New Delhi, 8th Edition, 2014.

3. S.C. GUPTA AND V.K. KAPOOR "*Fundamentals of mathematical statistics*" Elevanth thoroughly revised ed., Sultan Chand & Sons educational publishers, New Delhi (June 2003)

4. T. VEERARAJAN, "*Probability, Statistics and Random Processes"* Tata McGraw-Hill Publishing Company Limited, New Delhi(2006)

REFERENCE BOOKS:

1. VEERARAJAN.T AND RAMACHANDRAN. T " Numerical Methods with Programming in C" second Ed., Tata Mc. Graw Hill Publishing. Co. Ltd (2007)

2. SANKARARAO.K " Numerical Methods for Scientists and Engineers" - 3rd edition Printice Hall of India Private Ltd. New Delhi-(2007).

3.WALPOLE, R.E., MYERS, R.H., MYERS, S.L. and YE. K., "Probability and Statistics For Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

AM640202-Data Science Essentials

Course Category: Programme Core	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT 1: INTRODUCTION TO DATA SCIENCE	**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

UNIT 2 : DESCRIBING DATA	**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

UNIT 3: DESCRIBING RELATIONSHIPS	**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

UNIT 4: PYTHON LIBRARIES FOR DATA WRANGLING	**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 5: DATA VISUALIZATION	**9**

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand the basic concepts of Data Science to practice Python functionality and libraries.

CO2: Understand different types of data description for data science process.

CO3: Gain knowledge on relationships between datas.

CO4: Use the Python Libraries for Data Wrangling.

CO5: Apply visualization Libraries in Python to interpret and explore data.
TEXT BOOKS:
1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. 2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017 3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.
REFERENCE BOOKS:
1. Allen B. Doney, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014

CS640205-Object Oriented Programming using JAVA						
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- To learn about Java features
- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the basic principles of inheritance and interfaces
- To develop Java applications with threads and package
- To define exceptions and use I/O streams

UNIT 1: INTRODUCTION	**9**
Fundamentals of Object-Oriented Programming - Java Features – Difference between Java and C - Java Environment - Overview of Java Language: Introduction - Simple Java Program - Java Program Structure – Java Tokens – Java statements – Implementing a Java program – Java Virtual Machine – Command line arguments – Constants, variables and Data Types – Operators and Expressions – Branching and Looping	

UNIT 2: BASIC CONSTRUCTS	**9**
Class: Introduction – Defining a Class – Fields Declaration – Methods Declaration – Creating Objects – Accessing Class Members – Constructors – Method Overloading – Static Members – Nesting of Methods – Arrays, Strings and Vectors: Introduction – One-Dimensional Arrays – Creating an Array – Two-Dimensional Arrays – Strings	

UNIT 3: INHERITANCE AND INTERFACES	**9**
Inheritance: Extending a class – Overriding methods – Final Variables and Methods – Final Classes – Finalizer Methods – Abstract Methods and Classes – Visibility Control - Interfaces: Multiple Inheritance: Introduction – Defining Interfaces – Extending Interfaces – Implementing Interfaces – Accessing Interface Variables	

UNIT 4: PACKAGES AND MULTITHREADING	**9**
Packages: – Java API Packages – Using System Packages – Naming Conventions – Creating Packages – Accessing a Package – Using a Package – Adding a Class to a Package – Hiding Classes - Multithreaded Programming: Introduction – Life Cycle of a Thread – – Creating Threads – Extending the Thread Class - Implementing the 'Runnable' Interface - Stopping and Blocking a Thread — Using Thread Methods	

UNIT 5: EXCEPTION AND I/O HANDLING	**9**
Exception Handling: Introduction – Types of Errors – Exceptions – Syntax of Exception Handling Code – Multiple Catch Statements – Using Finally Statement – Throwing Our Own Exceptions - Input/output: Introduction – Concept of Streams – Stream Classes – Byte Stream Classes – Character Stream Classes – Handling Primitive Data Types - Simple input and output	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1:Understand to implement, compile, test and run Java program

CO2:Develop Java programs using OOP principles

CO3: Develop Java programs implementing the concepts of inheritance and interfaces

CO4: Develop multi-threaded and package Java applications

CO5: Build Java applications with exception handling and using I/O streams

TEXT BOOKS:

1. E. Balagurusamy, "Programming with Java: A Primer", Fourth Edition, First reprint, Tata McGraw Hill, Reprint 2011

REFERENCE BOOKS:

1. Herbert Schildt, "Java: A Beginner's Guide", 4thEdition, Tata McGraw Hill, 2007
2. C. Xavier, "Java Programming: A Practical Approach", Tata McGraw Hill, 2011
3. Paul Deitel& Harvey Deitel, "Java How to Program", Eleventh Edition, Pearson Education Ltd. 2017

AM640203-ARTIFICIAL INTELLIGENCE AND REASONING						
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

• To understand the foundational approaches to Artificial Intelligence
• To design problem-solving and search-based agents
• To apply techniques from game theory and constraint satisfaction
• To implement logical inference using propositional and first-order logic
• To model uncertainty and make decisions using probabilistic reasoning

UNIT 1: INTELLIGENT AGENTS	**9**

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies

UNIT 2: PROBLEM SOLVING	**9**

Heuristic search strategies – heuristic functions. - Manhattan distance in pathfinding - Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments – A* algorithm

UNIT 3: GAME PLAYING AND CSP	**9**

Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP.

UNIT 4: LOGICAL REASONING	**9**

Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic-– Declarative Vs Proportional. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution.

UNIT 5:PROBABILISTIC REASONING	**9**

Acting under uncertainty – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

TOTAL: 30+15=45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:Explain intelligent agent frameworks

CO2:Apply problem solving techniques

CO3:Apply game playing and CSP techniques

CO4:Perform logical reasoning

CO5:Perform probabilistic reasoning under uncertainty

Lab Experiments:

1. Implementation of toy problems
2. Developing agent programs for real world problems
3. Implementation of constraint satisfaction problems
4. Developing Best first search and A* Algorithm for real world problems

5. Implementation of unification and resolution for real world problems. 6. Implementation of block world problem
TEXT BOOKS:
1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
REFERENCE BOOKS:
1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007 2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008 3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education,

CS640303-Java Programming laboratory

Course Category: Programme Core	Course Type: Practical	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To develop simple Java programs
- To apply reusability using the concept of inheritance, Package and Interfaces concept to achieve reusability.
- To develop applications with appropriate exception handling& Multithreading
- To Implement the concept of Exception Handling.
- To Develop a multi-threaded Java program

LIST OF EXPERIMENTS:

1. Develop a Java program to generate the first 'N'terms of the Fibonacci sequence
2. Implement a Java program to generate the first 'N' Prime numbers using looping statements
3. Develop a Java program to determine if the given string is a Palindrome or not
4. Develop a Java program to find both the largest and smallest number in a list of integers after arranging them in ascending order
5. Implement a Java program to check if two matrices can be multiplied and perform matrix multiplication if possible. if not display a suitable message
6. Illustrate Function Overloading by:

    a) Swapping Two Integers
    b) Swapping Two Real Numbers

7. Illustrate how Single Inheritance is supported and demonstrate use of method overriding
8. Develop with suitable hierarchy, classes for Point, Shape and Rectangle. Design a simple test application to demonstrate dynamic polymorphism
9. Demonstrate how interfaces are created, implemented and inherited
10. Implement the concept of importing classes from user defined package
11. Develop a multi-threaded Java program with one thread to print all prime numbers below 100 and another to print all Fibonacci numbers less than 100
12. Implement the concept of Exception Handling using predefined and user-defined exceptions

TOTAL: 30 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Develop and implement Java programs for simple applications that make use of classes

CO2: Understand the use of inheritance, Package and Interfaces concept to achieve reusability

CO3: Implement Java programs with exception handling& Multithreading

CO4: Implement the concept of Exception Handling.

CO5: Develop a multi-threaded Java program

Hardware Requirements:

LAN System with 30 nodes (Or) Standalone PCs – 30 Nos.

Software Requirements:

- OS - Windows 2000 Professional/XP
- Java IDE (such as Net beans) or JDK 1.6 or above

TEXT BOOKS:

1. E. Balagurusamy, "Programming with Java: A Primer", Fourth Edition, First reprint, Tata McGraw Hill, Reprint 2011

REFERENCE BOOKS:

1. Herbert Schildt, "Java: A Beginner's Guide", 4th Edition, Tata McGraw Hill, 2007

2. C. Xavier, "Java Programming: A Practical Approach", Tata McGraw Hill, 2011

AM640301-Data Science Laboratory

Course Category: Programme Core	Course Type: Practical	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

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

LIST OF 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

TOTAL: 30 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Make use of the python libraries for data science

CO2: Make use of the basic Statistical and Probability measures for data science.

CO3: Perform descriptive analytics on the benchmark data sets

CO4: Perform correlation and regression analytics on standard data sets CS3361 Data Science Laboratory.

CO5: Present and interpret data using visualization packages in Python.

Python 3.10 Desktop Systems: 30 Nos
Anaconda Navigator/Jupyter/Spyder/Colab
TEXTBOOKS: 1. Joel Grus ,"Data Science from Scratch",O 'Reilly Publishers, First Edition,2015 2. Wes McKinney,"Python for data analysis",O'Reilly Media.Second edition, 2017

INTEGRATED APTITUDE SKILLS – II (LOWER)

Course Category: EEC	Course Type: Skill based course	L	T	P	C
		0	0	1	0.5

COURSE OBJECTIVES:

- To understand the basic concepts of quantitative ability
- To understand the basic concepts of logical reasoning Skills
- To acquire satisfactory competency in use of verbal reasoning

UNIT 1: QUANTITATIVE APTITUDE(SET 1) — **9**

Percentage -Ratio & Proportions -Pipes & Cisterns-Permutations & Combinations Partnership-Alligation (Or) Mixture-Races & Games -**Stocks & Shares**

UNIT 2: QUANTITATIVE APTITUDE(SET 2) — **9**

Height & Distance-True Discount & Banker's Discount -Probability-Mensuration (Area, Volume & Surface Area)-Interest (Simple Interest, Compound Interest)-Logarithm-Chain Rule -Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)

UNIT 3: LOGICAL REASONING(Verbal Reasoning) — **9**

Logic -Statement – Argument -Statement – Assumptions -Statement –Courses of action Statement –Conclusion -Deriving Conclusion from passages -Theme Detection -Cause and Effect reasoning

UNIT 4: LOGICAL REASONING(Non - Verbal Reasoning) — **9**

Series-Analogy -Classification -Analytical Reasoning -Mirror – Images -Water – Images-Spotting out the embedded figures -Completion of incomplete patterns -Figure Matrix-Paper Folding-Paper Cutting-Rule Detection-Grouping of identical figures -Cubes and Dice

UNIT 5: VERBAL ABILITY — **9**

Concord -Cloze Passage-Analogies or Reverse Analogies-Jumbled Sentences-Error Deduction-Reading Comprehension Paragraph Formation-Completing Statements -Usage of Prepositions-Inference(Theme Detection)-Verification of Truth from the Statements Change of Speech

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand the basic concepts of quantitative ability

CO2: Understand the basic concepts of logical reasoning Skills

CO3: Acquire satisfactory competency in use of verbal reasoning

CO4: Apply non-verbal reasoning skills to analyze and solve problems

CO5: Apply verbal ability skills to analyze and solve problems

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2								1	2		
CO2	2	1	1											
CO3	1	2	1									2		
CO4	2	2									2	2		
CO5	2	1	2								2	1		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2016

2. Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1994, Reprint, 2016

3.Agarwal R.S, "Objective General English," S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1997, Reprint,2016

REFERENCE BOOKS:

1. Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd., New Delhi, Edition, 2016
2. Arun Sharma, "How to Prepare for Logical Reasoning," Tata-McGraw Hill Education Series. New Delhi, First Edition 2016
3. Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers. First Edition 1995, Reprint, 2016

WEB RESOURCES:

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

1. https://prepinsta.com/learn-aptitude/

SEMESTER – V

CS650208 - COMPUTER NETWORKS AND MANAGEMENT

Course Category: Programme Core	Course Type: Theory with Practical Component	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the concepts of physical layer
- To study the concepts of data link layer
- To introduce function with network layer
- To make the students get familiarized with transport and Application layer
- To understand the principles of network management.

UNIT 1: INTRODUCTION AND PHYSICAL LAYER	**6**
Introduction: Data Communication-Network types - Reference models: The OSI reference model – The TCP/IP reference model - The Physical layer: Data and Signals	
UNIT 2: DATA LINK LAYER	**6**
Introduction to Data link layer- Error detection and correction: Introduction-Block Coding-Cyclic Codes-Checksum –Data Link Control: DLC Services- Framing - Flow and Error control - Connectionless and Connection Oriented-Data Link Layer Protocols: Simple Protocol-Stop and Wait Protocol-HDLC	
UNIT 3: NETWORK LAYER	**6**
Network layer services – Packet switching – Network layer performance - IPv4: Address space – Classful addressing – Classless addressing – Forwarding of IP packets – Network layer protocols: Internet Protocol – Unicast routing: Introduction - Routing algorithms – Unicast routing protocols	
UNIT 4: TRANSPORT AND APPLICATION LAYER	**6**
Introduction: Transport Layer Services – Transport layer protocols-Transmission control protocol- Stop and wait protocol – Go back N protocol – Selective repeat Introduction – Client server programming – Standard client server protocols - Electronicmail: Architecture – Web based email – Telnet: Local Vs Remote Logging	
UNIT 5: NETWORK MANAGEMENT	**6**
Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.	

TOTAL: 30 PERIODS

LAB EXEPERIMENTS:

- Implementation of RPC
- Implementation of RMI
- Simulation of Network Management Protocols
- Implementation of PING Service
- Program for Remote Command Execution
- Simulation using Wireshark tool - Analyze the network traffic using Wireshark tools
- Simulation using Packet Tracer - Design a Network using Packet Tracer

TOTAL : 15 PERIODS
COURSE OUTCOMES: At the end of the course, the student will be able to,
CO1: Understand the basic concepts of Physical Layer and its functions
CO2: Understand the concept of Data Link Layer and its functions
CO3: Analyze the various methods in network layer and its functions.
CO4: Analyze the different techniques on Transport layer & Application layer and its functions
CO5: Understand fundamental goals, organization, and functions of network management
TEXT BOOKS:
1. Behrouz A. Forouzan, "Data communication and networking", Fifth Edition,McGraw-Hill Education (India) Pvt. Ltd. 2013
2. Mani Subramanian, Network Management Principles and Practice, 2nd Edition,Pearson Education, 2010.
REFERENCE BOOKS:
1. William S.Stallings,"Data and Computer Communications", Ninth Edition,Prentice-Hall,2011.
2. Tanenbaum and David Wetherall, "Computer Networks", Fifth Edition, Prentice-Hall, 2011.
1. Mark Burges, Principles of Network System Administration, 1st Edition, Wiley DreamTech, 2008.
WEB RESOURCES:
1. https://csc-knu.github.io/sys-prog/books/Andrew%20S.%20Tanenbaum%20-%20Computer%20Networks.pdf
2. https://www.tutorialspoint.com/what-is-network-management

AM650204-ARTIFICIAL INTELLIGENCE TECHNIQUE						
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

1. Understand the basic concepts and approaches of Artificial Intelligence.
2. Explain the fundamentals of intelligent agents and machine learning techniques.
3. Apply different search and problem-solving methods in AI.
4. Use AI techniques to solve real-world problems.
5. Develop logical reasoning skills using propositional and predicate logic.

UNIT 1: INTRODUCTION AND STIMULUS RESPONSE	**9**
AI: Acting Humanly, thinking humanly, thinking rationally, acting rationally - Approaches to Artificial Intelligence – The History of AI – Stimulus-Response Agents: Perception and Action, Representing and Implementing Action Functions.	
UNIT 2: SOFTWARE AGENTS	**9**
Software Agents – Architecture for Intelligent Agents – Agent Communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent Systems. Machine Learning: Forms of Learning – Supervised & Unsupervised Learning – Learning Decision Trees – Model Selection and Optimization – Linear Regression and Classification – Ensemble Learning – Developing Machine Learning Systems.	
UNIT 3: INTELLIGENT AGENTS	**9**
Agents and Environments – Good Behavior: The Concept of Rationality – The Nature of Environments – The Structure of Agents: Agent programs, Simple reflex Agents, Model-based reflex agents, Goal-based agents, Utility-based Agents, Learning Agents.	
UNIT 4: FORMULATING THE PROBLEM	**9**
Tower of Hanoi - Backtracking: N-Queens – Depth-First-Search – Breadth-First-Search –Annealing – Min-Max Algorithm – Gaming – PAEAS.	
UNIT 5: PROPOSITIONAL CALCULUS AND PREDICATE CALCULUS	**9**
Propositional Calculus: The Language – Rules of Inference – Semantics – A New Rule of Inference: Resolution, Predicate Calculus: The language and its Syntax – Quantification – Semantics of Quantifiers – Predicate Calculus as a Language for Representing Knowledge	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Explain the fundamental concepts, approaches, and history of Artificial Intelligence and stimulus-response agents.

CO2: Analyze software agents, agent communication, and basic machine learning techniques.

CO3: Differentiate various types of intelligent agents and evaluate their behavior in different environments.

CO4: Apply search algorithms and problem-solving techniques to solve AI problems.

CO5: Use propositional and predicate logic for knowledge representation and reasoning.

TEXT BOOKS:

1. Russell, S. and Norvig, P. 2020. Artificial Intelligence - A Modern Approach, 4th edition, Prentice Hall.
2. Efraim Turban and Jay E. 2002. Aronson Decision Support Systems and Intelligent Systems, 6th edition, Pearson Education
3. Castillo, E., Gutiérrez, J. M., and Hadi, A. S. 2012. Expert Systems and Probabilistic Network Models, Springer-Verlag.
4. Ric, E., Knight, K and Shankar, B. 2017. Artificial Intelligence, 3rd edition, Tata McGraw Hill.

REFERENCE BOOKS:

1. Alpaydin, E. 2015. Introduction to Machine Learning. 3rd edition.

2.. Alpaydin, E. 2015. Introduction to Machine Learning. 3rd edition.
3. Sutton R.S. and Barto, A.G. 2018. Reinforcement Learning: An Introduction, 2nd Edition MIT Press.
4. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.

WEB RESOURCES

1. **https://www.geeksforgeeks.org/artificial-intelligence/what-is-an-ai-technique/**
2. **https://www.theknowledgeacademy.com/blog/artificial-intelligence-techniques/**

AD650208 - Data Warehousing and Data Mining

Course Category: Institute Core	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the principles of Data warehousing and Data Mining.
2. To be familiar with the Data warehouse architecture and its Implementation.
3. To know the Architecture of a Data Mining system.
4. To understand the various Data preprocessing Methods.
5. To perform classification and prediction of data.

UNIT 1: DATA WAREHOUSING AND BUSINESS ANALYSIS — **9**

Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse – Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

UNIT 2: DATA MINING & ASSOCIATION RULE MINING — **9**

Data Mining: - Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

UNIT 3: CLASSIFICATION AND PREDICTION — **9**

Classification and Prediction: - Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT 4: CLUSTER ANALYSIS — **9**

Cluster Analysis: - Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT 5: -DATA MINING METHODOLOGIES APPLICATIONS AND TRENDS — **9**

Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

total: 45 periods

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand my data warehouse and OLAP technology.

CO2: Apply various data preprocessing technology.

CO3: Identify appropriate data mining classification algorithms to solve real world problem.

CO4: Udentify out of your data mining clustering algorithm to solve real world problem.

CO5: Understand the other data mining methodologies application and trends.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3

CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	2	2	-	-	-	1	-	1	2	3	2	2
CO3	3	2	2	2	2	-	-	-	1	-	1	2	3	3	2
CO4	3	2	2	2	2	-	-	-	1	-	1	2	3	3	3
CO5	3	2	-	2	2	-	-	-	1	-	1	2	2	2	3

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.JiaweiHan,MichelineKamber,JianPai,"DataMining:ConceptsandTechniques",Mo
Rgan Kaufman Publishers,ThirdEdition,2012.

REFERENCE BOOKS:

1.BharatBhushanAgarwal,SumitPrakashTayal,"DataMiningandDataWarehousing",UniversityScie
nce,FirstEdition,2009.

2.MehmedKantardzic,"DataMiningConcepts,Models,MethodsandAlgorithms",WileyPublications
,SecondEdition,2011.

AM650204-ARTIFICIAL INTELLIGENCE TECHNIQUE LAB						
Course Category: Programme Core	**Course Type: Practical**	**L**	**T**	**P**	**C**	
		0	**0**	**3**	**1.5**	

COURSE OBJECTIVES:

1. Apply fundamental AI problem-solving techniques through practical implementation.
2. Develop and analyze searching and pruning algorithms used in intelligent systems.
3. Design and implement AI algorithms to solve real-world and classical problems.

List of Experiments

1. Implement Tower of Hanoi.
2. Develop a gaming problem.
3. Implement Travelling Salesman Problem (TSP) techniques.
4. Perform Backtracking using N-Queen Problem.
5. Implement Depth First Search (DFS) algorithm.
6. Implement Breadth First Search (BFS) algorithm.
7. Solve the Monkey and Banana Problem.
8. Implement Alpha-Beta Pruning.
9. Simulate Simulated Annealing technique in AI.
10. Implement the Water Jug Problem.
11. Develop Minimax Algorithm.
12. Formulate a problem and provide PEAS description.

TOTAL: 45 PERIODS

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS

HARDWARE REQUIREMENT:

- 30 Personal Computers

SOFTWARE REQUIREMENT:

Operating System

- Windows / Linux / macOS

Programming Language

- Python (Version 3.x)

Development Environment

- Jupyter Notebook / Google Colab / VS Code / PyCharm

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Implement classical AI problems such as Tower of Hanoi, Monkey-Banana, and Water Jug problems.

CO2: Develop and apply search algorithms including Depth First Search (DFS) and Breadth First Search (BFS).

CO3: Design and solve constraint-based problems using backtracking techniques such as the N-Queen problem.

CO4: Implement game-playing strategies using Minimax and Alpha-Beta pruning algorithms.

CO5: Apply optimization techniques such as Simulated Annealing and Travelling Salesman Problem approaches.

CO6: Formulate AI problems and represent them using PEAS (Performance, Environment, Actuators, Sensors).

TEXT BOOKS:

1. Artificial Intelligence: A Modern Approach – Stuart Russell and Peter Norvig, 4th Edition, Pearson, 2021.
2. Artificial Intelligence – Elaine Rich, Kevin Knight, and Shivashankar B Nair, 3rd Edition, McGraw Hill, 2017.

3. Artificial Intelligence: Foundations of Computational Agents – David Poole and Alan Mackworth, 2nd Edition, Cambridge University Press, 2017.

REFERENCE BOOKS:

1. Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.
2. Pattern Recognition and Machine Learning – Christopher M Bishop, Springer, 2006.
3. Machine Learning: A Probabilistic Perspective – Kevin P Murphy, MIT Press, 2012.
4. Reinforcement Learning: An Introduction – Richard S Sutton and Andrew G Barto, 2nd Edition, MIT Press, 2018.

AD650305 - Data Warehousing and Data Mining Lab

Course Category: Institute Core	Course Type: Practical	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Understand the data sets and data preprocessing
- To Demonstrate the working of algorithms for data mining tasks such association rule mining, classification, clustering
- To Exercise the data mining techniques with varied input values for different parameters.
- To Analyze to conceptualize Data Mining and the need for pre-processing
- To develop the algorithms used for various types of Data Mining Problem

LIST OF EXPERIMENTS:

1. Create a "employee.arff" file with the attributes EmpId, EmpName and Salary. Include sample data for five employees.

2. Convert an existing Excel file containing employee details like EmpId, EmpName and Salary to ARFF file using "Simple CLI" application, "Explorer" application and "Knowledge Flow" application.

3. Add, Remove and Normalize techniques for an available data set using "Knowledge Flow" application.

4. Discretize an available data set containing some numerical attributes in it.

5. Illustrates some of the basic elements of association rule mining using WEKA

6. Illustrates the use of simple k-mean clustering with Weka explorer.

7. Illustrates the use of one hierarchical clustering with Weka explorer.

8. Illustrates the use of Bayesian classifier with Weka explorer.

9. Illustrates the use of j-48 classifier in weka.

10. Analyze an application of classification for web ming using weka tool..

Course Outcomes: At the end of the course, the student will be able to,

CO1: Able to demonstrate the classification and clusters Techniques in large datasets

CO2: Able to construct algorithms to solve data mining problems using weka tool

CO3: Ability to apply mining techniques for realistic data.

CO4: Analyze to conceptualize Data Mining and the need for pre-processing

CO5: Develop the algorithms used for various types of Data Mining Problem

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
CO2	2	2	3	1	3	-	-	-	-	1	-	1	3	3	3
CO3	3	3	2	2	2	1	-	-	-	1	-	1	2	3	3
CO4	3	3	1	3	2	-	-	-	-	-	-	2	3	2	2
CO5	3	3	3	2	2	-	-	-	-	-	-	2	3	3	3

1- low, 2 - medium, 3 - high, '-' no correlation
TEXT BOOKS:
1.JiaweiHan,MichelineKamber,JianPai,"DataMining:ConceptsandTechniques",Mo rganKaufmanPublishers,ThirdEdition,2012.
REFERENCE BOOKS:
1.BharatBhushanAgarwal,SumitPrakashTayal,"DataMiningandDataWarehousing",University Science,FirstEdition,2009.
2.MehmedKantardzic,"DataMiningConcepts,Models,MethodsandAlgorithms",WileyPublicat ions,SecondEdition,2011.

CS650503 - INTEGRATED APTITUDE SKILLS - I (HIGHER)					
Course Category: EEC	Course Type: Skill Based Course	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

To impart knowledge on the following Topics,

- Solve aptitude, logical and questions.
- Excel the talents of students in logical Verbal reasoning Analysis
- The non-verbal Reasoning Analysis
- enable the students to speak and write in English without making any mistakes Excel the students in mock interview, group discussion.

UNIT 1: QUANTITATIVE APTITUDE	**6**
Percentage - Ratio & Proportions - Pipes & Cisterns - Permutations & Combinations - Partnership - Allegation (Or) Mixture - Races & Games - Stocks & Shares - Height & Distance - True Discount & Banker‟s Discount - Probability - Mensuration (Area, Volume & Surface Area) - Interest (Simple Interest, Compound Interest) - Logarithm - Chain Rule - Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)	
UNIT 2: LOGICAL REASONING- VERBAL REASONING	**6**
Logic - Statement – Argument, Assumptions, Courses of action, Conclusion - Deriving Conclusion from passages - Theme Detection - Cause and Effect reasoning	
UNIT 3: LOGICAL REASONING- NONVERBAL REASONING:	**6**
Series - Analogy - Classification - Analytical Reasoning - Mirror Images - Water Images - Spotting out the embedded figures - Completion of incomplete patterns - Figure Matrix - Paper Folding - Paper Cutting - Rule Detection - Grouping of identical figures - Cubes and Dice - Dot Situation - Construction of squares and triangles - Figure formation and analysis	
UNIT 4: VERBAL ABILITY	6
Concord - Cloze Passage - Analogies or Reverse Analogies - Jumbled Sentences - Error Deduction - Reading Comprehension - Paragraph Formation - Completing Statements - Usage of Prepositions - Inference - Verification of Truth from the Statements - Change of Speech	
UNIT V: PRACTICALS	**6**
Extempore speech, Group Discussion, Mock Interview	
TOTAL: 30 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1	Understand the basic concepts of quantitative ability.
CO2	Understand the basic concepts of verbal logical reasoning Skills.
CO3	Acquire satisfactory competency in use of nonverbal reasoning.
CO4	Understand the concepts in verbal ability
CO5	Acquire satisfactory competency in Group Discussion and Mock Interview

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	2	2	2	2	2	3	2	2	2	-	-
CO2	3	3	2	3	3	2	2	2	2	3	1	2	-	-
CO3	2	3	2	3	2	2	2	2	3	2	2	1	-	-
CO4	2	3	2	2	2	2	3	3	2	2	1	2	-	-
CO5	2	3	3	3	2	3	3	3	2	2	2	3	-	-

1- Low, 2 - Medium, 3 - High, „-' No Correlation

I) TEXT BOOKS:

1. Legal Reasoning for CLAT, AILET, SLAT & Other Law Entrance Exams (3rd Edition, 2022) by Disha Experts, Disha Publications, ISBN: 9789355642219
2. Quantitative Aptitude for Competitive Examinations (2023 Edition) by R.S. Aggarwal, S.Chand & Company Pvt. Ltd.

II) REFERENCE BOOKS:

1. Quantitative Aptitude for Competitive Examinations (2023 Edition) by Anand P. A., Wiley India Pvt. Ltd..
2. How to Crack Test of Reasoning: In All Competitive Exams (2023 Edition) by Jaikishan and Premkishan, Arihant Publications India Limited

III) AICTE FREE BOOKS :

https://free.aicte-india.org/Quantitative-Aptitude-Basics.php

IV) ONLINE LEARNING:

NPTEL: Developing Soft Skills and Personality (NPTEL)
https://nptel.ac.in/courses/109104107

V) WEB RESOURCES:

Aptitude Skills

1. https://www.udemy.com/course/quant_aptitud_tricks_and_shortcuts

Reasoning

2. https://aptitudeclass.com/

Practical Aptitude tests

3. http://www.practiceaptitudetests.com/

SEMESTER – VI

Course Category: Institute Core	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1.To understand the fundamentals of NoSQL databases and MongoDB architecture.

2.To learn the data modeling concepts and document-based storage structure in MongoDb

3.To acquire knowledge about CRUD operations and indexing techniques in MongoDB.

4.To gain skills in designing scalable applications using MongoDB database systems.

5.To understand the aggregation framework and advanced query operations.

UNIT 1: INTRODUCTION TO NOSQL AND MONGODB — 9

Introduction to NoSQL Databases – Limitations of Relational Databases – Characteristics of NoSQL – Types of NoSQL Databases – Key Value Stores – Document Databases – Column Family Stores – Graph Databases – Introduction to MongoDB – MongoDB Architecture – Installing MongoDB – MongoDB Shell – MongoDB Data Types – JSON and BSON formats – MongoDB Database Structure.

UNIT 2: MONGODB CRUD OPERATIONS — 9

Creating Databases and Collections – Insert Operations – Single and Multiple Document Insertion– Querying Documents – Filtering and Projection – Update Operations – Replace and Modify Documents – Delete Operations – Sorting and Limiting Results – Cursor Methods.

UNIT 3: DATA MODELING AND INDEXING — 9

Data Modeling Concepts – Embedded Documents and References – Schema Design – One-to-One, One-to-Many, Many-to-Many Relationships – Indexing in MongoDB – Types of Indexes – SingleField Index – Compound Index – Multikey Index – Text Index – Index Management and Performance.

UNIT 4: AGGREGATION AND ADVANCED QUERIES — 9

Aggregation Framework – Aggregation Pipeline – Stages of Aggregation – Grouping Data – Filtering and Transformation – MapReduce Concepts – Advanced Query Operations – Regular Expressions – Array Queries – Geospatial Queries.

UNIT 5: MONGODB ADMINISTRATION AND SECURITY — 9

MongoDB Replication – Sharding and Scalability – Backup and Restore – User Authentication –Role-Based Access Control – Data Security – Performance Monitoring – Deploying MongoDB in Production Environment.

total: 45 periods

Lab Exercises:

1.llustration of Where Clause, AND,OR operations in MongoDB. a. Execute the Commands of MongoDB and operations in MongoDB : Insert, Query, Update, Delete and Projection. (Note: use any collection).

2. a. Develop a MongoDB query to select certain fields and ignore some fields of the documents from any collection. b.Develop a MongoDB query to display the first 5 documents from the results obtained in a. [use of limit and find].

3. a. Execute query selectors (comparison selectors, logical selectors) and list out the results on any collection b. Execute query selectors (Geospatial selectors, Bitwise selectors) and list out the results on any collection.

4. Create and demonstrate how projection operators ($, $elematch and $slice) would be used in the MondoDB.

Execute Aggregation operations ($avg, $min,$max, $push, $addToSet etc.). students encourage to execute several queries to demonstrate various aggregation operators).

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand the fundamentals of NoSQL databases and MongoDB architecture.

CO2: Perform CRUD operations and manage data using MongoDB queries.

CO3: Design efficient data models and indexing techniques for document databases.

CO4: Apply aggregation framework and advanced queries to analyze data.

CO5: Implent mongodp administration ,security,sclablity techniques.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	2	1	3	-	-	-	1	2	1	3	2	2	1
CO2	2	2	3	2	3	-	-	-	2	2	1	3	3	3	2
CO3	3	3	2	3	3	-	-	-	2	2	2	3	2	3	3
CO4	2	3	3	2	3	-	-	-	2	2	2	3	2	3	3
CO5	3	3	3	2	3	-	-	-	3	2	2	3	2	3	3

1- low, 2 – medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Kristina Chodorow, MongoDB: The Definitive Guide, O'Reilly Media, 2019.

2. Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, MongoDB: The Definitive Guide (3rd Edition), O'Reilly Media, 2019.

3. Kyle Banker, MongoDB in Action, Manning Publications, 2016.

REFERENCE BOOKS:

1. Alex Giamas, Mastering MongoDB, Packt Publishing

2. David Hows, Peter Membrey, Eelco Plugge, Tim Hawkins, The Definitive Guide to MongoDB, Apress.

3.Cyrus Dasadia, MongoDB Cookbook, Packt Publishing.

AM660205-DATA ANALYTICS						
Course Category: Programme Core	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	

COURSE OBJECTIVES:

- Understand the fundamentals of data analytics and data preprocessing
- Learn statistical methods and exploratory data analysis techniques
- Apply machine learning algorithms for predictive analytics
- Analyze and visualize data using modern analytical tools
- Explore big data technologies and real-world analytics applications

UNIT 1:INTRODUCTION TO DATA ANALYTICS	**9**

Introduction to Data Analytics – Types of Data – Data Analytics Lifecycle – Data Collection and Data Sources – Structured and Unstructured Data – Data Cleaning and Preprocessing – Data Integration – Descriptive, Predictive, and Prescriptive Analytics – Introduction to Python for Data Analytics.

UNIT 2: DATA EXPLORATION AND VISUALIZATION	**9**

Exploratory Data Analysis (EDA) – Statistical Measures – Data Summarization – Correlation Analysis – Data Visualization Techniques – Bar Charts, Histograms, Scatter Plots, Box Plots – Visualization using Matplotlib and Seaborn – Dashboards and Reporting – Introduction to Tableau/Power BI.

UNIT 3: MACHINE LEARNING FOR DATA ANALYTICS	**9**

Introduction to Machine Learning – Supervised and Unsupervised Learning – Regression Techniques – Classification Algorithms – Decision Trees – k-Nearest Neighbors – Clustering using k-Means – Model Evaluation Metrics – Cross Validation – Feature Selection

UNIT 4: BIG DATA ANALYTICS	**9**

Introduction to Big Data – Characteristics of Big Data – Hadoop Ecosystem – HDFS – MapReduce – Apache Spark – Data Stream Processing – NoSQL Databases – Data Warehousing – Cloud-based Analytics Platforms.

UNIT 5: ADVANCED ANALYTICS AND APPLICATIONS	**9**

Time Series Analysis – Sentiment Analysis – Recommendation Systems – Predictive Analytics – Business Intelligence – Applications in Healthcare, Finance, Retail, and Social Media – Ethical Issues in Data Analytics – Data Privacy and Security.

TOTAL: 45 HOURS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand the fundamentals of data analytics and preprocessing techniques

CO2: Perform exploratory data analysis and visualization

CO3:Apply machine learning algorithms for analytical tasks

CO4: Analyze big data using modern analytics frameworks.

CO5: Develop analytics solutions for real-world applications

TEXT BOOKS:

1. Wes McKinney, Python for Data Analysis (3rd Edition), O'Reilly Media, 2022
2. Jake VanderPlas, Python Data Science Handbook (2nd Edition), O'Reilly Media, 2023
3. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques (4th Edition), Morgan Kaufmann, 2022
4. Foster Provost, Tom Fawcett, Data Science for Business (2nd Edition), O'Reilly Media, 2023

REFERENCE BOOKS:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning (2nd Edition), Springer, 2017

2. Cathy O'Neil, Rachel Schutt, Doing Data Science, O'Reilly Media, 2013
3. Mohammed J. Zaki, Wagner Meira Jr., Data Mining and Machine Learning, Cambridge University Press, 2020
4. Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets (3rd Edition), Cambridge University Press, 2020

Web Resources

1. https://www.oracle.com/in/analytics/data-analytics/
2. https://www.qlik.com/us/data-analytics
3. https://www.geeksforgeeks.org/data-analysis/what-is-data-analytics/

CS660212-MACHINE LEARNING

Course Category: Programme Core	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamental concepts of machine learning
- Apply classification techniques and regularization methods
- Implement ensemble learning strategies, clustering algorithms, and dimensionality reduction techniques
- Utilize probabilistic learning models and graphical models
- Develop and evaluate artificial neural networks, including perceptrons and multi-layer perceptrons, and explore reinforcement learning methods

UNIT 1: MACHINE LEARNING BASICS **9**

Introduction to Machine Learning (ML) – Essential concepts of ML – Types of Machine learning methods – Early trends in Machine learning – Data understanding, representation and visualization – Hypothesis – Modelling in Machine learning – Classification: Probability theory and Bayes rule – Generative vs. discriminative training – Self-supervised Learning and Transfer learning.

UNIT 2: CLASSIFICATION TECHNIQUES **9**

Regularization techniques – Decision Tree based Learning algorithms – Induction algorithms – Regression trees – Instance based Learning – Support Vector Machines: Hard and soft margin – Functional and Geometric margin – Maximum margin linear separators – Kernels for learning non-linear functions.

UNIT 3: ENSEMBLE, CLUSTERING AND DIMENSIONALITY REDUCTION **9**

Ensemble Learning: Using committees of multiple hypotheses. Bagging – Random Forest – Adaptive Boosting, Stacking and DECORATE – Active learning with ensembles – Clustering – K- means Clustering– Hierarchical Clustering – Expectation Maximization algorithm – Gaussian Mixture Model – Dimensionality Reduction – Principal Component Analysis (PCA) – Linear Discriminant Analysis (LDA) – Latent Variable Models (LVM) – Latent Dirichlet Allocation – Independent Component Analysis (ICA)

UNIT 4: PROBABILISTIC LEARNING MODEL **9**

Bayesian Learning – Naïve Bayes Algorithm – Introduction to Graphs – Bayesian Belief Networks - Inference in Graphical Models – Markov Chain – Markov Model – Hidden Markov Models – Inference – Learning – Generalization – Undirected Graphical Models

UNIT 5: ANN & REINFORCEMENT LEARNING **9**

Artificial Neural Networks – Structure and Activation functions – Perceptron – Multi Layer Perceptron – Back Propagation – Gradient descent training – Radial Basis function Neural Network- Overview of Reinforcement Learning – Components of Reinforcement Learning – Markov decision process – Model Based Learning – Model Free Learning – Q Learning.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand the basics of machine learning.

CO2: Solve analytical problems with relevant mathematics background knowledge.
CO3: Explain testing and evaluation machine learning algorithms.
CO4: Understand ANN model apply knowledge in data analytics
CO5: Explore the knowledge of unsupervised learning in data analysis.
TEXT BOOKS:
1. Ameet V Joshi, "Machine Learning and Artificial Intelligence", Springer Publications, 2020. 2. Sridhar S. and Vijayalakshmi M., "Machine Learning", Oxford University Press, 2021. 3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer Publications, 2011 4. John D. Kelleher, Brain Mac Namee, Aoife D' Arcy, "Fundamentals of Machine learning for Predictive Data Analytics, Algorithms, Worked Examples and case studies", MIT press, 2015
REFERENCE BOOKS:
1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997 2. Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial Intelligence: A Modern Approach, Prentice Hall, 2020 3. Machine Learning Dummies, John Paul Muller, Luca Massaron, Wiley Publications, 2021 4. Jerome Friedman, Robert Tibshirani, Trevor Hastie, "The Elements of Statistical Learning",
WEB RESOURCES
1. https://www.geeksforgeeks.org/machine-learning/machine-learning/
2. https://www.ibm.com/think/topics/machine-learning

Training With AI Tools						
Course Category: Institute Core	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
• To understand the fundamentals of Artificial Intelligence and AI tools						
• To gain hands-on experience with popular AI-based platforms						
• To apply AI tools for content creation, coding, and data analysis						
• To explore real-world applications of AI in various domains						
• To understand ethical considerations and limitations of AI tools						
UNIT 1: Module 1: AI Fundamentals & Prompt Engineering						**9**
Introduction to AI: Overview of Generative AI, Large Language Models (LLMs), and how AI tools process information.Prompt Engineering Basics: The anatomy of a good prompt (Context, Task, Tone, Output Format). Role-Playing & Constraints: How to instruct AI to act as an expert and enforce length, style, or specific domain rules.Iterative Refinement: Modifying prompts to get the exact desired output.						
UNIT 2: Text, Copywriting & Research Tools						**9**
Using Text Models: Leveraging top AI models (e.g., ChatGPT, Gemini, Claude). Research & Summarization: Using AI to digest lengthy documents, research papers, or PDFs and extract key insights. Content Generation: Drafting emails, blogs, reports, and social media posts.						
UNIT 3: Data Analysis & Visualization						**9**
Data Wrangling: Uploading CSVs or Excel sheets and asking AI to clean and format the data. Querying & Insights: Generating pivot tables, charts, and identifying trends using natural language. Automating Spreadsheets: Writing complex formulas or VBA scripts using AI assistance.						
UNIT 4: Visuals, Design & Multimedia						**9**
Image Generation: Using tools (e.g., Midjourney, DALL-E, Adobe Firefly) to create custom graphics and marketing materials.Video & Audio AI: Creating voiceovers (Voice AI), video editing via text, and AI-generated avatars. Presentation Building: Automatically generating slide decks and outlines.						
UNIT 5: Workflow Automation & Coding						**9**
Task Automation: Integrating AI into daily apps (e.g., Slack, Notion, Gmail) using AI-assisted no-code tools (Zapier, Make.com). AI-Assisted Coding: Using tools like GitHub Copilot or ChatGPT to write, debug, and explain code without a heavy programming background.						
COURSE OUTCOMES: At the end of the course, the student will be able to,						
CO1: Understand the fundamentals of AI and various AI tools						
CO2: Apply AI tools for content creation and productivity tasks						

CO3: Utilize AI tools for programming and software development

CO4: Analyze and apply AI tools for data analysis and real-world applications

CO5: Evaluate ethical issues and future trends in AI tools

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12	PSO1	PSO2	PSO 3
CO 1	3	2	1	-	2	-	-	-	-	-	-	1	3	2	1
CO 2	2	2	3	1	3	-	-	-	1	1	-	1	2	3	2
CO 3	3	3	3	2	3	-	-	-	1	1	-	2	3	3	3
CO 4	3	3	2	3	3	1	-	-	1	1	-	2	3	3	3
CO 5	1	2	1	1	2	1	1	3	1	1	-	3	1	2	3

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Artificial Intelligence Basics – A non-technical introduction to AI concepts and tools

REFERENCE BOOKS:

1.You Look Like a Thing and I Love You – Practical insights into AI behavior and limitations

2.Artificial Intelligence A Guide for Thinking Humans – Understanding AI concepts and real-world impact

AM660303-DATA ANALYTICS LABORATORY						
Course Category: Programme Core	**Course Type: Practical**	**L**	**T**	**P**	**C**	
		0	**0**	**3**	**1.5**	

COURSE OBJECTIVES:

- To understand the basic concepts of statistics and data analysis
- To learn NumPy for numerical computations
- To learn Pandas for data handling
- To understand data cleaning and data wrangling techniques
- To develop skills to analyze and interpret data using Python tools

List of Experiments

1. Write a Python program to calculate mean, median, mode and standard deviation of a given dataset.
2. Write a Python program to find correlation between two variables.
3. Write a Python program to create NumPy arrays with different data types.
4. Write a Python program to perform indexing and slicing on NumPy arrays.
5. Write a Python program to create a Pandas Series and DataFrame.
6. Write a Python program to load a dataset and display basic information.
7. Write a Python program to handle missing data.
8. Write a Python program to perform data wrangling (merging and reshaping).
9. Write a Python program to perform GroupBy operation in Pandas.
10. Write a Python program to perform data aggregation functions.

TOTAL: 60 PERIODS

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS

HARDWARE REQUIREMENT:

- 30 Personal Computers

SOFTWARE REQUIREMENT:

Operating System

- Windows / Linux / macOS

Programming Language

- Python (Version 3.x)

Python Libraries

- **NumPy** → Numerical operations
- **Pandas** → Data manipulation
- **Matplotlib** → Data visualization
- **Seaborn** → Advanced visualization

Development Environment

- Jupyter Notebook / Google Colab / VS Code / PyCharm

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand basic statistics and data analysis concepts.

CO2: Use NumPy for numerical computations.

CO3: Use Pandas for data manipulation.

CO4: Perform data cleaning and wrangling.

CO5: Apply data aggregation and group operations.

TEXT BOOKS:

1. Python for Data Analysis, Second Edition, O'Reilly Media, 2017.
2. Python Data Analytics, Apress, 2015.

REFERENCE BOOKS:

1. Python Data Science Handbook, O'Reilly Media, 2016.
2. Practical Statistics for Data Scientists, O'Reilly Media, 2017

CS660308-MACHINE LEARNING LABORATORY						
Course Category: Programme Core	**Course Type: Practical**	**L**	**T**	**P**	**C**	
		0	**0**	**3**	**1.5**	

COURSE OBJECTIVES:

- Understand Practical Implementation of ML Algorithms
- Apply Data Preprocessing Techniques
- Use Popular ML Libraries and Tools
- Develop and Evaluate ML Models
- Perform Exploratory Data Analysis (EDA)

LIST OF EXPERIMENTS:

1. Use a dataset (e.g., Iris or MNIST) to perform data understanding and visualization.
2. Explore data distributions, identify missing values, and create visualizations to represent data characteristics.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm.
4. Write a program to handle over fitting.
5. Implement SVM algorithm for a given data set.
6. Implement Bagging, boosting, and DECORATE algorithms with performance evaluation mechanisms.
7. Write a program to implement k-Nearest Neighbour algorithm.
8. Implement a k-means partitional clustering
9. Implement Naive Bayes learning algorithm for a sample training data set.
10. Implement a linear regression method

TOTAL: 30 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Implement basic machine learning algorithms such as linear regression, logistic regression, decision trees, and k-nearest neighbors using appropriate tools.

CO2: Apply data preprocessing techniques including data cleaning, transformation, normalization, and feature selection on real-world datasets.

CO3: Analyze datasets using exploratory data analysis (EDA) techniques and visualize results using suitable plotting tools.

CO4: Evaluate the performance of machine learning models using metrics such as accuracy, precision, recall, F1-score, and confusion matrix.

CO5: Develop and optimize machine learning models using techniques like cross-validation and hype rparameter tuning for improved performance.

Hardware Requirements:

- 30 Personal Computers
- Minimum 4 GB RAM (8 GB recommended)
- Standard processor (Intel i3 or above / equivalent)

Software Requirements:

- **Operating System**
  Windows 10/11 / Linux (Ubuntu or equivalent) / macOS
- **Programming Language**
  Python (Version 3.x recommended)
- **Development Environment / IDE**
  Jupyter Notebook / JupyterLab
  Google Colab (optional, cloud-based)
  Visual Studio Code / PyCharm

TEXT BOOKS:

1. Pattern Recognition and Machine Learning – Christopher M Bishop, Springer, 2006.
2. Machine Learning – Tom M Mitchell, McGraw Hill, 1997.
3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurelien Geron, 3rd Edition, O Reilly Media, 2022.

REFERENCE BOOKS:

1. The Elements of Statistical Learning – Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer, 2nd Edition, 2009.
2. Machine Learning: A Probabilistic Perspective – Kevin P Murphy, MIT Press, 2012.
3. Introduction to Machine Learning with Python – Andreas C Muller and Sarah Guido, O Reilly Media, 2016.
4. Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.

CS650801A-INTRODUCTION TO QUANTUM COMPUTING					
Course Category: Programme Mandatory	**Course Type: Theory**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

COURSE OBJECTIVES:

- To understand the fundamentals of quantum mechanics and quantum computation.
- To learn quantum gates and quantum circuits.
- To study quantum algorithms and quantum information theory.
- To understand quantum cryptography and quantum error correction.
- To explore applications of quantum computing.

SYLLABUS

UNIT 1: INTRODUCTION TO QUANTUM COMPUTING	**6**
History of Quantum Computing – Importance of Mathematics, Physics and Biology – Bits vs Qubits – Classical vs Quantum logical operations..	
UNIT 2 :MATHEMATICAL AND PHYSICAL FOUNDATIONS	**6**
Background Mathematics: Basics of Linear Algebra – Vector spaces – Hilbert space – Probabilities and measurements. Background Physics: Pauli's Exclusion Principle – Superposition – Entanglement – Super-symmetry – Density operators and correlation – Basics of Quantum Mechanics – Measurements in bases other than computational basis.Background Biology: Basic concepts of Genomics and Proteomics – Central Dogma.	
UNIT 3: QUBITS AND QUANTUM CIRCUITS	**6**
Physical implementations of Qubit – Qubit as a quantum unit of information – Bloch Sphere – Single qubit gates – Multiple qubit gates – Designing quantum circuits – Bell states.	
UNIT 4: QUANTUM ALGORITHMS	**6**
Classical computation on quantum computers – Relationship between quantum and classical complexity classes – Deutsch's Algorithm – Deutsch–Jozsa Algorithm – Shor's Factorization Algorithm – Grover's Search Algorithm.	
UNIT 5: QUANTUM INFORMATION AND ERROR CORRECTION	**6**
Noise and error correction – Graph states and codes – Quantum error correction – Fault-tolerant computation – Comparison between classical and quantum information theory – Quantum Cryptography – Quantum Teleportation.	

TOTAL: 30 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Explain the fundamentals of quantum computing.

CO2: Describe the mathematical and physical principles behind quantum systems.

CO3: Analyze qubit representations and quantum circuits.

CO4: Apply quantum algorithms to computational problems.

CO5: Evaluate quantum error correction and quantum cryptographic techniques.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	–	1	–	–	–	–	–	–	2	3	2
CO2	3	3	1	2	–	–	–	–	–	–	–	2	3	3
CO3	3	3	2	2	2	–	–	–	–	–	–	2	3	3

CO4	3	3	3	2	2	–	–	–	–	–	–	2	3	3
CO5	3	2	2	1	1	2	–	2	–	–	–	3	3	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Michael Nielsen & Isaac Chuang, Cambridge University Press, "Quantum Computation and Quantum Information", 2010, 10th Anniversary Edition

2. Eleanor Rieffel & Wolfgang Polak, " Quantum Computing: A Gentle Introduction", MIT Press, 2011, First Edition

3. Phillip Kaye, Raymond Laflamme," An Introduction to Quantum Computing", Oxford University Press, 2007, First Edition

REFERENCE BOOKS:

1. Noson Yanofsky & Mirco Mannucci, "Quantum Computing for Computer Scientists", Cambridge University Press, 2008, First Edition

2. David McMahon," Quantum Computing Explained", Wiley Publications, 2007, First Edition

SEMESTER – VII

AM670206-Data Visualization and Automation						
Course Category: Programme Core	**Course Type : Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	

COURSE OBJECTIVES:

- Understand the **basic concepts of data and data analysis.**
- Learn how to explore data and interpret data clearly.
- Create simple graph and charts for visualization.
- Analyze relationships between two variables.
- Study data patterns over time using simple methods.

UNIT 1: EXPLORATORY DATA ANALYSIS	**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 - Grouping Datasets - data aggregation – Pivot tables and cross-tabulations.

UNIT 2: VISUALIZING USING MATPLOTLIB	**9**

Importing Matplotlib – Simple line plots – Simple 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.

UNIT 3 : UNIVARIATE ANALYSIS	**9**

Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series.

UNIT 4 : BIVARIATE ANALYSIS	**9**

Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations.

UNIT 5: MULTIVARIATE AND TIME SERIES ANALYSIS	**9**

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

TOTAL:45 PERIODS

COURSE OUTCOMES :At the end of the course, the student will be able to,

CO1: Understand the fundamentals of exploratory data analysis.

CO2: Implement the data visualization using Matplotlib.

CO3: Perform univariate data exploration and analysis.

CO4: Apply bivariate data exploration and analysis.

CO5: Use Data exploration and visualization techniques for multivariate and time series data.

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", Oreilly, 1st Edition, 2016. (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.
WEB RESOURCES:
Pandas Project – Official Pandas Documentation https://pandas.pydata.org/docs/
NumPy Official Documentation https://numpy.org/doc/
Matplotlib Project – Visualization Library Documentation https://matplotlib.org/stable/index.html
Seaborn Project – Statistical Data Visualization Library https://seaborn.pydata.org/
Python Software Foundation – Python Official Documentation https://docs.python.org/3/

CS670215 - DEEP LEARNING		
Course Category: Institute Core	**Course Type: Theory**	**L T P C** **3 0 0 3**

COURSE OBJECTIVES:

- To understand and need and principles of deep neural networks
- To understand CNN and RNN architectures of deep neural networks
- To comprehend advanced deep learning models
- To learn the evaluation metrics for deep learning models
- To Auto encoder for Classification & Feature Extraction

UNIT 1: DEEP NETWORKS BASICS **9**

Linear Algebra: Scalars – Vectors – Matrices and tensors; Probability Distributions – Gradient based Optimization – Basics: Capacity – Overfitting and underfitting – Hyperparameters and validation sets – Estimators – Bias and variance – Stochastic gradient descent – Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization – Optimization

UNIT 2: CONVOLUTIONAL NEURAL NETWORKS **9**

Convolution Operation – Sparse Interactions – Parameter Sharing – Equivariance – Pooling – Convolution Variants: Strided – Tiled – Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions – Loss Functions – Regularization – Optimizers – Gradient Computation.

UNIT 3: RECURRENT NEURAL NETWORKS **9**

Unfolding Graphs – RNN Design Patterns: Acceptor – Encoder – Transducer; Gradient Computation – Sequence Modeling Conditioned on Contexts – Bidirectional RNN – Sequence to Sequence RNN – Deep Recurrent Networks – Recursive Neural Networks – Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM.

UNIT 4: MODEL EVALUATION **9**

Performance metrics – Baseline Models – Hyperparameters: Manual Hyperparameter –Automatic Hyperparameter – Grid search – Random search – Debugging strategies.

UNIT 5: AUTOENCODERS AND GENERATIVE MODELS **9**

Autoencoders: Undercomplete autoencoders – Regularized autoencoders – Stochastic encoders and decoders – Learning with autoencoders; Deep Generative Models: Variational autoencoders – Generative adversarial networks.

Total: 45 periods

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Feature Extraction from Image and Video Data

CO2: Implement Image Segmentation and Instance Segmentation in Images

CO3: Implement image recognition and image classification using a pretrained network

CO4: Traffic Information analysis using Twitter Data

CO5: Auto encoder for Classification & Feature Extraction

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	-	-	-	-	-	-	1	3	3	2

CO2	3	3	3	2	3	-	-	-	-	1	-	1	3	3	2
CO3	3	3	3	2	3	-	-	-	-	1	-	1	3	3	2
CO4	2	3	2	3	2	2	-	-	-	2	-	2	2	3	3
CO5	3	3	3	2	3	-	-	-	-	1	-	2	3	3	3

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

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

2. Andrew Glassner, "Deep Learning: A Visual Approach", No Starch Press, 2021.

REFERENCE BOOKS:

1. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, "A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool Publishers, 2018.

2.Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool Publishers, 2017.

3. Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.

4. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.

5. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.

AM670207-COMPUTER VISION						
Course Category: Programme Core	**Course Type : Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- Understand the **basics of computer vision and image processing.**
- Learn feature detection and segmentation methods.
- Understand image alignment and motion estimation.
- Study 3D reconstruction techniques.
- Explore image rendering and recognition concepts.

UNIT 1: INTRODUCTION TO IMAGE FORMATION AND PROCESSING	**9**
Computer Vision – Geometric primitives and transformations – Photometric image formation – The digital camera – Point operators – Linear filtering – More neighborhood operators – Fourier transforms – Pyramids and wavelets – Geometric transformations – Global optimization.	
UNIT 2: FEATURE DETECTION, MATCHING AND SEGMENTATION	**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 3 : FEATURE BASED ALIGNMENT AND & MOTION ESTIMATION	**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 – Spindle based motion – Optical flow – Layered Motion.	
UNIT 4 : 3D RECONSTRUCTION	**9**
Shape from X – Active rangefinding – Surface representations – Point-based representations-Volumetric representations – Model-based reconstruction – Recovering texture maps and albedosos.	
UNIT 5: IMAGE-BASED RENDERING AND RECOGNITION	**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 PERIODS	

COURSE OUTCOMES :At the end of the course, the student will be able to,
CO1: Understand image formation and processing.
CO2: Identify features and segments in images.
CO3: Analyze motion and image alignment.
CO4: Apply 3D reconstruction techniques.
CO5: Understand image rendering and recognition.

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

Pandas Project – Official Pandas Documentation https://pandas.pydata.org/docs/
Matplotlib Project – Visualization Library Documentation https://matplotlib.org/stable/index.html
Seaborn Project – Statistical Data Visualization Library https://seaborn.pydata.org/
Python Software Foundation – Python Official Documentation https://docs.python.org/3/

AM670304- DATA VISUALIZATION AND AUTOMATION LABORATORY

Course Category: Programme Core	Course Type: Practical	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- Learn to install and use data analysis tools like python, R or Tableau.
- Understand how to load and prepare data for analysis.
- Practice creating basic graphs and charts.
- Analyze data using simple techniques and methods.
- Present results clearly using visualizations and reports.

LIST OF EXPERIMENTS:

1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI.
2. Perform exploratory data analysis (EDA) on with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
3. Working with Numpy arrays, Pandas data frame , Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
5. Perform Time Series Analysis and apply the various visualization techniques.
6. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc.
7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
8. Perform EDA on Wine Quality Data Set.
9. Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report.

TOTAL HOURS -45

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand, install and use data analysis tools.

CO2: Load and organize data properly.

CO3: Create simple graphs and charts.

CO4: Perform basic data analysis.

CO5: Present data clearly using visualizations.

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS

HARDWARE REQUIREMENT:

- 30 Personal Computers

SOFTWARE REQUIREMENT:

Operating System

- Windows / Linux / macOS

Programming Language

- Python (Version 3.x)

Python Libraries

- **NumPy** → Numerical operations
- **Pandas** → Data manipulation
- **Matplotlib** → Data visualization
- **Seaborn** → Advanced visualization

Development Environment

- Jupyter Notebook / Google Colab / VS Code / PyCharm

TEXT BOOKS

1.Python for Data Analysis, Second Edition, O'Reilly Media, 2017.

2.Python Data Analytics, Apress, 2015.

REFERENCE BOOKS:

1.Python Data Science Handbook, O'Reilly Media, 2016.

2.Practical Statistics for Data Scientists, O'Reilly Media, 2017.

WEB RESOURCES:

NumPy Official Documentation https://numpy.org/doc/

Matplotlib Documentation https://matplotlib.org/stable/contents.html

AD670308 - Deep Learning laboratory

Course Category: Institute Core	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn deep neural networks and apply for simple problems
- To Learn and apply Convolution Neural Network for image processing
- To Learn and apply Recurrent Neural Network and its variants for text analysis.
- To augment data using generative models
- To explore real world applications with deep neural networks

LIST OF EXPERIMENTS:

1. Solving XOR problem using Multilayer perceptron
2. Implement character and Digit Recognition using ANN.
3. Implement the analysis of X-ray image using autoencoders
4. Implement Speech Recognition using NLP
5. Develop a code to design object detection and classification for traffic analysis using CNN
6. Implement online fraud detection of share market data using any one of the data analytics tools.
7. Implement image augmentation using deep RBM.
8. Implement Sentiment Analysis using LSTM.
9. Mini Project: Number plate recognition of traffic video analysis

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Apply deep neural network for simple problems.

CO2: Apply Convolution Neural Network for image processing.

CO3: Apply Recurrent Neural Network and its variants for text analysis.

CO4: Apply generative models for data augmentation.

CO5: Develop a real world application using suitable deep neural networks .

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	-	-	-	-	-	-	1	3	2	2
CO2	3	3	3	2	3	-	-	-	-	1	-	1	3	3	3
CO3	3	3	3	2	3	-	-	-	-	1	-	1	3	3	3
CO4	3	3	3	2	3	-	-	-	-	1	-	2	3	3	3
CO5	3	3	3	3	3	1	-	-	2	2	-	2	3	3	3

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), "Deep Learning Applications", Volume 3, Springer Publications 2022.

2. Stone, James. (2019), " Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning", Sebtel Press, United States, 2019

REFERENCE BOOKS:

1. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, "A Guide to Convolutional

Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool Publishers, 2018.

2.Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool Publishers, 2017.

3. Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.

MG670019 - Innovation Entrepreneurship and Startups						
Course Category: Institute Core	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	

COURSE OBJECTIVES:	
• Understand Innovation & Entrepreneurship: Enable students to grasp the concepts of innovation, entrepreneurship, and the startup ecosystem.	
• Develop Entrepreneurial Mindset: Encourage creativity, opportunity recognition, and problem-solving skills essential for launching ventures.	
• Business Planning & Strategy: Teach the process of designing business models, preparing business plans, and understanding funding options.	
• Startup Management & Growth: Equip students with knowledge about operationl, marketing, Financial, and legal aspects of startups	
• Foster Social & Technological Impact: Promote sustainable and socially responsible entrepreneurial initiatives using technology and innovation.	
UNIT 1: INNOVATION AND ENTREPRENEURSHIP OVERVIEW	**9**
Concepts of innovation, creativity, and entrepreneurship.-Types of startups, evolution of entrepreneurship, and role in economic development.-Entrepreneurial traits, motivations, and risk-taking.	
UNIT 2: STARTUP ECOSYSTEM AND IDEATION	**9**
Ideation techniques, spotting opportunities, and validation processes.-Understanding the startup ecosystem, support systems, and incubators.-Intellectual Property (IP) Rights, patents, and copyright.	
UNIT 3: BUSINESS PLANNING AND STRATEGY	**9**
Business model design (e.g., Lean Canvas).-Mission, vision, and strategy formulation.- Feasibility analysis (technical, market, financial).	
UNIT 4: STARTUP FUNDING AND LEGAL ASPECTS	**9**
Funding options: Bootstrapping, Angel Investors, Venture Capital, Crowd Funding.-Legal forms of business, registration, and regulatory compliances.	
UNIT 5: LAUNCHING AND SCALING VENTURES	**9**
Go-to-market strategies and marketing for startups.-Team building, leadership, and scaling metrics (KPIs).-Exits and growth strategies.	
	total: 45 periods
COURSE OUTCOMES: At the end of the course, the student will be able to,	
CO1: Explain the concepts of innovation, entrepreneurship, and the characteristics of successful entrepreneurs.	
CO2: Identify and evaluate entrepreneurial opportunities in different sectors.	
CO3: Develop a comprehensive business model and create a viable business plan for a startup.	
CO4: Apply strategies for startup funding, marketing, operations, and scaling a new venture.	
CO5: Demonstrate ethical, sustainable, and socially responsible decision-making in entrepreneurial ventures.	
CO-PO MAPPING	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PS O1	PSO 2	PSO 3
CO1	1	2	1		1	2	-	2	2	2	-	2	1	2	
CO2	1	3	2	2	2	2	-	1	2	2	-	2	2	3	
CO3	1	2	3	2	2	2	-	1	3	3	2	2	2	3	1
CO4	1	2	3	2	2	2	-	1	3	3	3	2	2	3	1
CO5	1	2	1	2	1	3	2	3	2	2	1	3	1	2	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1."Innovation and Entrepreneurship" by John Bessant & Joe Tidd (4th Edition)

2."Entrepreneurship: Successfully Launching New Ventures" by Bruce R. Barringer & R. Duane Ireland (6th Edition)

REFERENCE BOOKS:

1.Innovation and Entrepreneurship by Peter F. Drucker

2.Entrepreneurship by R. Hisrich, M. Peters and D. Shepherd

3.Entrepreneurship Development by S.S. Khanka

SEMESTER -8

AM660501-PROJECT WORK

COURSE OBJECTIVES

Final year projects represent the culmination of study towards the Bachelor of Engineering degree in Artificial Intelligence and Machine Learning. Projects provide students with opportunities to apply, integrate, and extend the knowledge acquired throughout the programme in solving real-world problems using AI and ML techniques. Assessment is carried out through seminar presentations, project reviews, thesis submission, and demonstration of the developed system or application. This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor.

1. Apply Artificial Intelligence Concepts – Utilize AI principles such as intelligent agents, knowledge representation, reasoning, and decision-making to develop smart solutions.
2. Develop Machine Learning Models – Design, train, test, and evaluate supervised, unsupervised, and reinforcement learning models for real-world applications.
3. Analyze and Process Data – Apply data preprocessing, feature engineering, and visualization techniques to derive meaningful insights from structured and unstructured data.
4. Design Deep Learning Applications – Develop deep learning solutions using neural networks, CNNs, RNNs, LSTMs, and transformer-based architectures for complex problem-solving.
5. Implement Natural Language Processing Solutions – Build AI systems capable of language understanding, sentiment analysis, text summarization, translation, and chatbot development.
6. Develop Computer Vision Systems – Create intelligent vision-based applications involving image processing, object detection, face recognition, and video analytics.
7. Integrate AI with IoT and Cloud Technologies – Explore AI-enabled IoT systems, edge computing, and cloud-based AI deployment for smart applications.
8. Ensure Ethical and Responsible AI – Analyze fairness, transparency, privacy, security, and ethical issues associated with AI systems and propose responsible AI solutions.
9. Optimize AI Model Performance – Investigate techniques for model optimization, hyperparameter tuning, scalability, and efficient deployment.
10. Innovate in Emerging AI Technologies – Explore advanced technologies such as Generative AI, Explainable AI, Federated Learning, Robotics, and Autonomous Systems.
11. Provide Solutions for Problems Identified by Society – Develop AI and ML solutions addressing healthcare, agriculture, education, transportation, environment, and social welfare challenges.
12. Provide Solutions for Industrial Problems – Design intelligent systems and automation solutions for industrial applications and business analytics.
13. Enhance Existing Systems with Creativity and Innovation – Improve existing products, services, or processes by integrating advanced AI capabilities and innovative features.

Students will be required to:

- Perform a literature survey to review current research trends, technologies, and developments in the chosen area of AI and ML.
- Undertake detailed technical work using theoretical analysis, software development, simulations, dataset preparation, and hardware implementation wherever applicable.
- Prepare a detailed project work plan and timeline for successful completion within the stipulated duration.
- Deliver seminar presentations on the selected domain and project progress.
- Prepare interim and final project reports describing methodology, implementation, experimental results, and conclusions.
- Demonstrate the developed system/application through poster presentations, software demonstrations, or prototype implementations.

COURSE OUTCOMES

On successful completion of the course, students will be able to:
CO1: Demonstrate strong technical knowledge in the selected domain of Artificial Intelligence and Machine Learning.
CO2:Identify, formulate, and solve complex engineering and societal problems using AI and ML techniques. CO3:Design and develop intelligent systems and engineering solutions using appropriate algorithms, tools, and technologies.
CO4:Conduct independent research, experimentation, analysis, and project implementation effectively.
CO5: Communicate technical concepts, project findings, and innovative solutions effectively through oral presentations, demonstrations, and technical reports.

CO-PO MAPPING:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	3	3	2	2		-	-	-	2	2	-	-
CO2	1	1	3	3	2	2		-	1	-	2	2	-	-
CO3	1	1	3	3	2	2		-	2	-	2	2	-	1
CO4	1	1	3	3	2	2		-	1	-	2	2	-	-
CO5	1	1	3	3	1	2		-	1	-	1	2	-	-

PROGRAMME ELECTIVES

VERTICAL I
FULL STACK DEVELOPMENT

<table>
<tr><td colspan="7">CS606101 - Design And Analysis of Algorithms (NPTEL)</td></tr>
<tr><td colspan="2">Course Category: Programme Elective</td><td colspan="2">Course Type:
Theory</td><td>L
3</td><td>T
0</td><td>P
0</td><td>C
3</td></tr>
<tr><td colspan="2">COURSE OBJECTIVES:</td><td colspan="6"></td></tr>
<tr><td colspan="8">• To gain an idea about how to analyze algorithms
• To understand Divide and Conquer & Decrease and Conquer techniques and solve some problems using these techniques
• To understand Dynamic Programming technique and solve some problems using this technique
• To understand Branch and Bound technique and solve some problems using this technique
• To learn some basic approximation algorithms for NP-Hard Problems</td></tr>
<tr><td colspan="8">Week 1 Module 1: Introduction | Module 2: Examples and motivation | Module 3: Examples and motivation | Module 4: Asymptotic complexity: informal concepts | Module 5: Asymptotic complexity: formal notation | Module 6: Asymptotic complexity: examples | Assignments MCQ/Fill in blanks (unique answer)</td></tr>
<tr><td colspan="8">Week 2 Module 1: Searching in list: binary search | Module 2: Sorting: insertion sort | Module 3: Sorting: selection sort | Module 4: Sorting: merge sort | Module 5: Sorting: quicksort | Module 6: Sorting: stability and other issues | Assignments MCQ/Fill in blanks, programming assignment</td></tr>
<tr><td colspan="8">Week 3 Module 1: Graphs: Motivation | Module 2: Graph exploration: BFS | Module 3: Graph exploration: DFS | Module 4: DFS numbering and applications | Module 5: Directed acyclic graphs | Module 6: Directed acyclic graphs | Assignments MCQ/Fill in blanks, programming assignment</td></tr>
<tr><td colspan="8">Week 4 Module 1: Shortest paths: unweighted and weighted | Module 2: Single source shortest paths: Dijkstra | Module 3: Single source shortest paths: Dijkstra | Module 4: Minimum cost spanning trees: Prim’s algorithm | Module 5: Minimum cost spanning trees: Kruskal’s Algorithm | Module 6: Union-Find data structure | Assignments MCQ/Fill in blanks, programming assignment</td></tr>
<tr><td colspan="8">Week 5 Module 1: Divide and conquer: counting inversions | Module 2: Divide and conquer: nearest pair of points | Module 3: Priority queues, heaps | Module 4: Priority queues, heaps | Module 5: Dijstra/Prims revisited using heaps | Module 6: Search Trees: Introduction | Assignments MCQ/Fill in blanks, programming assignment</td></tr>
<tr><td colspan="8">Week 6 Module 1: Search Trees: Traversals, insertions, deletions | Module 2: Search Trees: Balancing | Module 3: Greedy : Interval scheduling | Module 4: Greedy : Proof strategies | Module 5: Greedy : Huffman coding | Module 6: Dynamic Programming: weighted interval scheduling | Assignments MCQ/Fill in blanks, programming assignment</td></tr>
</table>

Week 7 Module 1: Dynamic Programming: memoization | Module 2: Dynamic Programming: edit distance | Module 3: Dynamic Programming: longest ascending subsequence | Module 4: Dynamic Programming: matrix multiplication | Module 5: Dynamic Programming: shortest paths: Bellman-Ford | Module 6: Dynamic Programming: shortest paths: Floyd Warshall | Assignments MCQ/Fill in blanks, programming assignment

Week 8 Module 1: Intractability: NP-completeness | Module 2: Intractability: reductions | Module 3: Intractability: examples | Module 4: Intractability: more examples | Module 5: Misc topics | Module 6: Misc topics | Assignments MCQ/Fill in blanks

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Interpret the fundamental needs of algorithms in problem solving

CO2: Classify the different algorithm design techniques for problem solving

CO3: Develop algorithms for various computing problems

CO4: Analyze the time and space complexity of various algorithms

CO5: Identify the limitations of algorithms in problem solving

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2						2		2	3	
CO2	3	3		3						2		2	3	
CO3	3	3	2							2		2	3	
CO4	3	3	3	3						2		2	3	
CO5	3	3	3	3						2		2	3	

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.AnanyLevitin,"Introduction to the Design And Analysis of Algorithms", Third Edition, Pearson Education

2. Design and Analysis of Algorithms by ParagHimanshu Dave (Author), HimanshuBhalchandra Dave (Author)

3. Design and analysis of algorithms By S. Sridhar (Author)

REFERENCE BOOKS:

1.AlfredV.Aho, JohnE. Hopcroft, Jeffrey D.Ullman "The Design and Analysis of Computer Algorithms", 1st Edition

2.SachinDevGoyal, "Design and Analysis of Algorithm", First edition, University Science Press, 2009

3.Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.

WEB RESOURCES:

1.https://onlinecourses.nptel.ac.in/noc20_cs10/preview#:~:text=This%20course%20provides%20an%20introduction,used%20to%20solve%20these%20problems.

2.https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/

CS606102 - APP DEVELOPMENT					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

COURSE OBJECTIVES:

- To introduce Application Development & Designing.
- To work with Android Storing and Retrieving Data
- To know about Android Networking and Web
- To develop a Graphics & Mobility and Location Based Services

UNIT 1: INTRODUCTION	**9**

Introduction to Mobile Computing - Android Development Environment - Mobile Software Engineering. Frameworks and Tools - Generic UI Development - Android User - VUIs and Mobile Apps - Designing the Right UI - Multichannel and Multimodal UIs

UNIT 2: INTENTS AND SERVICES	**9**

Android Intents and Services - Characteristics of Mobile Applications - Successful Mobile Development - Storing and Retrieving Data: Synchronization and Replication of Mobile Data - Getting the Model Right - Android Storing and Retrieving Data - Working with a Content Provider

UNIT 3: WEB COMMUNICATION AND TELEPHONY	**9**

Communications Via Network and the Web : State Machine - Correct Communications Model - Android Networking and Web – Telephony : Deciding Scope of an App - Wireless Connectivity and Mobile Apps - Android Telephony - . Notifications and Alarms : Performance - Performance and Memory Management - Android Notifications and Alarms.

UNIT 4: GRAPHICS AND MULTIMEDIA	**9**

Graphics : Performance and Multithreading - Graphics and UI Performance - Android Graphics - . Multimedia : Mobile Agents and Peer-to-Peer Architecture - Android Multimedia – Location : Mobility and Location Based Services – Android.

UNIT 5: SECURITY AND HACKING	**9**

Security and Hacking : Active Transactions - More on Security - Hacking Android - Platforms and Additional Issues : Development Process – Architecture – Design - Technology Selection - Mobile App Development Hurdles – Testing.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Create simple basic PHP programs

CO2: Create programs using functions and strings

CO3: Explore the usage of arrays and objects

CO4: Implement graphics, security and web techniques in designing

CO5: Implement database connectivity with PHP

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Rick Rogers , John Lambardo "Android Application Development" 2018.

2.Android Application Development (With Kitkat Support) by Pradeep Kothari (Author), Kogent Learning Solutions Inc. (Author) 2014

3.Learning Android: Develop Mobile Apps Using Java and Eclipse, 2nd Edition,MarkoGargenta and Masumi Nakamura

REFERENCE BOOKS:

1.RavinderGoud&Gopichand "Mobile Application Development"

2.BenFeigin "Mobile Application Development"

WEB RESOURCES:

1.https://developer.android.com/?gclid=CjwKCAjw586hBhBrEiwAQYEnHQLEPhnP3_mYwjOUygwEhO4WH90BSCnOPMun_aK6SZxfeCgIidT1LhoCG-QQAvD_BwE&gclsrc=aw.ds

2. https://flutter.dev

1.RavinderGoud&Gopichand "Mobile Application Development"

CS606103 - **PHP Programming**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To introduce web development with PHP
- To work with various operations in PHP
- To model the design in a web environment
- To develop a webpage with database
- To test and work with a PHP application

UNIT 1: INTRODUCTION TO PHP	**9**
PHP – History and Evolution – Installation – Language Basics – Lexical Structure – Datatypes – Variables – Expression & Operators – Flow Control statements – embedding PHP in web pages	
UNIT 2: FUNCTIONS & STRINGS	**9**
Calling a function – Defining a function – Variable scope – function parameters – return values – variable functions – Strings – Quoting string constants – Printing string – cleaning strings – encoding and escaping – comparing strings – manipulating and searching strings	
UNIT 3: ARRAYS & OBJECTS	**9**
Indexed versus Associative Arrays – Identifying elements of an array – Storing data in arrays – Multidimensional arrays –Extracting multiple values – Conversion between arrays and variables – Traversing arrays – Sorting – Working with arrays – Objects – Creation – Accessing Properties and methods – Declaration of class – Introspection	
UNIT 4: WEB TECHNIQUES, GRAPHICS & SECURITY	**9**
HTTP basics – Server Information – Processing Forms –Setting Response Headers – Maintaining State – SSL – Graphics – Embed an image – Create and draw images – Images with text – Dynamic buttons – Color handling – Security – Cross site scripting – File uploads and Access	
UNIT 5: DATABASE ACCESS & APPLICATION	**9**
PHP to access a database – Relational databases and SQL – MySQL object interface – Connectivity – Direct file level manipulation – Application techniques – code libraries – handing output - error reporting and suppression – performance tuning	
TOTAL: 45 PERIODS	
COURSE OUTCOMES: At the end of the course, the student will be able to	
CO1: Create simple basic PHP programs	
CO2: Create programs using functions and strings	
CO3: Explore the usage of arrays and objects	
CO4: Implement graphics, security and web techniques in designing	
CO5: Implement database connectivity with PHP	
CO-PO MAPPING	

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Kevin Tatroe, Peter MacIntyre&RasmusLerdorf, "Programming PHP", Creating Dynamic Web Pages, O'Reilly Media, 3rd Edition, 2013

2.Programming PHP: Creating Dynamic Web Pages, 4th Edition,KevinTatroe,peterMaclntyre.

3.PHP : The Complete Reference for Beginners,Anshul Saini,2023

REFERENCE BOOKS:

1.Steven Holzner ,"PHP: The Complete Reference", McGraw Hill Education,2008

2.Timothy Boronczyk , Martin E. Psinas,"PHP and MYSQL: Create - Modify – Reuse", Wiley India Private Limited ,2008

3.Matt Doyle, "Beginning PHP 5.3", Wiley Publishing Inc., 2009

WEB RESOURCES:

1.https://www.cloudkampus.com/

2.https://www.codecademy.com/

CS606104 - UI and UX Design

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide students with the knowledge of user- centered design
- To understand user -centered methods in design, simulation and prototyping techniques To organize information about users into useful summaries with affinity diagrams.
- To convey user research and user experience design
- To understand wire framing and Prototyping software in the various UI/UX Design tools.

UNIT 1: INTRODUCTION TO THE UI — **9**

User Interface Design (UI) -The Relationship Between UI and UX , Roles in UI/UX, A Brief Historical Overview of Interface Design, Interface Conventions, Approaches to Screen Based UI, Template vs Content.

UNIT 2: UI INTERFACE DESIGN — **9**

Formal Elements of Interface Design, Active Elements of Interface Design, Composing the Elements of Interface Design, UI Design Process, Visual Communication design component in Interface Design.

UNIT 3: INTRODUCTION TO UX — **9**

UX Basics- Foundation of UX design, Good and poor design, Understanding Your Users, Designing the Experience Elements of user Experience. I vs UX – Roles in UX.Careers option in UX - Design Careers - Research Careers - Strategy Careers - Career in UX

UNIT 4: DESIGN AND TESTING — **9**

Visual Design Principles, Functional Layout, Interaction design, Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design - UX Techniques - Gather and Analyse User Ideation techniques - Scenarios and storyboarding - Paper Prototype design and testing - development cycle.

UNIT 5: UI/ UX DESIGN TOOL — **9**

User Study- Interviews, writing personas: user and device personas, User Context, Building Low Fidelity Wireframe and High-Fidelity Polished Wireframe Using wire framing Tools, Creating the working Prototype using Prototyping tools, Sharing and Exporting Design

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand iterative user-centered design of graphical user interfaces

CO2: Apply the user Interfaces to different devices and requirements

CO3:Create high quality professional documents and artifacts related to the design process.

CO4: Understand Design and Research Careers.

CO5: Create UI/UX Design Tools.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1									1		1	1	1

CO2	1									1		1	1	1
CO3	1	1	1							1		1	1	1
CO4	1	1	1							1		1	1	1
CO5	1	1	1							1		1	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2012

2.The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education. 2011.

REFERENCE BOOKS:

1.The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz , Wiley Publishing, 2007.

2.The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier, 2012

WEB RESOURCES:

1.https://www.cloudkampus.com/

2.https://www.codecademy.com/

CS606105 - Software Testing (NPTEL)

Course Category: Programme	Course Type: Theory	L	T	P	C
Elective		3	0	0	3

COURSE OBJECTIVES:

- To learn the criteria for test cases.
- To learn the design of test cases.
- To understand test management and test automation techniques.
- To apply test metrics and measurements.

Week 1 : Introduction – Level of Testing – Basic Concepts of Testing – Unit Testing.

Week 2 : Equivalence and BV Testing – Special Value Testing Combinational Testing – Pairwise Testing – White Box Testing

Week 3 : MC/DC Testing – Path testing – Dataflow and Mutation Testing

Week 4 : Integration Testing – System Testing – Regression Testing

Week 5: Testing Object Oriented Programing

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to CO1:Design test cases suitable for a software development for different domains.

CO2:Identify suitable tests to be carried out.

CO3:Prepare test planning based on the document.

CO4:Document test plans and test cases designed.

CO5:Use automatic testing tools.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Srinivasan Desikan and Gopalaswamy Ramesh, ―Software Testing – Principles and Practices‖, Pearson Education, 2006.

2. Ron Patton, ―Software Testing‖, Second Edition, Sams Publishing, Pearson Education, 2007. AU Library.com

REFERENCE BOOKS:

1. Ilene Burnstein, ―Practical Software Testing, Springer International Edition, 2003. 2. Edward Kit,Software Testing in the Real World – Improving the Process, Pearson Education, 1995.

3. Boris Beizer, Software Testing Techniques – 2nd Edition, Van Nostrand Reinhold, New York, 1990.

WEB RESOURCES:

1.https://www.besanttechnologies.com/

2.https://www.rejinpaul.com/

CS606106 - **Web Application Security**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To reveal the underlying in web application.
- To identify and aid in fixing any security vulnerabilities during the web development process.
- To understand the security principles in developing a reliable web application.
- To Understand penetration testing to improve the security of web applications
- To Use industry standard tools for web application security.

UNIT 1: OVERVIEW OF WEB APPLICATIONS & SECURITY	**9**

Introduction history of web applications interface ad structure benefits and drawbacks of web applications Web application Vs Cloud application - Security Fundamentals: Input Validation - Attack Surface Reduction Rules of Thumb- Classi- fying and Prioritizing Threads

UNIT 2:SECURITY PRINCIPLES	**9**

Origin Policy - Exceptions to the Same-Origin Policy - Cross-Site Scripting and Cross-Site Request Forgery - Reflected XSS - HTML Injection - Clickjacking - DNS rebinding - Flash security - Java applet security - Single-sign-on solution and security - IPv6 impact on web security.

UNIT 3: WEB APPLICATION VULNERABILITIES	**9**

Understanding vulnerabilities in traditional client server application and web applications, client state manipulation, cookie based attacks, SQL injection, cross domain attack (XSS/XSRF/XSSI) http header injection. SSL vulnerabilities and testing - Proper encryption use in web application - Session vulnerabilities and testing - Cross-site request forgery

UNIT 4: WEB APPLICATION MITIGATIONS	**9**

Http request , http response, rendering and events , html image tags, image tag security, issue, java script on error , Java script timing , port scanning , remote scripting , running remote code, frame and iframe , browser sandbox, policy goals, same origin policy, library import, domain relaxation

UNIT 5: SECURE WEBSITE DESIGN	**9**

Secure website design : Architecture and Design Issues for Web Applications, Deployment Considerations Input Validation, Authentication, Authorization, Configuration Management ,Sen- sitive Data, Session Management, Cryptography, Parameter Manipulation, Exception Manage- ment, Auditing and Logging, Design Guidelines, Forms and validity, Technical implementation

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:Understand the underlying in web application.

CO2:Identify and aid in fixing any security vulnerabilities during the web development process.

CO3:Understand the security principles in developing a reliable web application.

CO4:Understand penetration testing to improve the security of web applications

CO5:Create standard tools for web application security.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2								2		2	2	
CO2	2	2								2		2	2	
CO3	2	2						1		2		2	2	
CO4	2	2						1		2		2	2	
CO5	2	2								2		2	2	

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Sullivan, Bryan, and Vincent Liu. Web Application Security, A Beginner's Guide. McGraw Hill Professional, 2011.

2.Web Application Security,by Andrew Hoffman,2020

REFERENCE BOOKS:

1.Stuttard, Dafydd, and Marcus Pinto. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws. John Wiley Sons, 2011

2.Developing Web Applications,by M.T. Savaliya ,2013

WEB RESOURCES:

1.https://leveetech.com/

2.https://www.guvi.in/

CS606107 - **Dev-ops**						
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						
• To provide students with the knowledge of DevOps • To understand Cloud and virtualization architecture • To know about Jenkins and its architecture • To know about Docker and its technology • To know about Kubernetes Cluster Architecture						
UNIT 1: INTRODUCTION						**9**
DevOps Principles in detail - DevOps Engineer Skills in the market - Knowing DevOps Delivery Pipeline - Market trend of DevOps - DevOps Technical Challenges - Tools we use in DevOps.						
UNIT 2: DEVOPS ON CLOUD						**9**
Essentials of Cloud computing - Cloud and virtualization architecture - Cloud deployment architecture - Cloud providers – An overview - Introducing to Amazon web services.						
UNIT 3: JENKINS						**9**
Essentials of Continuous Integration - Jenkins and its architecture - Jenkins tool Management - User management in Jenkins – Authentication: Jenkins own database user creation – Authorization: Matrix based authorization - Project based authorization						
UNIT 4: WEB APPLICATION MITIGATIONS						**9**
Introduction - Real-world Shipping Transportation Challenges - Docker and its technology - Docker images and containers - Working with container: Share and copy a container - Container Life Cycle - Base Image and customize - Creation of Docker File - Publish Image on Docker Hub						
UNIT 5:KUBERNETES						**9**
Introduction to Kubernetes - Kubernetes Cluster Architecture — An overview - Understanding concepts of Pods, Replica sets, deployments and namespaces - concepts of services and networking - Persistent volumes and persistent volume claims —an overview - Design of Pods - labels, selectors, jobs, and schedulers						
						TOTAL: 45 PERIODS
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1:Understand with the knowledge of DevOps						
CO2:Create Cloud and virtualization architecture						
CO3:Understand Jenkins and its architecture & own database user creation						
CO4:Creation of Docker File and its technology						
CO5:Understand concepts of Pods, Replica sets, deployments and namespaces						
CO-PO MAPPING						

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Joseph Joyner , MihalisKonoplovs "DevOps for Begineers" 2015

2.MikaelKrief "Learning DevOps – Complete Guide" Packt Publications , 2019

REFERENCE BOOKS:

1.IshaqAzhar Mohammed , DhayaSindhuBattina , Dr.Mehul Patel "Introduction to DevOps" 2021

2.Effective DevOps,By Jennifer Davis, Ryn Daniels · 2016

WEB RESOURCES:

1.https://www.simplilearn.com/

2.https://intellipaat.com/

CS606108 - **Principles of Programming Languages**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To know the knowledge of Programming
- To understand Basic Knowledge of Names, Bindings, and Scopes
- To know about Subprograms and Blocks
- To know about Concurrency in Function Languages
- To know about Functional Programming & Scripting Languages

UNIT 1: PRELIMINARY CONCEPTS **9**

Concepts of Programming Languages, Programming Domains, Language Evaluation Criteria, Influences on Language Design, Language Categories, Language Design TradeOffs, Implementation Methods, Programming Environments - General Problem of Describing Syntax and Semantics, Formal Methods of Describing Syntax, Attribute Grammars, Describing the Meanings of Programs.

UNIT 2: NAMES, BINDINGS, AND SCOPES **9**

Introduction, Names, Variables, Concept of Binding, Scope, Scope and Lifetime, Referencing Environments, Named Constants - introduction, Primitive Data Types, Character String Types, User Defined Ordinal Types, Array, Associative Arrays, Record, Union, Tuple Types, List Types, Pointer and Reference Types, Type Checking, Strong Typing, Type Equivalence.

UNIT 3: SUBPROGRAMS AND BLOCKS **9**

Fundamentals of Sub-Programs, Design Issues for Subprograms, Local Referencing Environments, Parameter Passing Methods, Parameters that Are Subprograms, Calling Subprograms Indirectly, Overloaded Subprograms, Generic Subprograms, Design Issues for Functions, User Defined Overloaded Operators, Closures, Co routines

UNIT 4: CONCURRENCY **9**

Introduction, Introduction to Subprogram Level Concurrency, Semaphores, Monitors, Message Passing, Java Threads, Concurrency in Function Languages, Statement Level Concurrency. Exception Handling and Event Handling: Introduction, Exception Handling in Ada, C++, Java, Introduction to Event Handling, Event Handling with Java and C#.

UNIT 5: FUNCTIONAL PROGRAMMING LANGUAGES **9**

Introduction, Mathematical Functions, Fundamentals of Functional Programming Language, LISP, Support for Functional Programming in Primarily Imperative Languages, Comparison of Functional and Imperative Languages - Scripting Language: Pragmatics, Key Concepts, Case Study: Python – Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:Acquire the skills for expressing syntax and semantics in formal notation

CO2:Identify and apply a suitable programming paradigm for a given computing application

CO3:Gain knowledge of and able to compare the features of various programming languages

CO4:Understand Statement Level Concurrency

CO5:Create Functional Programming in Primarily Imperative Languages

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3							2			3	
CO2	2	3	3							2			2	
CO3	2		2	3	3					2			2	2
CO4		2	3		2					2			2	2
CO5		2	2		3					2			2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Concepts of Programming Languages Robert. W. Sebesta 10/E, Pearson Education.

2.Programming Language Design Concepts, D. A. Watt, Wiley Dreamtech, 2007

REFERENCE BOOKS:

1.Programming Languages, 2nd Edition, A.B. Tucker, R. E. Noonan, TMH.

2.Programming Languages, K. C. Louden, 2nd Edition, Thomson, 2003

WEB RESOURCES:

1.https://www.simplilearn.com/

2.https://intellipaat.com/

CS606109 - **Social Networks (NPTEL)**

Course Category: Programme		**L**	**T**	**P**	**C**
Course Type: Theory					
Elective		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- Build and strengthen your brand
- Increase your traffic
- Connect with your audience
- Drive conversions
- Increase your presence

Week 1: Introduction
Week 2: Handling Real-world Network Datasets
Week 3: Strength of Weak Ties
Week 4: Strong and Weak Relationships (Continued) &Homophily
Week 5: Homophily Continued and +Ve / -Ve Relationships
Week 6: Link Analysis
Week 7: Cascading Behaviour in Networks
Week 8: Link Analysis (Continued)
Week 9: Power Laws and Rich-Get-Richer Phenomena
Week 10: Power law (contd..) and Epidemics
Week 11: Small World Phenomenon
Week 12: Pseudo core (How to go viral on web)

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:Driving Traffic
CO2:Enhancing the Customer Experience
CO3:Learning and Education
CO4:Motivating Young People
CO5:Creativity

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2									2		
CO2	2	2	2		2								2	
CO3	2	2	2		2	2								2
CO4		2		2	2	2	2							
CO5	2		2		2	2	2	2						
	2				2									

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Social Networking And Cyberspirituality Towards A Theology of Networks by Rev Jim M R Paul, Christian World Imprints
2.Social Networking by Kenneth Partridge

REFERENCE BOOKS:

1.All About Social Networking by Patti Richards,Apr 2018
2.Social Network Analysis for Start-ups, October 2015 by Maksim Tsvetovat (Author), Alexander Kouznetsov (Author)

WEB RESOURCES:
https://www.frontiersin.org/
https://digitalcommons.unl.edu/libphilprac/3727/

CS606110 - **MULTIMEDIA TECHNOLOGY**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
• To examine the notions of multimedia, graphics and image data, video data, and audio data • To learn about digital audio and its compression • To learn the various multimedia data compression techniques • To know the idea behind the image and video compression techniques • To learn network protocols, multimedia content distribution and CBIR multimedia

UNIT 1: INTRODUCTION	9
Multimedia – Definitions, components. Multimedia software tools – Multimedia presentation – Data compression –Multimedia production – Multimedia sharing and distribution. Graphics and Image data representations	
UNIT-2 : DIGITAL AUDIO AND COMPRESSION	9
Basics of digital audio – Digitization of sound – MIDI – Quantizationa and Transmission of Audio - Basic audiocompression techniques: ADPCM in speech coding – MPEG audio compression.	
UNIT-3 : MULTIMEDIA DATA COMPRESSION	9
Lossless compression algorithms: Run-length coding, variable-length coding, dictionarybased coding, arithmeticcoding. Lossless image compression. Lossy compression algorithms: Quantization, transform coding,wavelet-based coding, wavelet packets, embedded Zerotree of wavelet coefficients.	
UNIT-4 : IMAGE COMPRESSION	9
Color models in images - Image compression standards: JPEG standard, JPEG2000 standard: Main steps, Region-of-Interest coding – JPEG-LS standard - Bi-level image compression standards.	
UNIT-5 : VIDEO COMPRESSION	9
Color models in Video - Basic video compression techniques: Video compression based on motion compensation, search for motion vectors, H.261 and H.263 – New video coding standards **TOTAL: 45 PERIODS**	

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1: Identify suitable data representations for use in appropriate multimedia applications
CO2: Work with the various audio compression techniques
CO3: Select suitable data compression technique for respective application
CO4: Interpret the image and video compression standards and techniques
CO5: Examine the protocols for multimedia transmission and content distribution
CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	2	2	-	-	-	-	2	-	2	-	-
CO2	2	2	2	2	2	-	-	-	-	2	-	2	-	-
CO3	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO4	2	2	2	-	2	-	-	-	-	2	-	2	-	-
CO5	2	2	-	2	2	-	-	-	-	2	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Ze-Nian Li, Mark S. Drew, and Jiangchuan Liu, "Fundamentals of Multimedia", Second Edition, Springer, 2014.

2.Tay Vaughan, "Multimedia: Making It Work", McGraw-Hill Education, ninth edition, 2014.

REFERENCE BOOKS:

1.Ralf Steinmetz and KlaraNahrstedt, "Multimedia: Computing, Communications and Applications",Pearson Education,
2012.

2.Banerji Ashok &GhoshAnanda Mohan, "Multimedia Technologies", Tata McGraw Hill, New Delhi 2010.

WEB RESOURCES:

1.https://core.ac.uk/download/pdf/82176089.pdf

2.https://developer.mozilla.org/en-US/docs/Web/Media

VERTICAL II
CLOUD AND DATA SCIENCE

CS606201 - **CLOUD COMPUTING (NPTEL)**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know about Cloud Architecture and Virtualization
- To learn Management Level and Google Cloud Platform
- To know about Cloudonomics and Security Level Implementation
- To apply Fog Computing and Sensor Cloud Computing
- To analyse various VM Migration Techniques used in Cloud Computing.

UNIT 1:INTRODUCTION	9
Overview –Introduction – Architecture – Deployment Models – Virtualization – XML Basics I - XML Basics – II – Web Services – Service Oriented Architecture	
UNIT-2 : SERVICE LEVEL MANAGEMENT	9
Service Level Management – Cloud Computing – Managing Data – Introduction to Mapreduce – Open Stack – Open Stack Demo – Cloud Microsoft Azure – Google Cloud Platform	
UNIT-3 : CLOUD COMPUTING SECURITY	9
SLA – Cloudonomics – Mapreduce – Resource Management – I , Resource Management –II , Cloud Computing Security – I , II , III – Security Issues in Colloborative SaaS Cloud – Broker for Cloud Marketplace	
UNIT-4 : FOG COMPUTING	9
Mobile Computing I ,II – Fog Computing I , II – Use case: Geo Spatial Cloud – Introduction to Docker Container – Green Cloud – Sensor Cloud Computing – IoT Cloud – Course Summary and Research Areas.	
UNIT-5 : VM MIGRATION	9
Cloud Federation – VM Migration – basic Migration Strategies – Containers Container based virtualization Kubernetes Docker Container - Demo	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe about Cloud Architecture and Virtualization

CO2: Apply Management Level and Google Cloud Platform

CO3: Demonstrate about Cloudonomics and Security Level Implementation

CO4: Analyse Fog Computing and Sensor Cloud Computing Techniques

CO5: Evaluate various VM Migration Techniques used in Cloud Computing.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3						3	2		3		2
CO2	3	2	2							3			2	3
CO3	2	3	3						2	2		2		

CO4	3	2	3							2			2	2
CO5	3	3	2						2	3		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Prof.Soumya Kanti Ghosh ,"Cloud Computing" Department of Computer Science and Engineering,IIT Guwahati,2017.

2.Lizhe Wang, Rajiv Ranjan, Jinjun Chen, Boualem Benatallah," Cloud Computing", CRC Press,2017.

3.Thomas Erl , Zalgharm Mahmood , Richard Puttini,"Cloud Computing – Concepts,Technology and Architecture"PearsonPublication,First Edition,201

REFERENCE BOOKS:

1) A.Srinivasan , J.Suresh , "Cloud Computing – A Practical approach for Learning and Implementation" Pearson Publication , First Edition ,2014.

2) Kailash Jayaswal,JagannathKallakurchi,DonaldJ.Houde,Dr.DevenShah,"Cloud Computing – Black Book"Dreamtech Press,2014.

3)Anthony T.Velte , Toby J.Velte , Robert Elsenpeter , "Cloud Computing-A Practical Approach",Tata McGraw Hill Education,2017.(Indian Edition)

WEB RESOURCES:

1.https://www.knowledgehut.com/blog/cloud-computing/top-cloud-computing-resources

2.https://westportlibrary.libguides.com/CloudComputing

CS606202 - **VIRTUALIZATION**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of Virtualization
- To know the virtualization infrastructure
- To build the cloud deployment models
- To know the Hadoop Framework
- To know the Cloud Infrastructure security

UNIT 1: VIRTUALIZATION	9
Basics of Virtual Machines - Process Virtual Machines System Virtual Machines – Emulation– Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization– Management Virtualization — Hardware Maximization – Architectures – Virtualization Management– Storage Virtualization– Network Virtualization	
UNIT 2: VIRTUALIZATION INFRASTRUCTURE	9
Comprehensive Analysis– Resource Pool – Testing Environment – Server Virtualization– Virtual Workloads – Provision Virtual Machines– Desktop Virtualization – Application Virtualization - Implementation levels of virtualization– virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management– Virtualization for data center automation.	
UNIT 3: CLOUD PLATFORM ARCHITECTURE	9
Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything asa service: Infrastructure, platform, software- A Generic Cloud Architecture Design– Layered cloud Architectural Development– Virtualization Support and Disaster Recovery– Architectural Design Challenges - Public Cloud Platforms : GAE,AWS– Inter-cloud Resource Management	
UNIT 4: PROGRAMMING MODEL	9
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Developing Map Reduce Applications -Design of Hadoop file system – Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus	
UNIT 5: CLOUD SECURITY	9
Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud – Cloud Security and Trust Management TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Deploy the concepts of virtualization strategies and virtual machines

CO2: Apply the concept of virtualization infrastructure in the cloud computing

CO3: Identify the architecture and deployment models of cloud computing

CO4: Develop cloud services using cloud computing for real time environment

CO5: Apply the security models in the cloud environment

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	1	2	2		1					3	2		2	1
CO2	2	3	3						2	2		1		2
CO3	2	1	3							3	1		1	
CO4	3	2	1		2				2	3		2		1
CO5	3	2	1		2					2	2	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Danielle Ruest, Nelson Ruest, ―Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media,2009.2.

2.Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 20053.

3.John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

REFERENCE 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, 2012.5.

2.Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O'Reilly Media,Inc.,2009.6.

3.Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.7.

WEB RESOURCES:

1.www.ibm.com/in-en/topics/virtualization

2.https://www.sciencedirect.com/topics/computer-science/virtualized-resource.

CS606203 - **CLOUD COMPUTING AND DISTRIBUTED SYSTEMS (NPTEL)**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the fundamental concepts of Cloud Computing To analyse different algorithms in Cloud Computing To simulate the different Cloud Data Centers.
- To get the knowledge of Key and HBase.
- To know about peer-to-peer and Spark Technique.

UNIT 1: OVERVIEW	9
Introduction to Cloud Computing - Virtualization - Hotspot Mitigation for Virtual Machine Migration - Server Virtualization - Software Defined Network - Geo-distributed Cloud Data Centers.	
UNIT 2: DISTRIBUTED ALGORITHM	9
Leader Election in Rings (Classical Distributed Algorithms) - Leader Election (Ring LE & Bully LE Algorithm) - Design of Zookeeper	
UNIT 3: CLOUD DATA CENTERS	9
Time and Clock Synchronization in Cloud Data Centers - Global State and Snapshot Recording Algorithms - Distributed Mutual Exclusion - Consensus in Cloud Computing and Paxos	
UNIT 4: KEY AND HBASE	9
Design of Key-Value Stores - Design of HBase - Introduction to Kafka	
UNIT 5: SPARK	9
Peer to Peer Systems in Cloud Computing - MapReduce - Introduction to Spark	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Build the fundamental concepts of Cloud Computing

CO2: Apply different algorithms in Cloud Computing

CO3:Develop the different Cloud Data Centers.

CO4: Learn the knowledge of Key and HBase

CO5: Apply about peer-to-peer and Spark Technique.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3						2	3		2		3
CO2	3	2	2						3	2			3	
CO3	2	3	2							3		3		2
CO4	3	2	3							2		2	3	
CO5	2	3	2						2	3		3		3

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Prof.Rajiv Mishra , “Cloud Computing and Distributed Systems” Department of Computer Science and Engineering,IIT Patna,2021.
2.Kai Hwang , Geoffrey C.Fox , Jack J.Dongarra , “Distributed and Cloud Computing” Morgan Kaufmann Publisher,First Edition,2013.
3.Rajiv Mishra,Yashwant Singh Patel,”Cloud and Distributed Computing – Algorithms and Systems”,Wiley Publisher,2020.
REFERENCE BOOKS:
1.Raj Kumar Bayya , James broberg , Andrzej Goscinski ,”Cloud Computing – Principles and Paradigms”, Wiley Publisher, First Edition,2018.
2.Kenneth P.Birman , “Guide to Reliable Distributed Systems”, Springer Publisher,2012.
3.Christian Vecchiola , S.Thamarai Selvi,Rajkumar Bayya , “Mastering Cloud Computing ”MorganKaufmann, First Edition.,2013.
WEB RESOURCES:
1.https://onlinecourses.nptel.ac.in/noc21_cs15/preview
2.https://www.classcentral.com/course/swayam-cloud-computing-anddistributed-systems-17544

CS606204 - **DATA WAREHOUSING**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand data warehouse concepts, architecture, business analysis and tools
- To understand data pre-processing and data visualization techniques
- To study algorithms for finding hidden and interesting patterns in data
- To understand and apply various classification and clustering techniques using tools.
- To Know about the Weka Tool

UNIT 1: DATA WAREHOUSING-INTRODUCTION	9

Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors - Multidimensional Data Model – Data Warehouse Schemas for Decision Support, Concept Hierarchies Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.

UNIT 2: DATA MINING – INTRODUCTION	9

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.

UNIT 3: DATA MINING - FREQUENT PATTERN ANALYSIS	9

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns

UNIT 4: CLASSIFICATION AND CLUSTERING	9

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines — Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy. Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods.

UNIT 5: WEKA TOOL	9

Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database - Introduction to WEKA, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Clustering algorithms, Association–rule learners.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Design a Data warehouse system and perform business analysis with OLAP tools.

CO2: Apply suitable pre-processing and visualization techniques for data analysis

CO3 : Apply the algorithms for finding hidden and interesting patterns in data.

CO4: Apply various classification and clustering techniques using tools.

CO5: Know about the Weka Tool

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Jiawei Han, Micheline Kamber, JianPai, "DataMining: Concepts and Techniques", Morgan Kaufman Publishers, Third Edition, 2012.

2.Nenad Jukic, SusanVrbsky, SvetlozarNestorov," DatabaseSystems: Introduction to Database and Data Warehouses", Prospect Press,1st Edition,2020.

3.Pang-Nong Tan, MichaelSteinbach,Anuj Karpatne,Vipin Kumar ,"Introduction to Data Mining"Pearson,Second Edition,2021.

REFERENCE BOOKS:

1.Bharat Bhushan Agarwal, Sumit Prakash Tayal, "Data Mining and Data Warehousing", University Science, First Edition, 2009.

2.Mehmed Kantardzic, "DataMining Concepts, Models, Methods and Algorithms", Wiley Publications, Second Edition,2011.

3.Khushboo Saxena , Sandeep Saxena , AkashSaxena ,"Data Mining and Data Warehousing"BPB Publications,2014.

WEB RESOURCES:

1.www.topcoder.com/thrive/articles/data-warehousing-data-mining.

2.https://www.simplelearn.com/data-warehouse-article.

CS606205 - **STORAGE TECHNOLOGIES**						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						

- To understand the underlying principles of spoilage and storage
- To provide knowledge on different storage methods and packaging techniques
- To Learn Functions of Packaging Materials
- To apply package material testing
- To implement Special Packaging Techniques

UNIT 1: SPOILAGE AND STORAGE	9
Direct damages, Indirect damages of perishable and durable commodities – control measures - factors affecting storage – types of storage – Losses in storage and estimation of losses.	
UNIT 2: STORAGE METHODS	9
Improved storage methods for grain-modern storage structures-infestation-temperature and moisture changes in storage structures-CAP storage-CA storage of grains and perishables construction operation and maintenance of CA storage facilities	
UNIT 3: FUNCTIONS OF PACKAGING MATERIALS	9
Introduction – packaging strategies for various environment – functions of package – packaging materials – cushioning materials – bio degradable packaging materials – shrink and stretch packaging materials.	
UNIT 4: FOOD PACKAGING MATERIALS AND TESTING	9
Introduction – paper and paper boards - flexible - plastics - glass containers – cans – aluminium foils - package material testing-tensile, bursting and tear strength.	
UNIT 5:SPECIAL PACKAGING TECHNIQUES	9
Vacuum and gas packaging - aseptic packaging - retort pouching – edible film packaging – tetra packaging – antimicrobial packaging – shrink and stretch packaging.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES: At the end of the course, the student will be able to	
CO1: Understand the underlying principles of spoilage and storage	
CO2: Provide knowledge on different storage methods and packaging techniques	
CO3: Learn Functions Of Packaging Materials	
CO4: Apply package material testing	
CO5: Implement Special Packaging Techniques	
TEXT BOOKS:	
1.Sahay, K.M. and K.K.Singh. 1996. Unit operations of agricultural processing. Vikas Publishing House Pvt. Ltd., New Delhi.	
2. Food Packaging Technology, Hand book, 2004. NIIR Board, New Delhi	
3.Pandey, P.H.2002. Post harvest engineering of horticultural crops through objectives. SarojPrakasam. Allahabad.	
REFERENCE BOOKS:	
1.Himangshu Barman. 2008, Post Harvest Food grain storage. Agrobios (India), Jodhpur.	

2.Chakaraverty, A. 2000. 3rd edition. Post harvest technology of cereals, pulses and oil seeds. Oxford & IBH publishing &Co.Pvt.Ltd. New Delhi.
3.P.Komarnicki,Pio Alessandro Lombadi,Z.A.Styczynski “Storage Technologies and Systems”,April 2017.
WEB RESOURCES:
1.https://www.researchgate.net/publication/318169073_Storage_Technologies_and_Systems.
2.https://www.sciencediredt.com/topics/computer-science/storage-resource.

CS606206 - **SOFTWARE DEFINED NETWORKS**						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
• To learn the fundamentals of software defined networks • To understand the separation of the data plane and the control plane. • To Know about data center concepts • To study about the SDN Programming • To study about the various applications of SDN						
UNIT 1: INTRODUCTION						9
History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes						
UNIT 2: OPEN FLOW & SDN CONTROLLERS						9
Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts						
UNIT 3: FUNCTIONS OF PACKAGING MATERIALS						9
Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE						
UNIT 4: SDN PROGRAMMING						9
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications						
UNIT 5: SDN						9
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Know the undying principle of Software Defined Networks						
CO2: Analyse the separation of data plane and control plane						
CO3: Learn the data center concepts						
CO4: Know SDN Programming in detail						
CO5: Learn various SDN Applications						
TEXT BOOKS:						
1.Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.						
2.Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013.						
3.Dr.Arati A.Dandavate , I.A.Dhotre “Software Defined Networks” Technical Publications,Feb 2023.						
REFERENCE BOOKS:						
1.Siamak Azodolmolky, —Software Defined Networking with Open Flow, Packet Publishing, 2013						
2. Vivek Tiwari, —SDN and Open Flow for Beginners‖, Amazon Digital Services, Inc., 2013.						

3.Fei Hu, Editor, —Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.
WEB RESOURCES:
1.https://www.vmware.com/topics/glossary/content/software-defined-networking.html
2.https://www.opensource.com/resources/what-is-software-defined-networking

CS606207 - **GRID COMPUTING**						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
• To understand about the basic fundamentals of Grid computing. • To gain knowledge about the standards of messaging in Grid Computing • To understand about the key concepts of Grid service Architecture. • To understand how to proceed basic services of Grid computing. • To learn about the architecture and model of Globus Toolkit.						
UNIT 1: INTRODUCTION						9
Early Grid Activities-Current Grid Activities-An Overview of Grid business Areas-Grid Computing Organizations and Their Roles						
UNIT 2: MESSAGING						9
Merging the Grid Services Architecture with the Web Services Architecture: Service-Oriented Architecture - Web Service Architecture–XML Messages and Enveloping						
UNIT 3: OPEN GRID SERVICES						9
OGSA–CDC–NFS-Online Media and Entertainment - OGS A Platform Components -Open Grid Services Infrastructure						
UNIT 4: OGSA BASIC SERVICES						9
Common Management Model(CMM) -Service domains -Policy Architecture- Security Architecture-Metering and Accounting						
UNIT 5: GLOBUS TOOL KIT						9
Architecture- GT3 Software Architecture Model- Programming Model– Service Programming Model-Sample Implementation						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Define the fundamentals of downstream processing for product recovery						
CO2:Understand the requirements for successful operations of downstream processing						
CO3 Describe the components of downstream equipment and explain the purpose of each						
CO4: Apply principles of various unit operations used in downstream processing and enhance problem solving techniques						
CO5: Understand the concept of Globus Toolkit.						
TEXT BOOKS:						
1.Belter, P.A., E.L. Cussler and Wei-HouhuBioseparations – Downstream Processing for Biotechnology, John Wiley, 1988.						
2.Sivasankar, B. Bioseparations: Principles and Techniques. PHI, 2005.						
3.Asenjo, Juan A. Separation Processes in Biotechnology. CRC / Taylor and Francis, 1990.						
REFERENCE BOOKS:						
1.Ghosh, Raja Principles of Bioseparations Engineering. World Scientific, 2006						

2.Product Recovery in Bioprocess Technology. (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.
3.Frederic Magoules,JiePan,Kiat-An Tan,AbhinitKumar,"Introduction to Grid Computing"CRC Press,2009.
WEB RESOURCES:
1.https://www.computerworld.com/article/2586983/grid-computing-resources.html
2.hhtps://www.ig-global.com/dictionary/grid-computing/12534

CS606208 - **SECURITY AND PRIVACY IN CLOUD**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of virtualization and virtual machines.
- To gain expertise in virtualization infrastructure
- To understand architecture and deployment models of cloud computing.
- To understand the various services in cloud computing.
- To get the idea of security models in the cloud environment

UNIT 1: INTRODUCTION	9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

UNIT 2: CLOUD ENABLING TECHNOLOGIES	9

Service Oriented Architecture – REST and Systems of Systems – Web Services – PublishSubscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices –Virtualization Support and Disaster Recovery.

UNIT 3: CLOUD ARCHITECTURE, SERVICES AND STORAGE	9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers

UNIT 4: RESOURCE MANAGEMENT AND SECURITY IN CLOUD	9

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

UNIT 5: CLOUD TECHNOLOGIES AND ADVANCEMENTS	9

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack –Federation in the Cloud – Four Levels of Federation –Federated Services and Applications – Future of Federation.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Deploy the concepts of virtualization strategies and virtual machines

CO2: Apply the concept of virtualization infrastructure in the cloud computing

CO3: Identify the architecture and deployment models of cloud computing

CO4: Develop cloud services using cloud computing for real time environment

CO5 Apply the security models in the cloud environment

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Chopra, Rajiv "Cloud Computing", New Age International (P) Ltd Publishers, First Edition, 2017

2.Tim Mather,Subra Kumaraswamy,Shahed Latif."Cloud Security and Privacy-An Enterprise Perspective on Risks and Compliance"Shroff Publishers,First Edition,2009.

3.Siani Pearson , George Yee , "Privacy and Security for Cloud Computing" Springer,2013.

REFERENCE BOOKS:

1.Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A PracticalApproach", McGraw-Hill Osborne Media., 2009.

2.Barrie Sosinsky, "Cloud Computing Bible", Kindle Edition, Wiley Publication, 2011.

3.Natte Jenner," CloudSecurity: Introduction to CloudSecurity and Data Protection" Createspace Independent Pub,2018.

WEB RESOURCES:

1.https://www.mdpi.com/1999-5903/14/1/11

2.http://pubs.sciepub.com/ajss/4/1/2/index.html.

CS606209 - **IOT AND CLOUD**

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand Smart Objects and loT Architectures.
- To learn about various !OT-related protocols

To build simple IoT Systems using Arduino and Raspberry Pi..

- To understand data analytics and cloud in the context of loT
- To develop loT infrastructure for popular applications

UNIT 1: FUNDAMENTALS OF loT	9
Evolution of Internet of Things - Enabling Technologies - loT Architectures: oneM2M, loT World Forum (loTWF) and Alternative loT models - Simplified loT Architecture and Core loT Functional Stack - Fog, Edge and Cloud in loT - Functioral blocks of an loT ecosystem - Sensors, Actuators, Smart Objects and Connecting Smart Objects	
UNIT 2: loT PROTOCOLS	9
loT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11 ah and LoRaWAN - Network Layer: IP versions, Constrained Nodes and Constrained Networks - Optimizing IP for loT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks - Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT	
UNIT 3: DESIGN AND DEVELOPMENT	9
Design Methodology - Embedded computing logic - Microcontroller, System on Chips - loT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.	
UNIT 4: DATA ANALYTICS AND SUPPORTING SERVICES	9
Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning - No SQL Databases - Hadoop Ecosystem - Apache Kafka, Apache Spark - Edge Streaming Analytics and Network Analytics - Xively Cloud for loT, Python Web Application Framework - Django -AWS for loT - System Management with NETGONF-YANG	
UNIT 5: CASE STUDIES/INDUSTRIAL APPLICATIONS	9
Cisco loT system - IBM Watson loT platform - Manufacturing - Converged Plantwide Ethernet Model (CPwE) - Power Utility Industry - GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand the concept of loT.
CO2:Analyze various protocols for loT
CO3 : Design a Poe of an +o'T system using Rasperry Pi/Arduino
CO4: Apply data analytics and use cloud offerings related to loT

CO5: Analyze applications of IoT in real time scenario

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.David Hanes, Gonzalo Salgueiro, Patrick Grossetete. Rob Barton and Jerome Henry, "loT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

2. ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015

3. Olivier Hersent, David Boswarthick, Omar Elloumi, ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012 (for Unit 2)

REFERENCE BOOKS:

1.Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.

3. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance your projects, 2nd Edition, O'Reilly_Media,2011.

WEB RESOURCES:

1.https://www.geeksforgreeks.org/iot-and-cloud-computing/amp/

2.https://www.knowledgehut.com/blog/cloud-computing/cloud-computing-and-internet-ofthings

CS606210 - **GOOGLE CLOUD COMPUTING FOUNDATIONS (NPTEL)**						
Course Category: Programme Elective	Course Type: Theory		L	T	P	C
			3	0	0	3

COURSE OBJECTIVES:

- To discuss the fundamental concepts of google cloud computing.
- To know about cloud functions and its applications
- To simulate the software query language with google cloud.
- To get the knowledge of cloud application programming interface
- To describe the security issues of google cloud computing with virtual private networks.

UNIT 1: INTRODUCTION	9

Introduction to Cloud - Cloud Computing - Cloud vs Traditional Architecture - Iaas, PaaS and SaaS - Google Cloud Architecture -Cloud Computing Recap Quiz - Summary - Cloud Computing - Introduction - Start with a Solid Platform - The GCP Console - Understanding Projects - Billing in GCP - Install and Configure Cloud SDK - Use Cloud Shell [With Labs] - GCP APIs - Cloud Console Mobile App - Recap Quiz - Start with a Solid Foundation

UNIT 2: CLOUD FUNCTIONS	9

Introduction-Compute Options in the Cloud-Exploring IaaS with Compute Engine [With Lab]-Configuring Elastic Apps with Autos calling-Exploring PaaS with App Engine [With Lab]-Event Driven Programs with Cloud Functions [With Lab]-Containerizing and Orchestrating Apps with GKESummary

UNIT 3: SOFTWARE QUERY LANGUAGE	9

Introduction-Storage Options in the Cloud-Structured and Unstructured Storage in the CloudUnstructured Storage using Cloud Storage [With Lab]- SQL Managed Services-Exploring Cloud SQL [With Lab]-Cloud Spanner as a Managed Service-No SQL Managed Services Options Cloud Data store a No SQL Document Store [With Lab]-Cloud Big table as a No SQL Option Summary

UNIT 4: APPLICATION PROGRAMMING INTERFACE	9

Introduction to API-The Purpose of APIs-Cloud Endpoints [With Lab]-Using Apigee-Managed Message Services-Cloud Pub/Sub [With Lab]-Recap Quiz - There's an API for that!Introduction - Cloud Security-Introduction to security in the cloud-Understanding the shared security model-Explore encryption options-Understand authentication and authorization [With Lab]-Identify best practices for authorization-Recap Quiz Security-Summary - Security.

UNIT 5: GOOGLE CLOUD SECURITY	9

Introduction-Intro to Networking in the Cloud-Defining a Virtual Private Cloud-Public and Private IP Address Basics-Googles Network Architecture-Routes and Firewall Rules in the Cloud [With Lab]- Multiple VPC Networks [With Lab]-Building Hybrid Clouds-Different Options for Load Balancing [With Labs]-Recap Quiz-Summary

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1 : Build the fundamental concepts of google cloud computing

CO2 : Handle about cloud functions and its applications

CO3 : Develop the software query language with google cloud.

CO4 : Integrate the knowledge of cloud application programming interface

CO5 : Access the security issues of google cloud computing with virtual private networks.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3						2	3			3	
CO2	3	3	2						3	3			2	2
CO3	3	2	3						2	2			3	3
CO4	2	3	2						3	2				2
CO5	3	2	2						2	3			3	

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Prof.Soumya Kanti Ghosh, "Google Cloud Computing Foundations" IIT Kharagpur,2020.

2.Praveen Kukreti , "Google Cloud Platform – All-In-One-Guide",bpb Publisher,2023.

3.Patrick Haggerty , "The Ultimate Guide to Building a Google Cloud Foundation",Packt Publishing,2022.

REFERENCE BOOKS:

1.Alasdair Gilchrist , "Google Cloud Platform an Architect's Guide"

2.Adney Ainsley , "Google Cloud Platform" – The Ultimate Guide for Beginners,2020.

3.Valarie Lestourgeon , "A Beginner's Guide To Google Cloud Computing"2021.

WEB RESOURCES:

1.https://www.cloudskillsboost.google/course_templates/153

2.https://alison.com/courses/google-cloud-computing-foundation/resources

VERTICAL III
CYBER SECURITY

CS606301-Ethical Hacking (NPTEL)						
Course Category: Programme Elective	**Course Type: Theory**		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
COURSE OBJECTIVES:						
• To gain an idea about how to analyseremote device. • To compare and contrast various Wireless Access Point attacks • To understand password cracking using different tools • To apply ethical theories to a cyber-related issue • To learn some techniques for launching server attacks						

Week 1 Module 1: Introduction to ethical hacking | Module 2: Fundamentals of computer networking | Module 3: TCP/IP protocol stack.
Week 2 Module 1: IP addressing and routing | Module 2: Routing protocols
Week 3 Module 1: Introduction to network security | Module 2: Information gathering: reconnaissance, scanning, etc
Week 4 Module 1: Vulnerability assessment: OpenVAS, Nessus, etc| Module 2: System hacking: password cracking, penetration testing, etc.
Week 5 Module 1: Social engineering attacks | Module 2: Malware threats | Module 3: penetration testing by creating backdoors
Week 6 Module 1: Introduction to cryptography | Module 2: private-key encryption | Module 3: public-key encryption
Week 7 Module 1: Key exchange protocols | Module 2: cryptographic hash functions | Module 3: applications
Week 8 Module 1: Steganography, biometric authentication | Module 2: lightweight cryptographic algorithms
Week 9 Module 1: Sniffing: Wire shark, | Module 2: ARP poisoning | Module 3: DNS poisoning | Module 4: Hacking wireless networks | Module 5: Denial of service attacks
Week 10 Module 1: Elements of hardware security: side-channel attacks, | Module 2: physical unclonable functions

Week 11 Module 1: Hacking web applications: vulnerability assessment, | Module 2: SQL injection, cross-site scripting.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Idea about how to analyse remote device

CO2: Compare and contrast various Wireless Access Point attacks

CO3: Understand password cracking using different tools

CO4: Apply ethical theories to a cyber-related issue

CO5: learn some techniques for launching server attacks

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.**Hacking: The Art of Exploitation**," Jon Erickson", Second Edition, Pearson Education

2**. The Basics of Hacking and Penetration Testingby Patrick**Engebretson, Second Edition, Pearson Education

3. The Web Application Hacker's Handbook By DafyddStuttard

REFERENCE BOOKS:

1.The Hacker Playbook 2 byPeter Kim, 1st Edition

2.Georgia Weidman, "Penetration Testing", First Edition, PHI Learning Private Limited, 2012.

WEB RESOURCES:

https://www.synopsys.com/glossary/what-is-ethicalhacking.html#:~:text=Definition,and%20actions%20of%20malicious%20attackers.

https://www.eccouncil.org/cybersecurity/what-is-ethical-hacking/

CS606302-Digital and Mobile Forensics					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the role of investigator and lab requirements in Digital Forensics.
- To analyse the Data Acquisition methods, tools and storage formats of digital evidence.
- To classify the Collecting, Preserving and Seizing of various digital evidences
- To apply the Validating and Testing of evidences using various methods.
- To understand the techniques in developing standard methods of network forensics

UNIT 1: COMPUTER FORENSICS AND INVESTIGATIONS	**9**
Understanding Computer Forensics, Preparing for Computer Investigations, Taking A Systematic Approach, Procedure for Corporate High- Tech Investigations, Understanding Data Recovery Workstations and Software Office and Laboratory: Understanding Forensics Lab Certification Requirements Determining the Physical Requirements for a Computer, Forensics Lab Selecting a Basic Forensic Workstation	
UNIT 2: INTENTS AND SERVICES	**9**
Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisition, Performing RAID Data Acquisition, Using Remote Network Acquisition Tools, Using Other Forensics Acquisition Tools	
UNIT 3: WEB COMMUNICATION AND TELEPHONY	**9**
Identifying Digital Evidence, Collecting the Evidence in Private-Sector Incident Scenes, Processing law Enforcement Crime Scenes, preparing for a Search, Securing a Computer Incident or Crime Scene, Seizing Digital evidence at the crime Scene, Storing Digital evidence, Obtaining a Digital Hash, Current Computer Forensics Tools, Evaluating Computer Forensics Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools	
UNIT 4: GRAPHICS AND MULTIMEDIA	**9**
Forensics Software Computer Forensics Analysis and Validation, Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisition, data carving, Recovering Graphics and Network Forensics, Recognizing a Graphics File, Understanding Data Compression, Locating and Recovering Graphics Files, live Memory forensics (RAM), Understanding Copyright Issues with Graphics, Network Forensic, social media forensics.	
UNIT 5: SECURITY AND HACKING	**9**
Developing Standard Procedure for Network Forensics, Using Network Tools, Examining Honey net Project, E-mail Investigations, Cell Phone and Mobile Device Forensics, Exploring the Role of E- mail in Investigations, Exploring the Role of Client and Server in Email, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools, Understanding Mobile Device Forensics, Understanding Acquisition Procedure for Cell Phones and Mobile Devices**TOTAL: 45 PERIODS**	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:Understand the role of investigator and lab requirements in Digital Forensics.

CO2 : Analyze the Data Acquisition methods, tools and storage formats of digital evidence

CO3 : Classify the Collecting, Preserving and Seizing of various digital evidences

CO4 : Apply the Validating and Testing of evidences using various methods

CO5 : Understand the techniques in developing standard methods of network forensics

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Guide to computer forensics and investigation 3rd or 4th edition by Amelia Philips, Bill Nelsonand Christopher Steuart.

REFERENCE BOOKS:

1.https://www.coursehero.com/file/p3ip151/Understanding-Data-Recovery-WorkstationsandSoftware-Investigations-are/"

2.https://www.intaforensics.com/2012/01/20/understanding-the-computer-forensics-process"

WEB RESOURCES:

https://www.geeksforgeeks.org/mobile-forensics-definition-uses-and-principles/

https://securityscorecard.com/blog/what-is-mobile-forensics-a-real-example-from-thesecurityscorecard-forensics-lab/

CS606303-Systems and Usable Security (NPTEL)					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn how to design and analyse usability studies
- To overview of the definitions of privacy as well as some of the legal and social aspects of it.
- To analyse of common privacy issues and how they are expressed through user interaction with systems.
- To discuss of ethics, particularly around research in topics in security and privacy where participants can be particularly vulnerable.
- To test and work with a system security

WEEK 1

Introduction: Computer security concepts, threats, attacks Malicious Software: Types of Malicious Software (Malware), Vulnerability, Exploits, Social Engineering–SPAM E-mail, Zombie, Bots, Keyloggers, Phishing, Spyware.

WEEK 2

Operating System Security: System Security Planning, Application Security, Linux/Unix Security, Windows Security, Virtualization Security

WEEK 3

Web Security: Secure E-mail and S/MIME, Domain Keys Identified Mail, Secure Sockets Layer (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security, PublicKey Infrastructure and Federated Identity Management.

WEEK 4

Usable Security: Introduction to Privacy, Trust and Semantic Security, Visualizing Privacy, Web Browser Security and Privacy, Authentication and Text Passwords, Biometrics and Graphical Passwords.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Learn how to design and analyse usability studies

CO2: Overview of the definitions of privacy as well as some of the legal and social aspects of it.

CO3: Analyse of common privacy issues and how they are expressed through user interaction with systems

CO4: Discuss of ethics, particularly around research in topics in security and privacy where participants can be particularly vulnerable.

CO5: Test and work with a system security

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.John Slavio, "Hacking: A Beginners' Guide to Computer Hacking, Basic Security, And Penetration Testing", O'Reilly Media, 3rd Edition, 2013

2.RaefMeeuwisse,"CybersecurityforBeginners,May 14, 2015 by Lulu Publishing Services.

REFERENCE BOOKS:

1.Hacking for Beginners: A Step By Step Guide For You To Learn the Basics of Cyber security And Hacking - Ramon Nastase ,August 6, 2018 by Independently Published

2.The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography - Simon Singh, August 15, 2011 by Little, Brown and Company

WEB RESOURCES:

1.https://www.knowledgehut.com/blog/security/best-book-on-cyber-security

2.https://www.simplilearn.com/tutorials/cyber-security-tutorial/cyber-security-books

CS606304-Modern Cryptography					
		L	T	P	C
Course Category: Programme Elective	**Course Type: Theory**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand basics of Cryptography and Network Security.
- To be able to secure a message over insecure channel by various means.
- To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
- To understand various protocols for network security to protect against the threats in the networks.
- To learn the IP Security

UNIT 1: INTRODUCTION TO CRYPTOGRAPHY AND BLOCK CIPHERS	**9**
Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and blockciphers - Modern Block Ciphers: Block ciphers principals - Shannon's theory of confusion anddiffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linearcrypt analysis of DES - block cipher modes of operations - triple DES – AES.	
UNIT 2: CONFIDENTIALITY AND MODULAR ARITHMETIC	**9**
Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat's and Euler's theorem - primality testing - Euclid's Algorithm - Chinese Remainder theorem - discrete algorithms.	
UNIT 3: Public key cryptography and Authentication requirements)	**9**
Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.	
UNIT 4: (Integrity checks and Authentication algorithms)	**9**
MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME.	
UNIT 5: IP Security and Key Management	**9**
IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand basics of Cryptography and Network Security.

CO2: Understand the secure a message over insecure channel by various means.

CO3: Classify how to maintain the Confidentiality, Integrity and Availability of a data.

CO4: understand various protocols for network security to protect against the threats in the networks.

CO5:Apply IP Security methods

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1									1		1		
CO2	1									1		1		
CO3	1	1	1							1		1		
CO4	1	1	1							1		1		1
CO5	1	1	1							1		1	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.William Stallings, "Crpyptography and Network security Principles and Practices", Pearson/PHI. 2. Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", Pearson.

REFERENCE BOOKS:

1.W.Mao, "Modern Cryptography – Theory and Practice", Pearson Education. 2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.

WEB RESOURCES:

1.https://www.tutorialspoint.com/cryptography/modern_cryptography.htm

2.http://staff.ustc.edu.cn/~mfy/moderncrypto/reading%20materials/Introduction_to_Modern_Cryptography.pdf

CS606305-Engineering Secure software systems					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
• Demonstrate knowledge of the distinction between critical and non-critical systems. • Demonstrate the ability to manage a project including planning, scheduling and risk assessment/management. • Remember a software requirements document. • Demonstrate an understanding of the proper contents of a software requirements document. • Remember a formal specification for a software system.					
UNIT 1: Security a software Issue					**9**
Introduction, the problem, Software Assurance and Software Security, Threats to software security, Sources of software insecurity, Benefits of Detecting Software Security What Makes Software Secure: Properties of Secure Software, Influencing the security properties of software, Asserting and specifying the desired security properties?					
UNIT 2:Requirements Engineering for secure software					**9**
Introduction, the SQUARE process Model, Requirements elicitation and prioritization					
UNIT 3: Secure Software Architecture and Design					**9**
Introduction, software security practices for architecture and design: architectural risk analysis, software security knowledge for architecture and design: security principles, security guidelines and attack patterns Secure coding and Testing: Code analysis, Software Security testing, Security testing considerations throughput the SDLC					
UNIT 4: Security and Complexity					**9**
System Assembly Challenges: introduction, security failures, functional and attacker perspectives for security analysis, system complexity drivers and security					
UNIT 5: Governance and Managing for More Secure Software					**9**
Governance and security, Adopting an enterprise software security framework, How much security is enough, Security and project management, Maturity of Practice					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1:Apply contemporary techniques to model and analyze the security of a software system					
CO2: Identify project security risks & selecting risk management strategies.					
CO3: Use statistical methods to collect and analyze metrics for assessing and improving the security of a product, process, and project objectives.					
CO4:Describe and discuss security concerns designs at multiple levels of abstraction					
CO5: Comply with data privacy and security requirements when designing a software system.					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2								2		2		
CO2	2	2								2		2		
CO3	2	2						1		2		2		
CO4	2	2						1		2		2		
CO5	2	2								2		2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Software Security Engineering: Julia H. Allen, Pearson Education

REFERENCE BOOKS:

1.Developing Secure Software: Jason Grembi, Cengage Learning

2.Software Security : Richard Sinn, Cengage Learning

WEB RESOURCES:

1.https://resources.sei.cmu.edu/library/asset-view.cfm?assetid=513522

2.https://www.coursera.org/lecture/software-security/designing-and-building-securesoftware-introduction-kUWem

CS606306-Crypto currency and Block chain Technologies					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basic concepts and technology used for blockchain.
- To learn the primitives of the distributed computing and cryptography related to blockchain.
- To Illustrate the concepts of Bitcoin and their usage
- To Implement Ethereum block chain contract
- To Apply security features in blockchain technologies

UNIT 1: INTRODUCTION	**9**
Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc	
UNIT 2 : BASIC DISTRIBUTED COMPUTING & CRYPTO PRIMITIVES	**9**
Atomic Broadcast, Consensus, Byzantine Models of fault tolerance, Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems	
UNIT 3: ETHEREUM BASICS	**9**
Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts, Writing smart contracts using Solidity & JavaScript	
UNIT 4: PRIVACY, SECURITY ISSUES IN BLOCKCHAIN	**9**
Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains: Sybil attacks, selfish mining, 51% attacks advent of algorand; Sharding based consensus algorithms to prevent these attacks	
UNIT 5: CASE STUDIES	**9**
Block chain in Financial Service, Supply Chain Management and Government Services	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe the basic concepts and technology used for block chain.

CO2: Describe the primitives of the distributed computing and cryptography related to block chain.

CO3: Illustrate the concepts of Bitcoin and their usage. 4. Implement Ethereum block chain contract.

CO4: Implement Ethereum block chain contract

CO5: Apply security features in block chain technologies.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Ramayana, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press.

2.Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

3.Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing.

REFERENCE BOOKS:

1.MerunasGrincalaitis, "Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols", Packt Publishing.

2.Prof.SandipChakraborty, Dr. Praveen Jayachandran, "Blockchain Architecture Design And Use Cases"[MOOC], NPTEL: https://nptel.ac.in/courses/106/105/106105184/

WEB RESOURCES:

1.https://www.pwc.com/us/en/industries/financial-services/fintech/bitcoin-blockchaincryptocurrency.html

2.https://online.stanford.edu/courses/xcs251-cryptocurrencies-and-blockchain-technologies

CS606307-Cryptography And Network Security (NPTEL)					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

- To understand the most common type of cryptographic algorithm ·
- To understand the Public-Key Infrastructure ·
- To understand security protocols for protecting data on networks ·
- To be able to digitally sign emails and files ·
- To understand vulnerability assessments and the weakness of using passwords for authentication

WEEK1: Introduction to cryptography, Classical Cryptosystem, Block Cipher.
WEEK2: Data Encryption Standard (DES), Triple DES, Modes of Operation, Stream Cipher.
WEEK3: LFSR based Stream Cipher, Mathematical background, Abstract algebra, Number Theory.
WEEK4: Modular Inverse, Extended Euclid Algorithm, Fermats Little Theorem, Euler Phi-Function
WEEK5: Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange
WEEK6: Primarily Testing, ElGamal Cryptosystem, Elliptic Curve over the Reals,
WEEK7: Generalized ElGamal Public Key Cryptosystem, Rabin Cryptosystem.
WEEK8: Cryptographic Hash Function, Secure Hash Algorithm (SHA), Digital Signature Standard (DSS).
WEEK9: Cryptanalysis, Time-Memory Trade-off Attack, Differential and Linear Cryptanalysis
WEEK 10: Cryptanalysis on Stream Cipher, Modern Stream Ciphers, Shamirs secret sharing and BE, Identity-based Encryption (IBE)
WEEK 11: Side-channel attack, The Secure Sockets Layer (SSL), Pretty Good Privacy (PGP), Introduction to Quantum Cryptography
TOTAL: 45 PERIODS
COURSE OUTCOMES: At the end of the course, the student will be able to
CO1:Understand the most common type of cryptographic algorithm ·
CO2:Understand the Public-Key Infrastructure ·
CO3:Understand security protocols for protecting data on networks ·
CO4:Be able to digitally sign emails and files ·
CO5:Understand vulnerability assessments and the weakness of using passwords for authentication
TEXT BOOKS:
1.William Stallings , “Cryptography and Network security”, Pearson Education, 4th ed.,
REFERENCE BOOKS:
1.WilliamStallings, “Network Security Essentials Applications and Standards”, 2nd ed., Pearson Education, 2003.
2.Charlie Kaufman, Radis Perlman and Mike Speciner, “Network Security – Private Communication in a Public World” 2nd ed., Pearson Education, 2003
WEB RESOURCES:
1.https://rguktrkv.ac.in/curriculampdf/CS3505.pdf
2.https://www.gvpce.ac.in/syllabi/Cryptography%20and%20Network%20Security.pdf

CS606308-Network Management					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basic concepts in networking
- To understand the various network protocols and effective representation of multimedia data.
- To learn the congestion control and avoidance techniques and how to secure the data transmission.
- To learn the network management technologies and tools. To understand the network management applications

Unit 1 FOUNDATION FOR NETWORKS	**9**
Introduction - Architecture - Framing - Error Detection - Ethernet and Multiple Access Networks - Wireless Networks - Internetworking: Switching and Bridging, Basic Internetworking (IP), Routing – Advanced Internetworking: Global Internet, Multicast, Routing Among Mobile Devices	
Unit 2 PROTOCOLS AND DATA REPRESENTATION	**9**
End-to-End Protocols: UDP, TCP, RPC, Transport for Real Time Applications - End-toEnd Data: Presentation Formatting: Taxonomy, Markup Languages - Multimedia Data Lossless Compression Techniques - Image Representation and Compression - Video Compression - Audio Compression	
Unit 3 CONGESTION CONTROL AND NETWORK SECURITY	**9**
Congestion Control**:** Effects of Congestion - Congestion and Control - TCP Congestion Control - Congestion Avoidance Schemes Issues in Resource Allocation - Traffic Management - TCP Traffic Control -TCP Flow Control - Network Security: Cryptographic Building Blocks - Key Pre Distribution -Authentication Protocols	
Unit 4 DATA COMMUNICATION AND NETWORK MANAGEMENT	**9**
Data and Tele communication Network-Distributed Computing Environment - TCP/IPBased Networks: Internet and Intranet-Communication Protocols and Standards-Networks, Systems, and Services-System and Service Management-Challenges of IT Managers- Network Management: Goals, Organization, and Functions-Network Management Architecture and Organization-Network Management Perspectives Section-NMS Platform Section-Current Status and Future of Network Management.	
Unit 5 NETWORK MANAGEMENT APPLICATIONS	**9**
Configuration Management - Fault Management-Performance Management-Event Correlation Techniques-Security Management-Accounting Management- Report Management-Policy-Based Management -service Level Management.	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Acquire knowledge about the developments in the area of Networking

CO2: understand the different network management tools and techniques

CO3: apply the networking principles to design a network

CO4: Develop network applications in various platforms

CO5: understand the network management applications

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Larry L. Peterson and Bruce S. Davie, "Computer Networks - A systems Approach", Morgan Kaufmann publications, Fifth Edition, 2011. (UNIT I, II, III)

2.Mani Subramanian, "Network Management - Principles and Practice", Pearson Education, Second Edition, 2010. (UNIT IV,V)

REFERENCE BOOKS:

1.Stallings. W, "High Speed Networks and Internets: Performance and Quality of service", Prentice Hall, Second Edition, Seventh Impression, 2008

2.Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill Second Edition, 2006

WEB RESOURCES:

1.https://www.cisco.com/c/en/us/solutions/enterprise-networks/what-is-networkmanagement.html

2.https://www.spiceworks.com/tech/networking/articles/what-is-network-management/

CS606309-Cyber Crime And Laws					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand Cyber Crime Attacks
- To learn Denial-of-service (DOS) attack
- To know about Phases of cyber attack
- To learn Different types of tools used in cybercrime
- To learn Prevention of Cyber Crime

Unit 1 Introduction **9**

Cyber Crime- Overview, Internal and External Attacks, Attack Vectors. Cybercrimes against Individuals – E-mail spoofing and online frauds, Phishing and its forms, Spamming, Cyber-defamation, Cyberstalking, Cyber Bullying and harassment, Computer Sabotage, Pornographic offenses, Password Sniffing. Keyloggers and Screenloggers. Cyber Crimes against Women and Children.

Unit 2 Cybercrime **9**

Cybercrime against organization – Unauthorized access of computer, Password Sniffing, Denial-of-service (DOS) attack, Backdoors and Malwares and its types, E-mail Bombing, Salami Attack, Software Piracy, Industrial Espionage, Intruder attacks. Security policies violations, Crimes related to Social Media, ATM, Online and Banking Frauds. Intellectual Property Frauds. Cyber Crimes against Women and Children.

Unit 3 Phases of cyber attack **9**

A global perspective on cybercrimes, Phases of cyber attack – Reconnaissance, Passive Attacks, Active Attacks, Scanning, Gaining Access, Maintaining Access, Lateral movement and Covering Tracks. Detection Avoidance, Types of Attack vectors, Zero-day attack, Overview of Network based attacks.

Unit 4 Attacks **9**

Cybercrime and cloud computing, Different types of tools used in cybercrime, Password Cracking – Online attacks, Offline attacks, Remote attacks, Random Passwords, Strong and weak passwords. Viruses and its types. Ransomware and Cryptocurrencies. DoS and DDoS attacks and their types. Cybercriminal syndicates and nation state groups.

Unit 5 Prevention of Cyber Crimes **9**

Prevention of Cyber Crimes -Critical analysis of the IT Act, 2000 3. International position on Free Speech on Internet- Cyber Crimes: Obscenity, Stalking, Hate Speech 2. Data Theft Hacking, Phishing - Sedition, Privacy, Cyber-terrorism **TOTAL: 45 PERIODS**

COURSE OUTCOMES: At the end of the course, the student will be able to

- Understand Cyber CrimeAttacks
- Learn Denial-of-service (DOS) attack
- Classify about Phases of cyber attack
- Design Different types of tools used in cybercrime
- Learn Prevention of Cyber Crime

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3							2				
CO2	2	3	2					2		2				

CO3	2					1				2				
CO4		2	3							2				
CO5		2	2							2				

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.NinaGodbole and SunitBelapore; "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publications, 2011.

2. Shon Harris, "All in One CISSP, Exam Guide Sixth Edition", McGraw Hill, 2013. 3. Bill Nelson, Amelia Phillips and Christopher Steuart; "Guide to Computer Forensics and Investigations" – 3 rd Edition, Cengage, 2010 BBS.

3.William Stallings; "Cryptography and Network Security: Principles and Practices", Fifth Edition, Prentice Hall Publication Inc., 2007.

REFERENCE BOOKS:

1.Atul Jain; "Cyber Crime: Issues, Threats and Management", 2004. 6. Majid Yar; "Cybercrime and Society Sage Publications, 2006.

2.Michael E Whiteman and Herbert J Mattord; "Principles of Information Security", Vikas Publishing House, New Delhi, 2003. 8. Matt Bishop, "Computer Security Art and Science", Pearson/PHI, 2002

WEB RESOURCES:

1.https://blog.ipleaders.in/cyber-crime-laws-in-india/

2.https://legalserviceindia.com/legal/article-9498-an-overview-of-cyber-crimes-and-cyberlaws-in-india.html

CS606310-Design of Network Router					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
• To recognize the principles of the big picture of computer networks. • To understand the networking environment. • To know the importance of VPNs. • To convey the availability of tools and techniques for networking. • To discuss about evolving technologies in networks.					
Unit 1 FUNDAMENTALS OF NETWORK DESIGN					**9**
Design Principles - Determining Requirements - Analyzing the Existing Network - Preparing the Preliminary Design - Completing the Final Design Development - Deploying the Network - Monitoring and Redesigning – Maintaining - Design Documentation - Modular Network Design - Hierarchical Network Design					
Unit 2 UNDERLYING LAN CONCEPTS					**9**
LAN connectivity for small businesses – Integration – Token-Ring – Ethernet – ATM LAN emulation – InterLAN Switching – LAN to Mainframe – Building networks.					
Unit 3 VPNS, INTRANETS AND EXTRANETS					**9**
Virtual Network management and planning – VPNs for small businesses – Secure remote access in VPNs – IPSec VPNs – Integrating data centers with Intranets – Implementing and supporting Extranets.					
Unit 4 NETWORKING TOOLS AND TECHNIQUES					**9**
Trends in data communications – Merits of xDSL technology – Preparing for cable modems - Voice and video on the LAN – Internet voice applications – Building IP PBX telephony network – Fax over IP – Videoconferencing over IP networks					
Unit 5 EVOLVING TECHNOLOGIES					**9**
Prevention of Cyber Crimes -Critical analysis of the IT Act, 2000 3. International position on Free Speech on Internet- Cyber Crimes: Obscenity, Stalking, Hate Speech 2. Data Theft Hacking, Phishing - Sedition, Privacy, Cyber-terrorism					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Understand the principles of networks.					
CO2: Interpret LAN concepts and design					
CO3: Gain knowledge in evolving technologies.					
CO4:Clearly outline the logic behind VPNs.					
CO5: Know the importance of tools and techniques in building a network.					
CO-PO MAPPING					

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Gil Held, "Network Design: Principles and Applications (Best Practices)", Auerbach Publications, 1st edition, 2000.

2.Diane Tiare and Catherine Paquet, "Campus Network Design Fundamentals", Pearson Education, 1st edition, 2006.

3.Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers Inc., 5th edition, 2012.

REFERENCE BOOKS:

1.William Stallings, "Data and Computer Communications", Pearson Education, 8th edition, 2016.

2.James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Pearson Education, 6th edition, 2012

WEB RESOURCES:

1.https://www.networkcomputing.com/networking/network-design-router-vs-switch

2.https://www.sciencedirect.com/topics/computer-science/router-architecture

VERTICAL IV
INTERNET OF THINGS

CS606401 - **INTRODUCTION TO INTERNET OF THINGS (NPTEL)**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the Basics of IoT and Networking.
- To Implement the Connectivity of Sensor Networks.
- To Know the Knowledge of Arduino.
- To Implement IoT with Raspberry Pi.
- To determine the data analytics of Cloud Computing.

UNIT 1: INTRODUCTION TO IOT	**9**
Introduction to IoT- part-I ,Introduction to IoT-Part- II ,Sensing , Actuation ,Basics of IoT Networking-Part-I , Basics of IoT Networking-Part-II , Basics of IoT Networking- Part-III ,Basics of IoT Networking- Part- IV ,Connectivity Technologies- Part-1 ,Connectivity Technologies- Part-2 .	
UNIT-2 : SENSOR NETWORKS	**9**
Connectivity Technologies- Part-3 ,Connectivity Technologies- Part- 4 , Connectivity Technologies- Part- 5 ,Sensor Networks – I ,Sensor Networks – II , Sensor Networks – III Sensor Networks – IV , Sensor Networks – V , UAV Networks , Machine to Machine Communication .	
UNIT-3 : INTRODUCTION TO ARDUINO	**9**
Interoperability in Internet of Things ,Introduction to Arduino- I , Introduction to Arduino- II , Integration of Sensors and Actuators with Arduino- I ,Integration of Sensors and Actuators with Arduino- II Introduction to Python Programming – I , Introduction to Python Programming – II , Introduction to Raspberry Pi– 1 , Introduction to Raspberry Pi– 2 , Implementation of IoT with Raspberry Pi- I .	
UNIT-4 : IMPLEMENTATION OF IoT	**9**
Implementation of IoT with Raspberry Pi- II,Implementation of IoT with Raspberry Pi- II Software – Defined Networking – Part – I Software – Defined Networking – Part – II,Software-Defined loT Networking - Part- 1 ,Software-Defined loT Networking - Part- 2 Cloud Computing- Fundamentals , Cloud Computing - Service Models , Cloud Computing - Service Management and Security ,Cloud Computing- Case Studies .	
UNIT-5 : CLOUD COMPUTING	**9**
Cloud Computing: Practical Sensor - Cloud – I Sensor - Cloud – II Fog Computing – I Fog Computing – II Smart Cities and Smart Homes, Smart Cities and Smart Homes– II ,Smart Cities and Smart Homes– III , Connected Vehicles-I , Connected Vehicles– II ,Smart Grid-Part–I Smart Grid – Part – II , Industrial Internet of Things– Part–I ,Industrial Internet of Things– Part– II Data Handling and Analytics– Part–I ,Data Handling and Analytics- Part- II .Case Study: Agriculture , Case Study: Healthcare , Activity Monitoring (Case Study) –I Activity Monitoring (Case Study)– II .	
	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Determine the supporting technologies for design of IoT applications.
CO2: Apply the architecture and core modules for IoT applications.
CO3: Develop IoT applications using embedded systems.

CS606402 - **IOT ARCHITECTURE AND FRAMEWORK**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the concept and enabling IoT Technologies.
- To apply the knowledge on IoT architecture and modules
- To design Internet of Things with Embedded systems using data analytics To Analysis and evaluate the data received through sensors in IOT.
- To Determine the data analytics of IoT system.

UNIT 1: IOT CONCEPTS AND ENABLING TECHNOLOGIES	**9**
Introduction – Definition and Characteristics of IoT – Benefits of IoT –Physical design of IoT Logical design of IoT –IoT Enabling Technologies–Resource Management – Resource Partitioning – Computation Offloading – Identification and Resource/Service Discovery– IoT Levels.	
UNIT 2: IOT ARCHITECTURE AND ITS CORE MODULES	**9**
Reference architecture for IoT – SOA based & API oriented architecture – Four layer architecture – Seven Layer architecture – fog computing – Open stack cloud architecture – Gateways, Edge Devices, Data acquisition systems, Cloud services.	
UNIT 3: EMBEDDED PROTOTYPING OF IOT	**9**
Overview of Raspberry Pi – General-Purpose Input/Outputs – Sensors with Raspberry Pi – Actuators with Raspberry –Web Server with Raspberry Pi – Raspberry Pi as a Database Server ESP8266 Wi-Fi Module – Block Diagram, Features, applications.	
UNIT 4: IOT FRAME WORK & INDUSTRIAL IOT	**9**
IoT Value Chain – IoT Platforms – Cisco, Salesforce, Azure IoT, Eclipse IoT, Thingworx, GEPredix, AWSIoT, WatsonIoT, KaaIntroductiontoIndustrialInternetofThings&Industry4.0–IIoTArchitecture– ApplicationsandChallenges.	
UNIT 5: DATA ANALYTICS &IOT CASE STUDIES	**9**
IoT Data Management–Analytics–Apache Hadoop Programming Model, JobExecution, Hadoop Cluster–Case Studies Smart Parking, Smart Irrigation Control, Air Pollution Monitoring, Forest Fire Detection, Weather Forecasting.	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Determine the supporting technologies for design of IoT applications.

CO2: Apply the architecture and core modules for IoT applications.

CO3: Develop IoT applications using embedded systems.

CO4: Learn the necessary of framework required for IoT application.

CO5: Apply data analytics for IoT applications.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2							2	2	2	2	3
CO2	2	3	2							3	2	3	3	2

CO3	2	2	2							2	3	2	2	2
CO4	2	3	3							2	2	3	2	2
CO5	3	2	2							2	3	2	3	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.ArshdeepBahga, VijayMadisetti, "InternetofThings, A Hands-on-Approach" 1stEdition,Universitiespress Pvt.Ltd.,India,2015.

2.MayurRamgir, "Internet of Things-Architecture, Implementation, and Security", 1stEdition, Pearson Education,India,2019

3.Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri. Internet of Things: Architectures, Protocols and Standards. John Wiley & Sons, 2018.

REFERENCE BOOKS:

1.Raj KumarBuyya, Amir VahidDastjerdi, "Internet of Things: Principles and Paradigms",1st Edition,Elsevier,USA,2016

2.DimitriosSerpanos, MarilynWolf, "Internet-of-things (IoT) systems: architectures, algorithms, methodologies", 1stEdition, Springer,UK,2017.

3.CharlesBell, "Beginning Sensor Networks with Arduino and RaspberryPi",1stEdition, Apress Publishers,USA,2013

WEB RESOURCES:

Architecture of Internet of Things-https://www.geeksforgeeks.org/architecture-of-internet-ofthings-iot/

https://www.amazon.in/Introduction-IoT-Sudip Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1

CS606403 - **COMMUNICATION PROTOCOLS FOR IOT**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the fundamental concepts of internet protocols and standards To examine the protocol standards in data link and networking layers To simulate the different Network protocols through IoT open source tools.
- To get the knowledge of Iot based Edge Computing.
- To describe the security issues of protocols in IoT.

UNIT 1: EVOLVING IOT STANDARDS **9**

Overview and Approaches –IoT Ecosystem–Protocols for IoT-Structural Aspects-KeyTechnologies-Sensor Technology- RFID technology–Satellite Technology–CoAP–REST–ETSIM2M.

UNIT 2: DATA LINK PROTOCOLS **9**

IEEE802.15.4e-IEEE802.11ah–WirelessHART-Z-Wave-BluetoothLowEnergy-ZigbeeSmartEnergy-DASH7–HomePlug-G.9959-LTE-A –LoRaWAN–Weightless DECT/ULE.

UNIT 3: NETWORK LAYER PROTOCOLS **9**

RoutingProtocols–RPL–CORPL–CARP-EncapsulationProtocols-6LoWPAN-6TiSCH-6LoIPv6overG.9959-IPv6overBluetooth Low Energy- Session Layer Protocols–MQTT–SMQTT–XMPP–DDS.

UNIT 4: IOT EDGE COMPUTING **9**

Edge Computing– Purpose and Definition – Edge Hardware Architectures – Operating System–Edge Platforms, Virtualisation – Containers –Use Cases – Ambient Computing–Synthetic Sensing.

UNIT 5: SECURITY AND PRIVACY **9**

Security Issues in the IoT - Security Mechanisms- Key Agreement, Distribution, and Security Bootstrapping -Key Agreement Protocols. Privacy Issues in the IoT - Role of Authorization - IoT-OAS: Delegation-based Authorization for the Internet of Things- IoT-OASApplication Scenarios.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe the evolving IoT Standards

CO2: Demonstrate and visualize the data link protocols for IoT.

CO3:Evaluate the network protocols and standards for IoT.

CO4: Analyse the importance of IoT Edge devices.

CO5: Apply security mechanisms for protocol security.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							3		3	2	3
CO2	2	3	3							2		3	3	2
CO3	3	2	2							2		2	3	2
CO4	2	3	3							2		2	2	3
CO5	3	2	3							2		2	3	2

1- low, 2 - medium, 3 - high, '-' no correlation
TEXT BOOKS:
1.Geng,Hwaiyu."Internet of Things and Data Analytics in the Cloud with Innovation and Sustainability. "The Internet of Things &Data AnalyticsHandbook,2017.
2.SimoneCirani,GianluigiFerrari,MarcoPicone,LucaVeltri InternetofThings_Architectures,ProtocolsandStandards-Wiley,2018.
3.PerryLea,"IoTandEdge Computing for Architects_ Implementing edge and IoTsystems from sensors to clouds with communication systems, analytics, and security, 2ndEdition", PacktPublishing,2020.
REFERENCE BOOKS:
1.JanHoller, VlasiosTsiatsis, CatherineMulligan, StefanAves and, Stamatis Karnouskos, DavidBoyle, "From Machine-to-Machine to the Internet of Things :Introduction to a New Age of Intelligence", 1stEdition,AcademicPress, 2014.
2.Vijay Madisetti, ArshdeepBahga, "Internet of Things (AHands-on Approach)", 1stEdition, VPT,2014.
3.PerryLea, "Internet of Things for Architects_ArchitectingIoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt Publishing, 2018.
WEB RESOURCES:
Internet of Things (IoT)- https://www.gsma.com/iot/gsma-vision-of-smart-home-report/
Communication Protocols in IoT-https://www.geeksforgeeks.org/data-linklayer-communication-protocols-in-iot/

CS606404 - **CLOUD SERVICES FOR IOT**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To comprehend the cloud architecture and its services
- To illustrate the various sensors and their cloud interfaces
- To learn the cloud platforms of IoT
- To identify various cloud services for IoT
- To familiarize the applications security issues

UNIT 1: CLOUDPLATFORMARCHITECTUREANDSERVICES **9**

Cloud computing and service models: Public, Private and Hybrid clouds-Infrastructure as a service (IaaS)-Platformasa service(PaaS)- Software as a service(SaaS)- Architectural design of compute and storage clouds: Layered cloud architectural development- Architectural design challenges Public cloud platforms:GAE,AWSandAzure.

UNIT 2: PROGRAMMING IOTDEVICES FOR CLOUDINTERFACE **9**

Basics of Sensors and actuators – examples and working principles of sensors and actuators Cloud computing andIOT – Arduino/Equivalent Microcontroller platform. IoT Communication Technologies – RFID – Bluetooth – Zigbee –Wifi–Wired Communication

UNIT 3: CLOUDPLATFORMSFOR IOT **9**

Think speak IoT Cloud Platform, Kaa Open Source IoT Cloud Platform, AWS IoT Cloud Platform –AWS IoT Device SDK.Arduino AWS IoT development. Raspberry Pi3AWSIoTdevelopment.

UNIT 4: CLOUDSERVICESFOR IOT **9**

Service Management in Cloud Computing - Service Level Agreements (SLAs), Managing IoT Data – Looking at Data, Scalability & Cloud Services, Database& Data Storesin Cloud, LargeScaleData Processing.

UNIT 5: SECURITYANDAPPLICATIONS **9**

Application Safety and Service Vulnerability in Cloud Network- IoT Security and Privacy Preservation- Security and Challenges in Mobile Cloud Computing-The vital role of Fog computing in Internet of Things.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Build an appropriate cloud architecture and identify the cloud services

CO2: Handle various sensors and the technologies.

CO3:Develop IoT applications using cloud platforms.

CO4: Integrate the IoT applications into the cloud services.

CO5: Access the security issues in applications and networks.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2							2			3	2
CO2	2	2	3							3			3	2
CO3	3	2	3							2			2	2
CO4	2	2	3							3			2	3
CO5	3	2	3							2			3	2

1- low, 2 - medium, 3 - high, '-' no correlation
TEXT BOOKS:
1.KaiHwang, Geoffrey CFox, JackGDongarra, "Distributed and Cloud Computing, From parallel processing totheInternetofThings",MorganKaufmannPublishers,2012.
2.RajKamal,"InternetofThings:ArchitectureandDesignPrinciples",McGraw-HillEducationPvt.Ltd.,2018.
3.CharalamposDoukas,"BuildingInternetofThingswiththeArduino",CreateSpace, April2002.
REFERENCE BOOKS:
1.Dac-Nhuong Le, Chintan Bhatt, ManiMadhukar "Security Designs for the Cloud, IoT, and Social Networking" JohnWiley& Sons (11October2019)
2.HonboZhou,"TheInternetofThingsintheCloud:AMiddlewarePerspective", CRCPress,2013.
3.RajkumarBuyya,ChristianVecchiola.S.ThamaraiSelvi,"MasteringCloudComputing",McGrawHillEducation,2013.
WEB RESOURCES:
IoT Cloud Platforms-https://devopedia.org/iot-cloud-platforms
Connecting IoT Devices to Cloud Service **https://embeddedcomputing.com/**application/ networking-5g/connecting-iot-devices-to-cloud-services.

CS606405 - **COMPUTER NETWORKS AND INTERNET PROTOCOL (NPTEL)**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To comprehend the Computer Networks architecture and its services
- To illustrate the various sensors and their cloud interfaces
- To learn the cloud platforms of IoT
- To understand the various cloud services for IoT
- To familiarize the applications security issues

UNIT 1: INTRODUCTION TO COMPUTER NETWORKS	**9**
Introduction to computer networks and TCP/IP Protocols, The TCP/IP protocol suit and the TCP/IP model The concept of layering, The job of each layer, Connectionless vs. Connection oriented communication and services. TCP as CO service over CL connection and UDP as CL service over CL connection.	
UNIT 2: CONVENTIONAL NETWORK MODEL	**9**
Computer Networks and its fundamentals, definition of the network, its characteristics, network components and network connections. Modern network demands, packet classification, services using packet classification process, Conventional network model and modern network model based on service based on packet classification.	
UNIT 3: DATA COMMUNICATION PROCESS	**9**
Relation between the Bandwidth and the data rate of a channel, Data communication process and its ingredients, maximum data rate of a channel based on bandwidth of the channel and other parameters T.	
UNIT 4: WIRELESS NETWORKS	**9**
The EM spectrum, Radio, microwave and other types of waves. The frequencies used by different portions of the spectrum; frequency bands, characteristics of each of the portions and consequences. The relation between data communication and the frequency bands. Wired and wireless physical layers, UTP, FO cables and their use in data communication, total internal reflection principle and difference between UTP and FO cables Hidden and exposed stations problem for wireless data communication and their solution. 802.11,16 and xDSL physical layers, Wireless LAN 802.11, multiple standards and versions of 802.11, 802.11a,802.11b,802.11g,802.11n, 802.11ac, OFDM, OFDMA and Discrete multitone	
UNIT 5:DATA LINK LAYER SERVICE PRIMITIVES	**9**
The Data link layer duties, error handling process, introduction to CRC Error correction and other jobs of Data Link Layer, Hamming distance, hamming code, error correction vs. error detection, Convolution, Reed-Solomon, LDPC and Turbo codes Communication at data link and transport layers, need for protocols, sliding windows, Go back n and Selective repeat strategies for communication	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe the functions of the architecture and principles of today's computer networks

CO2: Know the concept of Fundamentals of Computer Networks.

CO3: Apply channel allocation, framing, error and flow control techniques

CO4: Implement the protocols and their functionalities,

CO5: Analyse the requirements for the future Internet and its impact on the computer network architecture.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2							2		2		
CO2	2	3	2							2		3		
CO3	3	3	2							3		2		
CO4	2	2	3							3		3		
CO5	3	2	3							2		2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Computer Networks by Bhushan Trivedi, Oxford University Press.

2.Data Communication and Networking by Bhushan Trivedi, Oxford University Press

3.Prof.SoumvaKanti Ghosh & Prof Sandip-Computer Networks and internet protocol, Department Computer Science Engineering,Kharagpur.

REFERENCE BOOKS:

1.Behrouz Forouzan, "Data Communication and Networking", McGraw Hill

2.Kurose and Ross, "Computer Networking- A Top-Down Approach",Pearson

3.W. A. Shay, "Understanding Communications and Networks",Cengage Learning.

WEB RESOURCES:

TCP/IP Tutorial and Technical Overview, (IBM Redbook) - Download From http://www.redbooks.ibm.com/abstracts/gg243376.html

TCP/IP Guide, Charles M. Kozierok, Available Online -http://www.tcpip guide .com Request for Comments (RFC) - IETF - http://www.ietf.org/rfc.html

CS606406 - **PRIVACY AND SECURITY IN IOT**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To analyse the security requirements in IoT.
- To learn the crypto graphic fundamentals in IoT.
- To know the working of authentication credentials and access control.
- To familiarize with privacy protection and trust models.
- To familiarize with the various IoT Attacks.

UNIT 1: INTRODUCTION: SECURING THE IOT	**9**

Security Requirements in IoT Architecture - Security in Enabling Technologies -Security Concerns in IoT Applications.SecurityArchitectureintheInternetofThingsSecurityRequirementsinIoT-Insufficient Authentication / Authorization– Insecure Access Control-Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity -Authentication/Authorization for SmartDevices -Transport Encryption–Attack & Fault trees.

UNIT 2: CRYPTOGRAPHIC FUNDAMENTALS FOR IOT	**9**

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random Number Generation – Cipher Suites – Key Management Fundamentals– Cryptographic Controls Built into IoT Messaging and Communication Protocols–IoTNodeAuthentication

UNIT 3: IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT	**9**

Identity Lifecycle – Authentication Credentials – IoT IAM infrastructure – Authorization with Publish / SubscribeSchemes–Access Control

UNIT 4: PRIVACY PRESERVATION AND TRUST MODELS FOR IOT	**9**

Concerns in Data Dissemination – Light weight and Robust Schemes for Privacy Protection – Trust and Trust Models for IoT–Self-organizing Things-Preventing Unauthorized Access

UNIT 5: IOT ATTACKS-CASE STUDIES	**9**

MIRAI Botnet Attack-Iran's Nuclear Facility Stuxnet Attack–Tesla Cryptojacking AttackThe TRENDnet Webcam Attack- TheJeepSUVAttack- The Owlet Wi-Fi Baby Heart Monitor Vulnerabilities- St.Jude_Hackable Cardiac Devices

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:Identify the security requirements in IoT Architecture

CO2: Apply different crypto graphic techniques in IoT Security.

CO3:Apply different solutions in Identity and Access Management.

CO4: Familiarize the privacy preservation and trust models in IoT.

CO5: Develop solutions for different types of IoT attacks.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							3			2	2

CO2	2	2	2							2			3	3
CO3	2	3	2							3			2	2
CO4	2	3	3							3			2	3
CO5	3	2	3							2			3	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Packt Publishing Limited, 2nd Edition, 2018.

2. ShancangLiandLiDaXu, "Securing the Internet of Things", Elsevier,2017.

3.**CunoPfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

REFERENCE BOOKS:

1.Raj Kumar Buyya, Amir VahidDastjerdi, "Internet of Things: Principles and Paradigms",1st Edition,Elsevier,USA,2016

2.ImitriosSerpanos, Marilyn Wolf, "Internet-of-things (IoT) systems: architectures, algorithms, methodologies", 1stEdition, Springer,UK,2017.

3.Charles Bell, "Beginning Sensor Networks with Arduino and RaspberryPi",1stEdition, Apress Publishers,USA,2013

WEB RESOURCES:

IoT Cloud Platforms- https://devopedia.org/iot-cloud-platforms

Connecting IoT Devices to Cloud Services **https://embeddedcomputing.com/application/** networking-5g/connecting-iot-devices-to-cloud-services.

CS606407 - **IOT PLATFORM FOR SMART CITY PLANNING**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To confidence in working along with Planning and civic agencies
- To work on different software/s (tools) to Simulate, analyze and authenticate the output to interpret and conclude.
- To identify the various stakeholders – both public and private.
- To involve in case studies and field visits/ field work.
- To accustom with the use of various acts and legal provisions in preparation of master plan etc.

UNIT 1:INTRODUCTION TO SMART CITIES **9**

Understanding Smart Cities Introduction to smart cities- Definition, dimensions, scope Smart Cities –Global Standards and Performance Benchmarks, Practice Code. India "100 Smart Cities" Policy and Mission. Planning for Urban Infrastructure Urban Infrastructure, Role of Planner in the provision of urban networks and services, feasibility studies for infrastructure projects, planning for major infrastructure projects, Various Infrastructure Programmes and policies by MOUD, PPP (DBOOT, BOOT, etc.) in infrastructure projects.

UNIT 2: WATER SUPPLY **9**

Water– sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning provisions, and management issues. Network design, Economics, distribution networks, Computer applications – Appurtenances – sensorbased Leak detection. Principles of design of water supply in buildings – House service connection.

UNIT 3: SANITATION AND SOLID WASTE **9**

Sanitation – points of generation, collection, treatment, disposal, norms and standards, grey water disposal, DEWATS, institutional arrangements, planning provisions, and management issues. storm water collection and disposal, norms and standards, institutional arrangements, planning provisions, and management issues. Municipal and other wastes –generation, typology, quantity, collection, storage, transportation, treatment, disposal, recycling and reuse, wealth from waste, norms, and standards, institutional arrangements, planning provisions, and management issues. management.

UNIT 4: ELECTRICITY & FIRE SERVICES AND RENEWABLE ENERGY **9**

Electricity – Sources of electricity, distribution networks, demand assessment, norms and standards, planning provisions, and management issues. Fire –fire hazards, vulnerable locations, methods of firefighting, norms, and standards, planning provisions, and management issues. Energy Management, energy requirement, non-conventional energy systems, management of solar energy, wind energy, tidal energy, biomass energy, energy from waste.

UNIT 5: SOCIAL INFRASTRUCTURE - EDUCATION, HEALTH, CIVIC **9**

Social Infrastructure – Education, Health, Civic Types, hierarchical distribution of facilities, Access to facilities, provision and location criteria, Norms and standards, etc. provisions for education, Tele- Health.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Confidence in working along with Planning and civic agencies

CO2: Work on different software/s (tools) to Simulate, analyze and authenticate the output to interpret and conclude

CO3 :Know the knowledge of various stakeholders – both public and private.

CO4: Involve in case studies and field visits/ field work.

CO5: Accustom with the use of various acts and legal provisions in preparation of master plan etc

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Ben Green, 2019, The Smart Enough City: Putting Technology in Its Place to Reclaim Our Urban Future, MIT Press.

2.**CunoPfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

3.**Daniel Chew** -The Wireless Internet of Things: A Guide to the Lower Layers 1st Edition, Kindle Edition,Standards Information Network; 1st edition.

REFERENCE BOOKS:

1.Rashid Mehmood, et.al., 2020, Smart Infrastructure and Applications: Foundations for Smarter Cities and Societies, Springer, Switzerland.

2.Sameer Kochhar, et.al., 2008, Infrastructure and Governance, Academic Foundation, New Delhi.

3.Gathe Donald E Billings, et.al., 2009, Managing urban water supply, Dordrecht, Kulwer, Academic Press.

WEB RESOURCES:

Connecting IoT Devices to Cloud Services **https://embeddedcomputing.com/application/** networking-5g/connecting-iot-devices-to-cloud-services.

IoT Cloud Platforms- https://devopedia.org/iot-cloud-platforms

CS606408 - **IOT FOR SMART GRIDS**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on Smart Cities
- To Identify the emerging area of Internet of Things and Smart Grid. To learn the Internet of Things and Smart Grid Applications To Familiar with application of HAN and WAN. To study the prototype process of IoT

UNIT 1: IOT AND SMART GRID	**9**
Internet of Things - Smart Grid- Importance of Smart Grid in Smart Cities-Integration of the Internet of Things into a Smart Grid	
UNIT 2: IOT TECHNOLOGIES	**9**
IoT Technologies – Communication Technologies: Home Area Network (HAN) - Neighbourhood Area Network (NAN)- Wide Area Network (WAN) - Standardization:Activities in IoT, Smart Grid and IoT aided Smart grid systems .	
UNIT 3: EXISTING APPLICATIONS	**9**
HAN applications: Smart Home – Electric vehicle – AMI – Integration of DERs – Power demand management- NAN applications: Smart Distribution – smart patrol – WAN applications: Transmission tower protection – monitoring of power transmission lines	
UNIT 4: ARCHITECTURES FOR IOT	**9**
Smart Grid Architecture Model – Three layered architecture – Four layered architecture – Cloud based architecture – Web enabled smart grid architecture – Last meter smart grid architecture	
UNIT 5: PROTOTYPES FOR IOT AIDED SMART GRID SYSTEMS	**9**
A Simple Prototype for Energy Efficiency- Integration of Renewable and Non Renewable energy Sources at Home- In Home Appliance Monitoring Implementation- Real time Monitoring of Medium Voltage Grid – Open issues & challenges.	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe the concepts of Internet of Things and Smart Grid

CO2: Work on different IoT technologies and communication technologies.

CO3 : Explicate the applications of HAN, NAN and WAN

CO4: Spell out the suitable architectures for IoT aided Smart grid systems

CO5: Enumerate the suitable architecture, possible applications and existing prototypes of IoT aided smart grid system

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.P. Waher, Learning Internet of Things. Packt Publishing, 2015.

2.N. Ramesh Babu, Smart Grid Systems: Modeling and Control, CRC Press,2018.

3.F. P. Sioshansi, Smart Grid: Integrating Renewable, Distributed and Efficient Energy, Academic Press, 2011.

REFERENCE BOOKS:

1.A. McEwen and H. Cassimally, Designing the Internet of Things. John Wiley & Sons, 2013.

2.D. Kellmereit, The Silent Intelligence: The Internet of Things. DnD Ventures, 2013.

3.S. Borlase, Smart Grids: Advanced Technologies and Solutions, Second Edition. CRC Press, 2017.

WEB RESOURCES:

IntroductionTo Internet Of Things (Nptel)- https://archive.nptel.ac.in/courses/106/105/106105166/

https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

CS606409 - **IOT AND ITS APPLICATIONS**					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the Fundamental concepts of IoT and its necessary towards society
- To Use of different protocols in IoT
- To Familiarize with IoT architectures
- To learn Sensors, actuators, development boards and Arduino programming
- To Identify the concepts of web of things and applications

UNIT 1: INTRODUCTION TO IOT	**9**
Introduction– Elements of an IoT ecosystem –Technology drivers– Business drivers–Trends and implications– Overview of Governance– Privacy and Security Issues	
UNIT 2: IOT PROTOCOLS	**9**
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee–Networklayer –APSlayer – Security.	
UNIT 3: IOTARCHITECTURE	**9**
IoT Open source architecture (OIC) – OIC Architecture & Design principles– IoT Devices and deployment models–IoTivity: An OpensourceIoTstack-Overview– IoTivitystackarchitecture–Resourcemodel and Abstraction	
UNIT 4: IOT HARDWARE AND PROGRAMMING	**9**
Basics of sensors and actuators – Examples and working principles of sensors and actuators – Arduino Programming for IOT– Raspberry Pi–Reading from Sensors. Communication: Connecting microcontroller with Bluetooth and USB Connection with the Internet using Ethernet.	
UNIT 5: APPLCIATIONS AND CASE STUDY	**9**
Connected vehicles– Traffic management- Smart grids–Environmental monitoring–Smart buildings / smart homes Smart cities –Supply chain management–Industrial, agricultural and commercial management.	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Identify the fundamentals of IoT

CO2: Illustrate various IoT Protocols for establishing communication between things.

CO3 :Design and Develop IoT application using IoT architecture.

CO4: Build simple IoT Systems using Arduino and Raspberry Pi.

CO5: Create IoT solutions using sensors, actuators and Devices

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Introduction of IoT- Prof.SudipMisra ,Department of Computer Science and Engineering,kharagpur,Published 2021,in India.

2.**CunoPfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

3.**Daniel Chew** -The Wireless Internet of Things: A Guide to the Lower Layers 1st Edition, Kindle Edition,Standards Information Network; 1st edition.

REFERENCE BOOKS:

1.ArshdeepBahga, Vijay Madisetti, "Internet of Things–A hands-on approach", Universities Press, 2015.

2.David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.

3.Dieter Uckelmann, Mark Harrison, Michahelles, Florian(Eds), "Architecting the Internet of Things", Springer,2011.

WEB RESOURCES:

IntroductionTo Internet Of Things (Nptel)- https://archive.nptel.ac.in/courses/106/105/106105166/

https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

CS606410 - **INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS (NPTEL)**					
		L	T	P	C
Course Category: Programme Elective	Course Type: Theory	3	0	0	3

COURSE OBJECTIVES:

- To study the Fundamental concepts of IoT and its necessary towards society
- To Use of different protocols in IoT
- To Familiarize with IoT architectures
- To learn Sensors, actuators, development boards and Arduino programming
- To Identify the concepts of web of things and applications

UNIT 1: INTRODUCTION OF COMMUNICATION AND NETWORK	**9**
Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II , Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories.	
UNIT 2: BIG DATA ANALYSIS	**9**
Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.Cyber security in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.	
UNIT 3: INDUSTRIAL IOT	**9**
IoT-Introduction, Industrial IoT: Business Model and Reference Architecture : IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.IndustrialIoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-PartIndustrial IoT-Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.IndustrialIoT: Big Data Analytics and Software Defined Networks: IIoT Analytics	
UNIT 4: INTRODUCTION, MACHINE LEARNING AND DATA SCIENCE	**9**
Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.IndustrialIoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.	
UNIT 5: IoT- APPLICATION DOMAINS	**9**
Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food industry. Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Apply the network concepts of communication

CO2: Identify the Big Data Analysis and basics of IoT in Industries .

CO3 :Implement the IoT Application in Industries.

CO4: Analyse the Machine learning and data science.

CO5: Design and Develop IoT application using IoT architecture.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.**Daniel Chew** -The Wireless Internet of Things: A Guide to the Lower Layers 1st Edition, Kindle Edition,Standards Information Network; 1st edition.

2.Introduction of IoT- Prof.SudipMisra ,Department of Computer Science and Engineering,kharagpur,Published 2021,in India.

3.**CunoPfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

REFERENCE BOOKS:

1.S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.

2.S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

3.DimitriosSerpanos, MarilynWolf, "Internet-of-things (IoT) systems: architectures, algorithms, methodologies", 1stEdition, Springer,UK,2017.

WEB RESOURCES:

Introduction To Internet Of Things (Nptel)-https://archive.nptel.ac.in/courses/106/105/106105166/

https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

VERTICAL V
BLOCK CHAIN

CS606501 - **FOUNDATIONS OF CRYPTOGRAPHY (NPTEL)**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Togain the knowledge about Symmetric-key Encryption
- To develop the knowledge in Theoretical & Practical Constructions of Block Ciphers.
- To learn about MAC &Generic Attacks on Hash Functions,
- To Compose CPA-secure Cipher with a Secure MAC& Cyclic Groups
- To analyse Public-key Encryption &Zero-Knowledge Protocols

UNIT 1:SYMMETRIC-KEY ENCRYPTION&STREAM CIPHERS	**9**

Introduction -Symmetric-key Encryption -Historical Ciphers and their Cryptanalysis - Perfect Security - Limitations of Perfect Security – Introduction to Computational Security - Semantic Security -Pseudo-random Generators (PRGs) - Operations on Pseudorandom Generators - Stream Ciphers - Provably-secure Instantiation of PRG - Practical Instantiations of PRG - CPA-security - Pseudo-random Functions (PRFs) - CPA-secure Encryption from PRF

UNIT 2: BLOCK CIPHERS&MESSAGE AUTHENTICATION	**9**

Modes of Operations of Block Ciphers Part I - Modes of Operations of Block Ciphers Part II - Theoretical Constructions of Block Ciphers - Practical Constructions of Block Ciphers: Part I - Practical Constructions of Block Ciphers: Part II - From Passive to Active Adversary - Message Integrity and Authentication - Message Authentication for Long Messages : Part I - Message Authentication for Long Messages : Part II

UNIT 3: INFORMATION-THEORETIC MACS&HASH FUNCTIONS	**9**

Information-theoretic MACs : Part I - Information-theoretic MACs : Part II - Cryptographic Hash Functions: Part I - Cryptographic Hash Functions: Part II - Message Authentication Using Hash Functions - Generic Attacks on Hash Functions and Additional Applications of Hash Functions - Random Oracle Model: Part I - Random Oracle Model: Part II - Authenticated Encryption

UNIT 4: COMPOSING CPA, CYCLIC GROUPS	**9**

Composing CPA-secure Cipher with a Secure MAC: Part I - Composing CPA-secure Cipher with a Secure MAC: Part II - Key-Exchange Protocols: Part I - Key-Exchange Protocols: Part II - Cyclic groups - Cryptographic Hardness Assumptions in the Cyclic Groups - Candidate Cyclic Groups for Cryptographic Purposes: Part I - Candidate Cyclic Groups for Cryptographic Purposes: Part II - Cryptographic Applications of the Discrete Log Assumption

UNIT 5: PUBLIC-KEY ENCRYPTION&ZERO-KNOWLEDGE PROTOCOLS	**9**

Public-key Encryption - El Gamal Public-key Encryption Scheme - RSA Assumption - RSA Public-key Cryptosystem - Hybrid Public-key Cryptosystem - CCA-Secure Public-key Ciphers - CCA-Secure Public-key Ciphers Based on Diffie-Hellman Problems - CCA-Secure Public-key Ciphers Based on RSA Assumption - Digital Signatures - RSA Signatures - Identification Schemes - Schnorr Signature Scheme and TLS/SSL - Number Theory - Secret Sharing - Zero-Knowledge Protocols: Part I - Zero-Knowledge Protocols: Part II

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Gain the knowledge about Symmetric-key Encryption

CO2:Develop the knowledge in Theoretical & Practical Constructions of Block Ciphers
CO3: Analyze security properties MAC &Generic Attacks on Hash Functions
CO4:Compose CPA-secure Cipher with a Secure MAC & Cyclic Groups
CO5: Analyse Public-key Encryption &Zero-Knowledge Protocols
TEXT BOOKS:
1.Foundations of Cryptography – Prof. Ashish Choudhury, CSE,IIIT - Bangalore
2.Understanding Cryptography - A Textbook for Students and Practitioners By Christof Paar, Jan Pelzl - 2014
3.Applied Cryptography - Protocols, Algorithms and Source Code in CBy Bruce Schneier · 2017
REFERENCE BOOKS:
1.Break the Code - Cryptography for BeginnersBy Bud Johnson · 2013
2.Practical CryptographyBy Niels Ferguson, Bruce Schneier · 2003
3.Serious Cryptography - A Practical Introduction to Modern Encryption By Jean-Philippe Aumasson · 2017
WEB RESOURCES:
1.https://archive.nptel.ac.in/courses/106/106/106106221/
2.https://inst.eecs.berkeley.edu//~cs161/sp11/

CS606502 - **BLOCK CHAIN AND ITS APPLICATIONS (NPTEL)**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide conceptual understanding of how Blockchain technology can be used to innovate and improve business processes& deploy Decentralized Application
- To gain the knowledge about the various Blockchain elements&Permissionless Model
- To learnEthereum & Distributed Consensus
- To describe Hyperledger Fabric
- To develop Blockchain Interoperability & Blockchain Security

UNIT 1:BLOCKCHAIN TECHNOLOGY & CRYPTOGRAPHIC PRIMITIVES	**9**
The Model of Decentralization - What is Blockchain- BasicCryptographic Primitives I - II – III – IV -V,Distributed Systems for Decentralization - The Evolution of Cryptocurrencies - Open Consensus and Bitcoin.	
UNIT 2: BLOCKCHAIN ELEMENTS	**9**
Bitcoin Mining and Beyond - Smart Contracts and the Permissioned Models of Blockchain - Blockchain Elements – I – II – III – IV –V, Permissionless Model and Open Consensus - Nakamoto Consensus (Proof of Work) - Limitations of PoW: Forking and Security	
UNIT 3: ETHEREUM & DISTRIBUTED CONSENSUS	**9**
Beyond PoW - Ethereum 1-2-3-4 - Consensus for Permissioned Models - State Machine Replication as Distributed Consensus – Paxos - Byzantine Faults - Byzantine Agreement Protocols	
UNIT 4: HYPERLEDGER FABRIC	**9**
Safety and Liveness of PBFT - Enterprise Blockchains – Hyperledger Fabric 1-2-3-4 - Consensus Scalability - Bitcoin-NG - Collective Signing	
UNIT 5: BLOCKCHAIN INTEROPERABILITY&SECURITY	**9**
Blockchain Interoperability – I – II –III - Hyperledger Indy I – II - Hyperledger Aries - Blockchain Security – I –II – III - Use Cases - A Potential Use Case From a Critics Perspective- Blockchain in Financial Services - Public Sector Use Cases - Blockchain for Decentralized Marketplace	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: implement Block chain technology & deploy Decentralized Application

CO2: knowledge about the various Blockchain elements &Permissionless Model

CO3: analyze block chain based solutions and write smart contract using Ethereum Framework

CO4: describe the knowledge about Hyperledger Fabric

CO5: develop Blockchain Interoperability &implement Blockchain Security

TEXT BOOKS:
1.Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Imran Bashir, Packt Publishing, 2020,
2.Bloomsbury A Practical Guide to Blockchain and Its Applications by PARIKSHIT JAIN Edition 2019
3.Blockchain Technology and Applications : A systematic and Practical approach Kindle Edition by Amit Dua (Author)
REFERENCE BOOKS:
1.Blockchain and its applications by PROF. SANDIP CHAKRABORTY Department of Computer Science and Engineering IIT Kharagpur PROF. SHAMIK SURAL Department of Computer Science and Engineering IIT Kharagpur
2.Advanced Applications of Blockchain Technology (Studies in Big Data Book 60) 1st ed. 2020 Edition, Kindle Editionby **Shiho Kim** (Editor), **Ganesh Chandra Deka** (Editor)
3.Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications (Grayscale Indian Edition) (Paperback, Lorne Lantz, Daniel Cawrey)
WEB RESOURCES:
1.https://www.packtpub.com/product/mastering-blockchain-third-edition/9781839213199
2.https://archive.nptel.ac.in/courses/106/105/106105235/
3.https://www.hyperledger.org/use/tutorials
4.https://ethereum.org/en/developers

CS606503 - **BLOCK CHAIN TECHNOLOGIES**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the various cryptography primitives used in block chain.
- To study the design principles of block chain.
- To describe the various consensus algorithms.
- To implement the block chain in networking.
- To learn the enhancements of block chain technologies

UNIT 1: CRYPTOGRAPHY IN BLOCKCHAIN	**9**

Block chain Definitions – Block chain versus Databases – History – Motivation – Characteristics – Types – Overview -Hashing in Block chain – Linking blocks in block chain – Linking blocks using SHA256 – Block structure – Block chain functionality – Creating Block chain – Byzantine failure problem in block chain – Digital signatures in block chain –Block chain wallets

UNIT 2: BLOCKCHAIN DESIGN PRINCIPLES	**9**

Networked Integrity – Distributed Power-Value as Incentive – Security – Privacy – Rights Preserved – Inclusion –Centralized Registries versus Distributed Ledgers – Public versus Private Ledgers – Transparency as a Strategic Risk –Transparency as a Strategic Asset-Zero Knowledge Proofs

UNIT 3: CONSENSUS ALGORITHMS	**9**

Proof of Work – Pure Stake Based Consensus – Proof of Stake - Leased Proof of Stake –
Delegated Proof of Stake –Hybrid Form of PoS and PoW – Practical Byzantine Fault Tolerance – Ripple – Tendermint – Proof of Elapsed Time –ProofofActivity–ProofofBurn– Hyperledger Fabric

UNIT 4: NETWORKING IN BLOCKCHAIN	**9**

Peer – to –peer Networking – Network Discovery – Block Synchronization – Building a simple Blockchain in P2PNetwork – Validating new Block – Selecting Longest chain –
Block Exchange between Peers – Application Interfaces-Blockchain Networks–Testnet– Regtest –Blockchain in 5G–Blockchain in Social Networking–Blockchain for IoT

UNIT 5: BLOCKCHAIN OPTIMIZATIONS AND ENHANCEMENTS	**9**

Blockchain Optimizations – Transaction Exchange – Off-chain Transactions – Block size improvements – Blockchain enhancements – Sharding – Evolution of consensus algorithm – Proof of Stake – Proof of Activity – Byzantine Fault Tolerance Consensus Models – Proof of Elapsed Time – Cross-chain Protocol – Privacy Enhancement – Blockchain Security – Transaction Security Model–Decentralized Security Model– Attacks on Blockchain

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1:Implement the required cryptography primitives for block chain systems.

CO2: Work with various block chain design principles.

CO3: Implement with various consensus algorithms.

CO4: Equip networks with the various block chain techniques.

CO5: Work with block chain optimization techniques.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							2		2		
CO2	2	2	2							2		2		
CO3	3	2	2							3		2		
CO4	2	2	2							2		3		
CO5	3	2	2							2		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.KoshikRaj, "Foundations of Blockchain", Packt Publishers, 2019

2.S.Shukla, M.Dhawan, S.Sharma and S.Venkatesan, "Blockchain Technology: Crypto currency and Applications", Oxford UniversityPress, 2019.

3.Josh Thompson, "Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming", Create Space Independent Publishing Platform, 2017

REFERENCE BOOKS:

1.AndreasM.Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", OreillyMedia, 1stEdition, 2014.

2.Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller,and Steven Goldfeder. "Bitcoin and cryptocurrency technologies: a comprehensive introduction", Princeton University Press, 2016.

3.Blockchain Technology: Exploring Opportunities, Challenges, and Applications **Publisher: CRC Press ,Authors:** Sonali Vyas, Vinod Kumar Shukla, Shaurya Gupta, Ajay Prasad

4.Blockchain and Web3: Building the Cryptocurrency, Privacy, and Security Foundations of the Metaverse , Publisher: Wiley , Author: Winston Ma and Ken Huang

WEB RESOURCES:

1.https://www.ibm.com/topics/blockchain#:~:text=first%20blockchain%20application,Blockchain%20overview,patents%2C%20copyrights%2C%20branding).

2.https://www.edx.org/course/introduction-to-hyperledger-blockchain-technologie

CS606504 - **BLOCKCHAIN ARCHITECTURE DESIGN AND USE CASES (NPTEL)**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the various cryptography primitives used in Blockchain.
- To study the Hyperledger Fabric of Blockchain.
- To describe the various use cases of Blockchain.
- To study the Blockchain security .
- To learn the research aspects of block chain in AI and Bigdata

UNIT 1:BLOCKCHAIN AND CRYPTO PRIMITIVES **9**

Introduction to Blockchain - Crypto Primitives - Distributed Consensus - Consensus in Bitcoin – I (The Basics, PoW and Beyond, The Miners) - Permissioned Blockchain : Basics, Consensus , RAFT Consensus, Byzantine General Problem, Practical Byzantine Fault Tolerance

UNIT 2: HYPERLEDGER FABRIC **9**

Hyperledger Fabric - Blockchain for Enterprise – Overview -Blockchain Components and Concepts - Hyperledger Fabric – Transaction Flow - Hyperledger Fabric Details - Fabric – Membership and Identity Management - Hyperledger Fabric Network Setup - Fabric Demo: Fabric Demoon IBM Blockchain Cloud Fabric Demo, deploy from scratch , Hyperledger Composer – Application Development , Hyperledger Composer – Network Administration

UNIT 3: USE CASES **9**

Block chain Use Cases - Financial Service - Payments and Secure Trading, Compliance and Mortgage, Financial Trade ; Revolutionizing Global Trade , Blockchain in Supply Chain - Blockchain in Other Industries

UNIT 4: BLOCK CHAIN SECURITY **9**

Blockchain in Government : Advantages, Use Cases, Digital Identity - Hyperledger Indy, Tax Payments and Land Registry Records -Blockchain Security : Overview, Membership and Access control in Fabric,Privacy in Fabric - Blockchain Security: Fabric SideDB

UNIT 5: RESEARCH ASPECTS **9**

Research Aspects : Consensus Scalability, Bitcoin-NG, Collective Signing, Byzcoin ; Research Aspects : Algorand,Cross Fault Tolerance, Secured Multi-Party Computation ; Blockchain for Science : Blockchain for Big Data,Blockchain and AI ; Comparing Ecosystems – Ethereum– Ethereum development tools and Quorum – Corda Part 1 – Corda Part 2

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Identify the various cryptography primitives used in Blockchain.

CO2: Summarize the Hyperledger Fabric of Blockchain.

CO3: Implement the various use cases of Blockchain..

CO4: Analyze the Blockchain security .

CO5: Describe research aspects of Blockchain in AI and Bigdata

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							2		2		

CO2	2	2	2							2		2		
CO3	3	2	2							3		2		
CO4	2	2	2							2		3		
CO5	3	2	2							2		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos - Blockchain by Melanie Swa, O'Reilly

2.Blockchain state-of-the-art: architecture, use cases, consensus, challenges and opportunities, Author:Bela Shrimali ' Hiren B. Patel

3.Hyperledger Fabric - Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits

REFERENCE BOOKS:

1.The Basics of Bitcoin and Blockchain 2021: Basics of Cryptocurrency for the Beginners by **Spazi Liberi** (Author)

2.Architecture for Blockchain Applications ByXiwei Xu, Ingo Weber, Mark Staples · 2019

3.The Blockchain and the New Architecture of Trust by Kevin Werbach

WEB RESOURCES:

1.https://www.udemy.com/course/understanding-blockchain-technology/

2.https://onlinecourses.nptel.ac.in/noc19_cs63/preview

CS606505 - **BLOCK CHAIN PLATFORMS**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To describe the various primitives used in block chain.
- To implement using Ethereum Platform.
- To analysis the various modules in Hyper ledger framework.
- To develop using Hyper ledger Platform
- To learn about different Block chain Platforms.

UNIT 1:INTRODUCTION	**9**
Decentralized applications-Dapp-Good and bad Dapps-Understanding the blockchain-A deeper look at decentralized applications-Ethereum's history and governance-Connecting to Ethereum through the wallet-Smart contracts: The brain of Dapps-Connecting to Ethereum with geth-Managing accounts with geth	
UNIT 2: ETHEREUM	**9**
Managing smart contracts with Web3.js-Revisiting deployment through geth's interactive console- Interacting with SimpleCoin through geth's console-Simplifying command-based deployment with Node.js-Deploying on a private network-Making development more efficient by deploying on mock networks-Smoother interaction with SimpleCoin through a web UI-The Ethereum ecosystem-The core components -Decentralized address resolution with ENSDecentralized content storage-Accessing external data through oracles-Dapp frameworks and IDEs	
UNIT 3: HYPER LEDGER FABRIC FRAMEWORK	**9**
Exploring Hyperledger Fabric- Hyperledger frameworks, tools, and building blocks-Hyperledger frameworks Hyperledger tools-The building blocks of blockchain solutionsHyperledger Fabric component design-the Journey of a sample transaction-Hyperledger Fabric explored-Understanding governance in business networks powered by blockchain	
UNIT 4: IMPLEMENTATION IN HYPERLEDGER	**9**
The Hyperledger Family-Prerequisites and Setting up a Development Environment – Developing First Business Network and Deploying it -Define your Business Network - Secure your API using Passport and Enable Multi-Use Case Study and Implementation	
UNIT 5: DIFFERENT BLOCK CHAIN PLATFORMS	**9**
Multichain-Features-Mechanisms-Deployment-R3 Corda-Features-Model-Consensus Mechanism –Use cases- Ripple Technology- Transaction- IOTA-Consensus Mechanism-Implementation-Setup-Real World Implementation	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Implement the required cryptography primitives for block chain systems

CO2: Develop and Deploy using Ethereum Platform.

CO3: Work with various techniques in Hyper ledger framework.

CO4: Develop and Deploy using Hyper ledger Platform

CO5: Work with alternate Block chain Platforms

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.RobertoInfante, " Building EthereumDapps ", Manning Publications, March 2019, ISBN: 9781617295157

2.Petr Novotny, Nitin Gaur, Luc Desrosiers, Salman A. Baset ,"Blockchain Development with Hyperledger", Packt Publishing, March 2019

3.NiazChowdhury, "Inside Blockchain, Bitcoin, and Cryptocurrencies", CRC press, Taylor & Francis,2020.

4.Ernesto Lee, Sudip Ghosh, "Enterprise Blockchain Development: With Hyperledger Fabric and Composer" , ConsultantsNetwork,2018

REFERENCE BOOKS:

1.Josh Thompson, "Blockchain: The Blockchain for Beginnings Guide to Blockchain Technology and Leveraging Blockchain Programming", Create Space Independent Publishing Platform, 2017.

2.Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", Oreilly Media, 1st Edition, 2014.

3.Austin Grice, Eric Everson Mendes Marins, Garrett Lee Woodworth, Juliana Medeiros Destro, Rahul Gupta, VasfiGucer , "Implementation Guide for IBM Blockchain Platform for Multicloud", IBM Redbooks,2019.

WEB RESOURCES:

1.https://www.youtube.com/watch?v=Xm5qx2ZG7Z4

2.https://ethereum.org/en/what-is-ethereum/

CS606506 - **BLOCK CHAIN FORENSICS**

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn about security and privacy in Bitcoin and Block chain
- To propose Block chain based security mechanism for different applications
- To understand the importance of bitcoin forensics
- To build Block chain-based apps and PKI solutions
- To understand challenges and the future of cyber security and Blockchain

UNIT 1:BLOCKCHAIN ON THE CIA SECURITY TRIAD **9**

CIA security triad- Blockchain on confidentiality-Blockchain on integrity-Blockchain on availability-Deploying PKI-Based Identity with Blockchain-Two-FactorAuthenticationwithBlockchain.

UNIT 2: BLOCKCHAIN BASED SECURITY MECHANISMS **9**

Domain Name System- Understanding DNS components- DNS structure and hierarchy-DNS topology for large enterprise-Blockchain-based DNS solution- Blockchain-Based DDoS Protection.

UNIT 3: BITCOIN FORENSICS **9**

Crypto currency artifacts and investigation–Bitcoin crimes–Crypto currency investigation challenges-CasestudiesTracking bitcoin transactions-Numisight bitcoin explorer

UNIT 4: SECURITYAND PRIVACY IN BITCOIN 9

SecurityofconfirmedtransactionsSecurityofZero-confirmationTransactions–BitcoinForks-Userprivacy-Networklayer attacks-Enhancing privacy in bitcoin

UNIT 5:BLOCKCHAIN AND CYBER SECURITY- CHALLENGES AND FUTURE **9**

Decision path for Blockchain – Checklist–Challenges- Future of cyber security with Blockchain.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand the security and privacy in Bitcoin and Blockchain

CO2: Develop Block chain-based security mechanism for different applications

CO3: Comprehend the need for bitcoin forensics

CO4:Summarize the security and privacy issues in bit coin

CO5: Realize the challenges and the potential of block chain in the field of cyber security.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Rajneesh Gupta, Hands-On Cyber security with Blockchain", PacktPublishing,2018

2.Niranjan Reddy, "Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations", Apress,2019
3.TianaLaurence, "Blockchain For Dummies", Dummies,2017.
REFERENCE BOOKS:
1.GhassanKarame, Elli And roulaki, "Bitcoin and Blockchain Security", Artech,2017
2.HarishGarg, "Hands-On Bitcoin Programming with Python", Packt Publishing, 2018
3.MakotoYano, ChrisDai, Kenichi Masuda, Yoshio Kishimoto, "Block chain And CryptCurrency: Building A High Quality Market place For Crypt Data", Springer2020.
WEB RESOURCES:
1.https://www.youtube.com/watch?v=mBW7djo_fg8
2.https://www.youtube.com/watch?v=Ylp4qexTwi4

CS606508 - **COMPUTER VISION WITH OPEN CV**					
Course Category: Program Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To gain the knowledge of the Open CV methods to apply the basic operations on images
- To learn about histogram and binary vision
- To study about geometric transformations and edge detection
- To analyze various features and recognition techniques
- To implement the video tracking and panoramas

UNIT 1:OPENCV AND BASIC OPERATIONS ON IMAGES	**9**
History of OpenCV - Built-in Modules - Setting up OpenCV on Your Computer - Stereo Matching - Homography Estimation in Video - Circle and Line Detection - Image Segmentation - Bounding Box and Circle - Image Inpainting -Displaying Images from Disk in a Window - The cv::Mat Structure - Converting Between Color-spaces - GUI Track-Bars and Callback Functions- ROIs: Cropping a Rectangular Portion out of an Image- Accessing Individual Pixels of an Image -Videos	
UNIT 2: IMAGES, HISTOGRAMS, BINARY VISION	**9**
Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing –1D and 3D histograms- Histogram / Image Equalisation - Histogram Comparison- Back- projection-k-means Clustering – Thresholding- Threshold Detection Methods- Variations on Thresholding-Mathematical Morphology- Connectivity	
UNIT 3: EDGES AND GEOMETRIC TRANSFORMATIONS	**9**
Problem Specification and Algorithm - Affine Transformations - Perspective Transformations - Specification of MoreComplex Transformations – Interpolation - Modelling and Removing Distortion from Cameras - Edge Detection -ContourSegmentation-Hough Transform	
UNIT 4: FEATURES AND RECOGNITION	**9**
Moravec Corner Detection - Harris Corner Detection - FAST Corner Detection – SIFT - Other Detectors - Template Matching - Chamfer Matching - Statistical Pattern Recognition - Cascade of Haar Classifiers - Other Recognition Techniques–Performance	
UNIT 5: VIDEO AND PANORAMAS	**9**
Moving Object Detection– Tracking- Video Datasets and Formats-Metrics for Assessing Video Tracking Performance– Affine Transformations- Perspective Transformations- Image panorama	
TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Apply Open CV image processing basic operations

CO2: Find the histogram and apply thresholding

CO3: Do edge detection and apply geometric transformations in images

CO4: Extract various features from images

CO5: Create image panorama and track videos

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3							2		3		
CO2	2	2	2							2		2		
CO3	2	2	2							2		3		
CO4	2	2	3							2		2		
CO5	2	2	2							2		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. KennethDawson-Howe,"APracticalIntroductiontoComputerVisionwithOpenCV",Wiley,2014

2. SamarthBrahmbhatt,"PracticalOpenCV",Apress,2013

3. Adrian Kaehler, Gary Bradski, "Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library", First Edition,O' Reilly Media, 2017

REFERENCE BOOKS:

1. PrateekJoshi, David MillánEscrivá,Vinicius Godoy, "OpenCV by Example", Packt Publishing, 2016.Adrian Rose brock, "Practical Python and OpenCV", Second Edition, PyImage Search, 2016.

2.Mastering OpenCV with Practical Computer Vision Projects Paperback by Shervin Emami (Author), Khvedchenia Levgen (Author), Naureen Mahmood (Author)

3.Mastering OpenCV 4: A comprehensive guide to building computer vision and image processing applications with C++, 3rd Edition by Roy Shilkrot (Author), David Millán Escrivá (Author)

WEB RESOURCES:

1.https://www.youtube.com/watch?v=l_Mhv0rxbQk&list=PLaHodugB5x-Ddy_H951h0VHjOjfzZNCBh

2.https://www.youtube.com/watch?v=oXlwWbU8l2o

CS606509 - **INTERNET SECURITY**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study the fundamental concepts of classical encryption techniques and Crypt Analysis.
- To gain the knowledge of the principles of secret keys management.
- To acquire the concepts of IP Security and its applications
- To study the concepts of Transport layer security and its applications
- To learn the working principle of Email and public key distribution

UNIT 1:INTRODUCTION AND BASIC ENCRYPTION **9**

IntroductionEssentialsofCryptography,EssentialsofNetworkingandInternet,SecurityObjectives,Communication Security, Legal restrictions, Basics of Encryption – Building Blocks of Encryption, Cryptanalysis and Modern Codes, Brute Force cracking of Secret Keys, Choosing Cryptography Algorithms

UNIT 2: LINK ENCRYPTION AND SECURE KEY MANAGEMENT **9**

Link Encryption – Inline Encryption, Point to Point Encryption, IP Routed Configuration, Managing Secret Keys –Issues in Secret Key Management, Technology - Random Key Generation, Random Seeding, Pseudorandom Number Generators, Manual Key Distribution, Automatic Rekeying, Key Distribution Centres, Maintaining Keys and SystemSecurity

UNIT 3: IPLAYER SECURITYAND APPLICATIONS **9**

Basic Issues in IP Security (IPSEC), Cryptographic Checksums, IP Security Protocol, IPSEC key management, TCP/IP Network Security Protocols, Virtual Private Network(VPN)–Issues in VPN, IPSEC proxy cryptography, IPSECencrypting Router, Site to Site Encryption, Remote Access with IPSEC – problems in IPSEC clients, IPSEC Client, ClienttoServer site access

UNIT 4: SECURE SOCKET LAYER **9**

Public Key Cryptography, RSA Encryption, Key Exchange with RSA, Secure Socket Layer (SSL), World Wide Web Transaction Security–Issues in Internet Transaction Security, Transactions on World Wide Web, Security Alternatives for Web Forms, Web Browser with SSL, Web Server with SSL

UNIT 5: SECURE E-MAIL AND PUBLIC KEY CERTIFICATES **9**

Secure Email- Email Security Issues, Basics of Internet E-Mail, Offline Message Keying, Digital Signature, Secure Email Client, Public Key Certificates–Distributing Public Keys,
Public Key Certificates, Certificate Distribution, Centralized Certification Authority, Hierarchical Certification Authority, Pretty Good Privacy(PGP)

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Interpret basic building blocks of encryption for crypt analysis

CO2: Identify suitable key generation technique for secret key management

CO3: Apply IP security in VPN and Remote Access

CO4: Apply SSL in Worldwide web transactions

CO5: Explore various public key and certificate distribution strategies and its using PGP

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2							2		2		
CO2	2	2	2							2		2		
CO3	2	3	2							2		2		
CO4	2	2	3							2		3		
CO5	3	2	2							2		2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Richard E.Smith, Internet Cryptography, 6thEdition, Pearson,2011

2.Uyless Black ,"Internet Security Protocols– Protecting IP Traffic", Pearson Education,2001

3.William Stallings, Cryptography and Network Security, 6thEdition, Pearson Education, March2013

REFERENCE BOOKS:

1.Bruce Schneier and NeilsFerguson, Practical Cryptography‖, First Edition, Wiley Dream tech India Pvt Ltd, 2003

2. Tim Speed, Juanita Ellis, "Internet Security",Elsevier,2006

3.Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory",2nd edition, Pearson,200

WEB RESOURCES:

https://www.youtube.com/watch?v=zd0U1zNBYNk

https://www.youtube.com/watch?v=SaZGjQBItBc

CS606510 - **INTELLIGENT TRANSPORT SYSTEMS**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To describe Fundamentals of intelligent transport systems.
- To learn Concepts of ATIS and its operations.
- To implement Basics of predictive route guidance system. To study Concepts of APTS and its operations.
- To analyze General issues related to ITS and environment

UNIT 1:ITS FUNDAMENTALS **9**

Introduction to Intelligent Transportation Systems (ITS) –Definition of ITS and Identification of ITS Objectives-Historical Background - Benefits of ITS - ITS Data collection techniques –Detectors - Automatic Vehicle Location (AVL)-Automatic Vehicle Identification(AVI).

UNIT 2: ADVANCED TRAVELLER INFORMATION SYSTEMS **9**

Basic concepts - Models - Simulation - LOS of transportation systems - Static, real time and dynamic information -Value of information - Topology - Where and When to receive data - Information flows - Travel support - Dynamic routing.

UNIT 3: PREDICTIVE ROUTE GUIDANCE **9**

ITS - Applications - Issues - Information types- Impact on route guidance - Case studies.

UNIT 4: ADVANCED PUBLIC TRANSPORTATION SYSTEMS(APTS) **9**

Scope-Components of APTS-Advantages- Limitations ofAPTS-Casestudies -Issues

UNIT 5: ITS AND ENVIRONMENT **9**

ITS and Flexibility- ITS and Customer - centricity - ITS and the Environment-General issues and Case studies - Overview of ITS implementations in developed countries.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Analyze the various types of traffic and suggesting ITS.

CO2: Plan and design the ATIS

CO3: Plan the predictive route guidance system.

CO4: Analyze the traffic data and able to suggest suitable APTS

CO5: Manage the issues arising out of introduction of ITS.

CO-PO MAPPING

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

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.PradipKumarSarkar, AmitKumarJain, "Intelligent Transport Systems", Paperback, PHILearning,2018

2.Intelligent Transportation Systems: Theory and Practice ; Authors: Amit Kumar Tyagi , Niladhuri Sreenath
3.Sussman,J.M., Perspective on ITS, Artech House Publishers, 2005.
REFERENCE BOOKS:
1.Paolo Baggano,"Intelligent transport Systems Good practices to standards", CRC press,2016.
2.ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by KanPaulChen, John Miles
3.**Intelligent Transportation Systems by Teodor Piatek, Scitus Academics;**Author: **Teodor Piatek** ; Publisher: **Scitus Academics**
WEB RESOURCES:
https://www.youtube.com/watch?v=YDM0Xh3S6JI
https://www.youtube.com/watch?v=aNhI2Jstouw

VERTICAL VI
DIVERSIFIED COURSES

CS606601 - **DATA ANALYTICS WITH PYTHON (NPTEL)**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study about probability and sampling distributions.
- To study about Hypothetical tests and ANOVA.
- To study about different regression.
- To study about cluster analysis.
- To study about Classifications and Regression Trees.

PRE-REQUISITES: Cryptography

SYLLABUS **46**

Week 1	**:**	**Introduction to data analytics and Python fundamentals**
Week 2	**:**	**Introduction to probability**
Week 3	**:**	**Sampling and sampling distributions**
Week 4	**:**	**Hypothesis testing**
Week 5	**:**	**Two sample testing and introduction to ANOVA**
Week 6	**:**	**Two way ANOVA and linear regression**
Week 7	**:**	**Linear regression and multiple regression**
Week 8	**:**	**Concepts of MLE and Logistic regression**
Week 9	**:**	**ROC and Regression Analysis Model Building**
Week 10	**:**	**c^2 Test and introduction to cluster analysis**
Week 11	**:**	**Clustering analysis**
Week 12	**:**	**Classification and Regression Trees (CART)**.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Solve problems in probability and probability distributions.

CO2: use ANOVA.

CO3: use different regression models to do predictions.

CO4: use clustering algorithms.

CO5: use classification and regression trees.

CO-PO MAPPING

TEXT BOOKS:

1.McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".

2.Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.

3.Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. “John Wiley & Sons, Inc”.

REFERENCE BOOKS:

1. Jiawei Han and MichelineKamber (2006). Data Mining: Concepts and Techniques. “

2. David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). “Wiley-Interscience Publication”.

CS606602 - **PROBLEM SOLVING USING PYTHON**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures – lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT 1: COMPUTATIONAL THINKING AND PROBLEM SOLVING	**9**
Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sortedcards, guess an integer number in a range, Towers of Hanoi.	
UNIT 2: DATA TYPES, EXPRESSIONS, STATEMENTS	**9**
Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.	
UNIT 3: CONTROL FLOW, FUNCTIONS, STRINGS	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search	
UNIT 4: LISTS, TUPLES, DICTIONARIES	**9**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.	
UNIT 5: FILES, MODULES, PACKAGES	**9**
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word countcopy file, Voter's age validation, Marks range validation (0-100).	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Develop and execute simple Python programs.

CO3: Write simple Python programs using conditionals and looping for solving problems.

CO4: Decompose a Python program into functions.

CO5: Represent compound data using Python lists, tuples, dictionaries etc.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	2	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	2	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	2	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	2	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	2	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.

2.Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCE BOOKS:

1.Paul Deitel and Harvey Deitel, "Python for Prammers", Pearson Education, 1st Edition, 2021.

2.G Venkatesh and MadhavanMukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.

3.John V Guttag, " Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data'', Third Edition, MIT Press

CS606603 - **DATA SCIENCE FOR ENGINEERS (NPTEL)**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Introduce R as a programming language
- Introduce the mathematical foundations required for data science
- Introduce the first level data science algorithms
- Introduce a data analytics problem solving framework
- Introduce a practical capstone case study

Week 1: Course philosophy and introduction to R

Week 2: Linear algebra for data science -Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudoinverse)- Geometric view - vectors, distance, projections, eigenvalue decomposition

Week 3:Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)

Week 4: Optimization

Week 5: Typology of data science problems and a solution framework

Week 6: Simple linear regression and verifying assumptions used in linearregression Multivariate linear regression, model assessment, assessing importance of different variables, subset selection

Week 7: Classification using logistic regression

Week 8: Classification using KNN and k-means clustering

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Describe a flow process for data science problems

CO2: Classify data science problems into standard typology

CO3: Develop R codes for data science solutions

CO4: Correlate results to the solution approach followed

C05: Assess the solution approach

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:
1.RaghunathanRengaswamy, Resmi Suresh, “Data Science for Engineers”, 1st edition, CRC Press.
REFERENCE BOOKS:
1.https://rpubs.com/uwaterloodatateam/r-programming-reference

CS606604 - **DATABASE DESIGN (NPTEL)**					
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn ER models with applying ER modelling.
- To learn Relational model.
- To learn Functional depencies and Normal Form.
- To learn File handling, applying Hassing and understanding B+ Trees.
- To learn Transactions.

MODULE 1:

Introductory Concepts (1 session) Databases and Information Systems, An example usage context, Database system concepts and architecture.

MODULE 2:

Semantic Database Design (3 sessions) High-level conceptual modeling, ER Modeling concepts, ER Diagrams, Cardinality constraints, Higher-order relationships, Enhanced ER Model (EER), Weak-entity types, Subclasses and inheritance, Specialization and Generalization, Modeling of UNION types using categories

MODULE 3:

Relational Model, Languages and Systems (7 sessions) Relational algebra (2 sessions): Relational model concepts, Relational integrity constraints, Update operations on relations, Relational algebra model, ER to relational mapping SQL (2 sessions): Data definition in SQL, Queries and update statements, Views, Integrity constraints, Specifying indexes, Embedded SQL. IBM DB2 case study (2 sessions): Architecture of DB2, Data definition and manipulation in DB2. EER to Relational mapping (1 session).

MODULE 4:

Database design using the relational model (4 sessions) Functional dependencies (2 sessions): Keys in a relational model, Concept of functional dependencies, Normal forms based on primary keys, Boyce-Codd Normal Forms Further Dependencies (2 sessions): Multi-values dependencies and fourth normal form, Join dependencies and fifth normal form, Inclusion dependencies, Other dependencies and normal forms

MODULE 5:

Storage and Indexing Structures (6 sessions) Storage structures (3 sessions): Secondary storage devices, Buffering of blocks, File Organization, Heaps, Sorted Files, Hashing and overflow handling techniques, Dynamic hashing, Extensible hashing, Other file organizations Indexing methods (3 sessions): Basic terminology, Primary indexes, Clustering index, Secondary index, Multilevel indexes, ISAM, B-trees, B+ trees, inserting and searching algorithms for B+ trees, Other indexing methods

MODULES 6:

Transaction Processing and Concurrency Control (6 sessions) Transaction Fundamentals (3 sessions): OLTP environments, Concurrency issues, need for transactions, Necessary properties of transactions (ACID properties), Transaction states, serializability, Serial schedules, Conflict serializability, View serializability, Recoverable and non-recoverable

schedules, Cascading rollbacks, Cascadeless schedules Concurrency control

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Design ER models.

CO2: Identify relational models.

CO3: Apply normal forms in splitting tables.

CO4: Identify the file forms and handle them and use hashing.

CO5: use transactions in DBMS.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database Design",McGraw Hill Education; Sixth edition (1 December 2013).

REFERENCE BOOKS:

1..C. J. Date, "Database Design and Relational Theory: Normal Forms and All That Jazz", Apress, December 2019.

2.Michael J. Hernandez, "Database Design for Mere Mortals: A guide to relational database design".

CS606605 - **MATLAB PROGRAMMING FOR ENGINEERS**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To Understand basic MATLAB concepts
- To learn Vectors and variables
- To know about the command statements
- To develop codes
- To understand Segmentation concepts

UNIT 1: INTRODUCTION **9**

Create, edit, and open scripts- Write Comments in Lines and Blocks- Using MATLAB for a Personal Budget- Personalize MATLAB Colors- Start MATLAB with an Encouraging Note

UNIT 2: VECTORS AND VARIABLES **9**

Create Vectors and Matrices-Unsolved: Valid and Invalid Matrices- Working with Text (Characters and Strings)- HTML Table from MATLAB Code- Round pi to N significant Digits- File/folder Information Using Structures

UNIT 3: COMMANDS STATEMENTS **9**

Create a Hilbert Matrix Using for-loops- Unsolved: Compare two while Loops- Save and Load Multiple Files- Import Formatted Text Data- Import Excel-format Data

UNIT 4: TRANSLATE FORMULAS INTO CODE **9**

Trig Functions and Gaussians- Laplace and log-normal Distributions- Complex Numbers and Euler's Formula- Piecewise Functions- Piecewise Function in one line of Code.

UNIT 5: SEGMENTATION **9**

Threshold-based Time Series Segmentation- Derivative-based Time Series Segmentation- Intensity-based Image Segmentation- Identify Neurons in a Mouse Brain Slice

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand basic MATLAB concepts.

CO2: learn Vectors and variables.

CO3: Understand to know about the command statements.

CO4: Develop the codes.

CO5: Understand Segmentation concepts

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	2	-	-	-	-	-	-	-	-	-
CO5	2	2	2	2	2	-	-	-	-	-	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.MATLAB Programming for Engineers, 6th edition, Stephen J. Chapman, BAE Systems 2020.

2.MATLAB Programming for Engineers Perfect Paperback – by Stephen J. Chapman 2012.

REFERENCE BOOKS:
1.MATLAB and its Applications in Engineering, 2e Paperback – 2016, by Bansal ,Goel, Sharma.
2.Programming and Engineering Computing with MATLAB 2017, Huei-Huang Lee :Sdc Publications.

CS606606 - **ROBOTICS AND ITS APPLICATIONS**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Identify robots and its peripherals for satisfactory operation and control of robots for industrial and non-industrial applications.

UNIT 1: ROBOT BASICS **9**

Robot-Basic concepts, Need, Law, History, Anatomy, specifications. Robot configurationscartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot.

UNIT 2: ROBOT ELEMENTS **9**

End effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.

UNIT 3: ROBOT KINEMATICS AND CONTROL **9**

Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point to point, Continuous Path Control, Robot programming

UNIT 4: ROBOT SENSORS **9**

Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence.

UNIT 5: ROBOT APPLICATIONS **9**

Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nanorobots, Future Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: list and explain the basic elements of industrial robots.

CO2: analyze robot kinematics and its control methods.

CO3: Classify the various sensors used in robots for better performance.

CO4: summarize various industrial and non-industrial robots.

CO5: Implement the real time applications.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	2	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	2	1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, "Industrial Robotics Technology, Programming and Applications", Tata –McGraw Hill Pub. Co., 2008.

2.Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata

McGraw Hill Publishing Company Limited, 2010.
3.Klafter.R.D, Chmielewski.T.A, and Noggin's., "Robot Engineering: An Integrated Approach"', Prentice Hall of India Pvt. Ltd., 1994.
REFERENCE BOOKS:
1.Fu.K.S, Gonzalez.R.C&Lee.C.S.G, "Robotics control, sensing, vision and intelligence", Tata- McGraw Hill Pub. Co., 2008 5. Yu. "Industrial Robotics", MIR Publishers Moscow, 1985.

CS606607 - **ADHOC NETWORKS**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Learn Ad hoc network and Sensor Network fundamentals.
- Understand the different routing protocols.
- Have an in-depth knowledge on sensor network architecture and design issues.
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks.
- Have an exposure to mote programming platforms and tools

UNIT 1: INTRODUCTION AND ROUTING PROTOCOLS **9**

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

UNIT 2: SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES **9**

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT 3: WSN NETWORKING CONCEPTS AND PROTOCOLS **9**

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

UNIT 4: SENSOR NETWORK SECURITY **9**

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

UNIT 5: SENSOR NETWORK PLATFORMS AND TOOLS **9**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Know the basics of Ad hoc networks and Wireless Sensor Networks.

CO2: Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement.

CO3: Apply the knowledge to identify appropriate physical and MAC layer protocols.

CO4: Understand the transport layer and security issues possible in Ad hoc and sensor networks.

CO5: Be familiar with the OS used in Wireless Sensor Networks and build basic modules.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	2	2	-	-	-	-	-	-	-	1	1
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	2	2	-	-	-	-	-	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.C.Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007. 2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

REFERENCE BOOKS:

1.Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, "Mobile ad-hoc networking", Wiley-IEEE press, 2004.

2.Mohammad Ilyas, "The handbook of ad-hoc wireless networks", CRC press, 2002.

3.T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad-hoc Network"

4.Research, "Wireless Communication, and Mobile Computing". Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.

CS606608 - **PRINCIPLES OF DISTRIBUTED SYSTEMS**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand Transactions and Concurrency control.
- To understand Security issues.
- To Understanding Distributed shared memory.
- To design distributed systems for basic level applications.
- To learn about distributed shared memory.

UNIT 1: INTRODUCTION **9**

Characterization of Distributed Systems-Introduction, Examples of Distributed systems, Resource sharing and web, challenges, System models -Introduction, Architectural and Fundamental models, Networking and Internetworking, Interprocess Communication, Distributed objects and Remote Invocation-Introduction, Communication between distributed objects, RPC, Events and notifications, Case study-Java RMI.

UNIT 2: OPERATING SYSTEM **9**

Operating System Support- Introduction, OS layer, Protection, Processes and Threads, Communication and Invocation, Operating system architecture, Distributed File SystemsIntroduction, File Service architecture.

UNIT 3: PEER TO PEER SYSTEMS **9**

Peer to Peer Systems–Introduction, Napster and its legacy, Peer to Peer middleware, Routing overlays, Overlay case studies-Pastry, Tapestry, Application case studies-Squirrel, OceanStore. Time and Global States-Introduction, Clocks, events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging. Coordination and Agreement-Introduction, Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.

UNIT 4: TRANSACTIONS AND CONCURRENCY **9**

Transactions and Concurrency Control-Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering. Distributed TransactionsIntroduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.

UNIT 5: REPLICATION **9**

Replication-Introduction, System model and group communication, Fault tolerant services, Transactions with replicated data. Distributed shared memory, Design and Implementation issues, Consistency models.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand Transactions and Concurrency control.

CO2: Understand Security issues.

CO3: Design distributed systems for basic level applications.

CO4: Understanding Distributed shared memory.

CO5: Implementation of the models.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	2	2	-	-	-	-	-	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Cormen, C. Leiserson, R. Rivest and C. Stein, "Introduction to Algorithms", Third Edition, McGraw-Hill, 2009.

2.R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995. J. J. McConnell, "Analysis of Algorithms: An Active Learning Approach", Jones & Bartlett Publishers, 2001.

3.D. E. Knuth, Art of Computer Programming, Volume 3, "Sorting and Searching", Second Edition, Addison-Wesley Professional, 1998.

4.S. Dasgupta, C. H. Papadimitriou and U. V. Vazirani, "Algorithms", McGraw-Hill, 2008.

REFERENCE BOOKS:

1."Distributed Systems – Principles and Paradigms", A.S. Tanenbaum and M.V. Steen, Pearson Education.

2.Distributed Computing, Principles, Algorithms and Systems, Ajay D. Kshemakalyani and MukeshSinghal, Cambridge, rp 2010.

CS606609 - **PYTHON SCRIPTING**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To Learn Fundamentals of Python
- To understand Control Flow Structures
- To know about Lists, Tuples, Sets and Dictionaries
- To create Functions and Modules
- To understand String Processing and File Handling

UNIT 1: FUNDAMENTALS OF PYTHON **9**

Introduction to Python- History of Python- Python Features- Python Applications- Python Applications- Elements of Python- Keywords and Identifiers- Assigning Values to Variables- Data types- Type Casting- Input-Output functions: input, print- Operators.

UNIT 2: CONTROL FLOW STRUCTURES **9**

Introduction to Control Structures- if Statement- if else Statement- Nested if-else- if-elifelse statements- Switch Statement- loop- while loop- for loop- Nested loops- break statement- continue statement- Pass Statement.

UNIT 3: LISTS, TUPLES, SETS AND DICTIONARIES **9**

Lists and operations on Lists- Create Python Lists- List operations- List Slicing- Add/Change List Elements- Insert( )- Delete- Remove( ) and pop( )- Tuples and operations on Tuples- Characteristics of Tuple- Concatenation - Sets and operations on Sets.

UNIT 4: FUNCTIONS AND MODULES **9**

Introduction to Python User defined Function- Passing parameters to a function and returning values from a function- Python Default Arguments- Recursion- Modules and Packages- rand module - Random numbers generators.

UNIT 5: STRING PROCESSING AND FILE HANDLING **9**

Introduction to String- String Operation- Add strings to list- Concatenate lists of strings- Access String elements using index operator- String functions- String functions- File Handling functions.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand the Fundamentals of Python

CO2: Understand the Control Flow Structures

CO3: know about Lists, Tuples, Sets and Dictionaries

CO4: create Functions and Modules

CO5: understand String Processing and File Handling

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	2	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Jones, M. (2013), "Python for Biologists: A complete programming course for beginners" Create

Space Independent Publishing Platform 1st edition. ISBN: 978-1492346135
REFERENCE BOOKS:
1.Pilgrim M, (2009), “Dive into Python 3” Apress ISBN: 978-1430224150.

CS606610 - **IMPLEMENT RUST**

Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the Rust language basics
- To learn advanced Rust
- To Implement the small programs
- To understand the practical engineering skills To design the APIs concepts.

UNIT 1: RUST LANGUAGE BASICS **9**

Basic syntax-pointers, references, and (im)mutability-ownership, borrowing, and lifetimesgeneric functions and types implementing and defining traits.

UNIT 2: ADVANCED RUST **9**

Concurrency-networking-Iterators-futures and async-lient-side web programming via Web Assembly-mixing Rust with C.

UNIT 3: IMPLEMENTATION **9**

How big are things, and where are they stored? Where does allocation happen?monomorphization versus dynamic dispatch translating Rust to C

UNIT 4: PRACTICAL ENGINEERING SKILLS **9**

Unit and integration testing-benchmarking and optimization-source control and continuous integration-writing API documentation

UNIT 5: DESIGN SKILLS **9**

Factoring components into minimum viable concepts-designing APIs for safety and efficiency-improving code clarity

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: Understand the Rust language basics

CO2: Learn advanced Rust

CO3: Implement the small programs

CO4: Understand the practical engineering skills

CO5: Design the APIs concepts

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	2	-	-	-	-	-	-	-	-	-
CO5	2	2	2	2	2	-	-	-	-	-	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Programming Rust, 2nd Edition by Jim Blandy, Jason Orendorff, Leonora F . S. Tindall Released June 2021Publisher(s): O'Reilly Media, Inc. ISBN: 9781492052548.

REFERENCE BOOKS:

https://doc.rust-lang.org/book/ch00-00-introduction.html

VERTICAL –VII
DEEP LEARNING

NLP TOOLS AND APPLICATIONS (NPTEL)

Course Category: Programme Elective (NPTEL)	Course Type: Theory	L	T	P	C
		3	0	0	3

Week 1:	
Week 1: Introduction and Basic Text Processing	
Week 2:	
Week 2: Spelling Correction, Language Modeling	
Week 3:	
Week 3: Advanced smoothing for language modeling, POS tagging	
Week 4:	
Week 4: Models for Sequential tagging – MaxEnt, CRF	
Week 5:	
Week 5: Syntax – Constituency Parsing	
Week 6:	
Week 6: Dependency Parsing	
Week 7:	
Week 7: Distributional Semantics	
Week 8:	
Week 8: Lexical Semantics	
Week 9:	
Week 9: Topic Models	
Week 10:	
Week 10: Entity Linking, Information Extraction	
Week 11:	
Week 11: Text Summarization, Text Classification	
Week 12:	
Week 12: Sentiment Analysis and Opinion Mining	
TOTAL: 45 PERIODS	
Course Outcomes (COs)	

CO1:Use the Python programming language to solve general problems
CO2:Process text by using NLP techniques such as lemmatization, POS tagging etc.
CO3: Extract meaningful information from a piece of text.
CO4:Engage various NLP techniques to solve a particular NLP problem
CO5:Create the Topic Models
Text Books
1. Natural Language Processing: Concepts, Methodologies, Tools, and Applications (Critical Explorations) Hardcover – Import, 30 November 2019 Publisher ： Business Science Reference; 3rd edition (30 November 2019) 2. Natural Language Processing: A Textbook with Python Implementation Hardcover – Import, 15 November 2023 by Raymond S. T. Lee (Author)
Reference Books
1. Real-World Natural Language Processing by Masato Hagiwara Released November 2021 Publisher(s): Manning Publications ISBN: 9781617296420Natural Language Processing: Concepts, Methodologies, Tools, and Applications (3 Volumes). 2. Noted as an IGI Global Core Reference Title in Computer Science & IT for 2019. Information Resources Management Association (USA)Release Date: November, 2019|Copyright: © 2020 |Pages: 1704DOI: 10.4018/978-1-7998-0951-7

Neural Networks and Deep Learning						
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- To identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- To implement deep learning algorithms and solve real-world problems.
- To Understand Conditional Random Fields
- To Apply training deep models
- To Classify Object recognition.

Unit 1 Introduction	**9**
Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	
Unit 2 Training Neural Network	**9**
Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.	
Unit 3 Conditional Random Fields	**9**
Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	
Unit 4 Deep Learning	**9**
Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	
Unit 5 Deep Learning Research	**9**
Object recognition, sparse coding, computer vision, natural language processing	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1-Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.

CO2-Implement deep learning algorithms and solve real-world problems.

CO3-Understand Conditional Random Fields

CO4-Apply training deep models

CO5-Classify Object recognition

TEXT BOOKS:

T1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..

T2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCE BOOKS:

R1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

R2.b, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.

R3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Text and Speech Analysis						
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- To Understand Speech production mechanisms
- To learn Front-end analysis
- To know the language models
- To understand parameter tying
- To classify Phrase-based translation systems

Unit 1 Introduction	**9**
Introduction & Applications. Speech production mechanisms, types of speech sound, source-filter model, applications of speech and text processing	
Unit 2 Analysis	**9**
FFT based methods. All-pole filter models, calculation of LP coefficients. LP Spectrum. Cepstral analysis. Front-end analysis for speech recognition (MFCCs).	
Unit 3 Language Models	**9**
Perplexity, N-gram language models, discounting, interpolation.Continuous speech recognition. Pruning. Integrating context dependent HMMs and N-gram language models.	
Unit 4 Sub-word Acoustic Models	**9**
Large vocabulary speech 37ecognition, continuous speech training, limitations of word models, context dependent phones, parameter tying, WSJ performance.	
Unit 5 SMT – Translation	**9**
Parallel text as training data. Models of word and phrase alignment in translation. Model estimation procedures.Phrase-based translation systems. Implementation via WFSTs.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES: At the end of the course, the student will be able to,	
CO1-Understand Speech production mechanisms	
CO2-Identify Front-end analysis	
CO3-Understand the language models	
CO4-understand parameter tying	
CO5-classify Phrase-based translation systems	
TEXT BOOKS:	
1.Daniel Jurafsky and James Martin. Speech and Language Processing (Second Edition) , Prentice Hall, 2008	
2. Xuedong Huang, Alex Acero and Hsiao-Wuen Hon, Spoken Language Processing, Prentice Hall, 2001	
REFERENCE BOOKS:	
1.Paul Taylor. Test-to_speech Synthesis, Cambridge University Press, 2009	

Drone Technology

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand Drone Concept
- To Design Drone and fabrication
- To develop Drone programming
- To understand Drone flying and operation
- To create Drone commercial applications

Unit 1 Introduction	**9**
Drone Concept – Vocabulary Terminology – History of drone – Types of current generation of drones based on their method of propulsion	
Unit 2 Drone design and fabrication	**9**
Classifications of the UAV Overview of the main drone parts Technical characteristics of the parts Function of the component parts Assembling a drone The energy sources Level of autonomy	
Unit 3 Drone programming	**9**
Drones configurations The methods of programming drone Download program Install program on computer Running Programs Multirotor stabilization Flight modes Wi-Fi connection	
Unit 4 Drone flying and operation	**9**
Concept of operation for drone Flight modes Operate a small drone in a controlled environment Drone controls Flight operations management tool	
Unit 5 Drone commercial applications	**9**
Choosing a drone based on the application Drones in the insurance sector Drones in delivering mail, parcels and other cargo Drones in agriculture Drones in inspection of transmission lines and power distribution Drones in filming and panoramic picturing	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1-understand Drone Concept

CO2-Design Drone and fabrication

CO3-develop Drone programming

CO4-understand Drone flying and operation

CO5-create Drone commercial applications

TEXT BOOKS:

1.Frank L Lewis, Darren M. Dawson, Chaouki T.Abdallah," Robot Manipulator Control – Theory and Practice", Marcel Dekker Inc., 2004

REFERENCE BOOKS:

1.Lorenzo Sciavicco and Bruno Siciliano, "Modelling and Control of Robot Manipulators" Springer, Second edition, December 2012.

2.Reza N. Jazar, "Theory of Applied Robotics- Kinematics, Dynamics, and Control ", Springer International, 2007

3.Moshe Shoham"A Text book of Robotics – Structure Control and Operation" EshedRobotec, 1984

Image and video analytics						
Course Category: Programme Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- To understand the need for video Analytics
- To understand the basic configuration of video analytics
- To understand the functional blocks of a video analytic system
- To get exposed to the various applications of video analytics

Unit 1 VIDEO ANALYTIC COMPONENTS	**9**
Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction- classifier – Preprocessing- edge detection- smoothening- Feature space-PCA-FLD-SIFT features	
Unit 2 FOREGROUND EXTRACTION	**9**
Background estimation- Averaging- Gaussian Mixture Model- Optical Flow based- Image Segmentation- Region growing- Region splitting-Morphological operations- erosion-Dilation- Tracking in a multiple camera environment	
Unit 3 CLASSIFIERS	**9**
Neural networks (back propagation) – Deep learning networks- Fuzzy Classifier- Bayesian classifier- HMM based classifier	
Unit 4 VIDEO ANALYTICS FOR SECURITY	**9**
Abandoned object detection- human behavioral analysis –human action recognition- perimeter security- crowd analysis and prediction of crowd congestion	
Unit 5 VIDEO ANALYTICS	**9**
Customer behavior analysis – people counting- Traffic rule violation detection- traffic congestion identification for route planning- driver assistance- lane change warning	
TOTAL: 45 PERIODS	
COURSE OUTCOMES: At the end of the course, the student will be able to,	
CO1-Design video analytic algorithms for security applications	
CO2-Design video analytic algorithms for business intelligence	
CO3-Design custom made video analytics system for the given target application	
CO4-understand the functional blocks of a video analytic system	
CO5-Understand the various applications of video analytics	
TEXT BOOKS:	
1.Graeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video-Based Surveillance Systems: Computer Vision and Distributed Processing , Kluwer academic publisher, 2001	
2.Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016	
REFERENCE BOOKS:	

1.Zhihao Chen (Author), Ye Yang (Author), Jingyu Xue (Author), Liping Ye (Author), Feng Guo (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform, 2014

2.Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012

Big Data Analytics(NPTEL)					
Course Category: Programme Elective (NPTEL)	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Week 1 :	
Week 1 : Introduction to Big Data	
Week 2:	
Week 2 : Introduction to Enabling Technologies for Big Data	
Week 3 :	
Week 3 : Introduction to Big Data Platforms	
Week 4 :	
Week 4 : Introduction to Big Data Storage Platforms for Large Scale Data Storage	
Week 5 :	
Week 5 : Introduction to Big Data Streaming Platforms for Fast Data	
Week 6 :	
Week 6 : Introduction to Big Data Applications (Machine Learning)	
Week 7 :	
Week 7 : Introduction of Big data Machine learning with Spark	
Week 8:	
Week 8 : Introduction to Big Data Applications (Graph Processing)	

TOTAL: 45 PERIODS

Course Outcomes (COs)

At the end of the course student will be able to

CO:1 Identify Big Data and its Business Implications

CO:2 List the components of Hadoop and Hadoop Eco-System

CO:3 Access and Process Data on Distributed File System

CO:4 Manage Job Execution in Hadoop Environment

CO:5 Develop Big Data Solutions using Hadoop Eco System

TEXT BOOKS:

1.Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley, 2014

2.Erik Brynjolfsson et al., The Second Machine Age: Work, Progress, and Prosperity in a Time of

Brilliant Technologies, W. W. Norton & Company, 2014.
REFERENCE BOOKS:
1. Dirk Deroos et al., Hadoop for Dummies, Dreamtech Press, 2014.
2. Chuck Lam, Hadoop in Action, December, 2010.
3. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, Cambridge University Press.

Data Mining Using R

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the data warehouse and OLAP technology
- To apply various data preprocessing techniques
- To recognize various data mining classification algorithms
- To recognize various data mining clustering algorithms
- To understand the Data Visualization

Unit 1 Data Warehouse	**9**

A Brief History, Characteristics, Architecture for a Data Warehouse. Fact and Dimension Tables, Data Mining: Introduction, Motivation, Importance, Knowledge Discovery Process, Data Mining Functionalities, Interesting Patterns, Classification of Data Mining Systems, Major issues, Data Preprocessing: Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization, Data Visualization, Outliers.

Unit 2 Data Mining Techniques	**9**

Statistical Perspective on Data Mining, Similarity Measures, Clustering- Requirement for Cluster Analysis, Clustering Methods, Decision Tree- Decision Tree Induction, Attribute Selection Measures, Tree Pruning. Association Rule Mining: Frequent Item-set Mining using Apriori Algorithm, Nearest Neighbour Classification: Performance of Nearest Neighbour Classifiers.

Unit 3 Data Analytics	**9**

Ways of Thinking About Data, Qualitative and Quantitative Data, And Data Strategies, Conceptualizing Data Analysis as a Process, Managing Data Analysis Process, Exploratory Data Analysis: Exploring a New Dataset, Summarizing Numeric Data, Anomalies in Numeric Data, Visualizing Relations between Variables. Working with External Data: Manual Data Entry, CSV Files, Other Files, Merging Data from Different Sources.

Unit 4 R Programming	**9**

Advantages of R over other Programming Languages, Working with Directories and Data Types in R, Control Statements, Loops, Data Manipulation and integration in R, Exploring Data in R: Data Frames, R Functions for Data in Data Frame, Loading Data Frames, Decision Tree packages in R.

Unit 5 Data Visualization	**9**

Data visualization -Examples and exercises in R -Reporting – Dynamic reports and presentations in R-Issues in Decision Tree Learning, Hierarchical and K-means Clustering functions in R, Mining Algorithm interfaces in R. .

TOTAL: 45 PERIODS
COURSE OUTCOMES: At the end of the course, the student will be able to,
CO1-Understand the data warehouse and OLAP technology
CO2-Apply various data preprocessing techniques
CO3-Identify appropriate data mining classification algorithms to solve real world problems
CO4-Identify appropriate data mining clustering algorithms to solve real world problems
CO5-Understand the Data Visualization
TEXT BOOKS:
1.Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Addison Wesley, 1st or 2nd edition, 2019.
2.An R Companion for Introduction to Data Mining by Michael Hahsler, 2021.
3.R for Data Science by Garrett Grolemund and Hadley Wickham, 2017.
4.Data Visualization: A practical introduction by Kieran Healy, 2019.
REFERENCE BOOKS:
1.Applied Predictive Modeling (with Examples using R and caret) by Max Kuhn and Kjell Johnson, Springer, 2013.

DEEP LEARNING USING TENSOR FLOW

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand Deep Learning
- To Understanding Neural Networks with TensorFlow
- To Understand Neural Networks
- To classify Master Deep Networks
- To apply Convolutional Neural Networks

Unit 1 Introduction to Deep Learning	**9**

Deep Learning: A revolution in Artificial Intelligence – Limitations of Machine Learning – What is Deep Learning? – Advantage of Deep Learning over Machine learning – 3 Reasons to go for Deep Learning – Real-Life use cases of Deep Learning – Review of Machine Learning: Regression, Classification, Clustering, Reinforcement Learning, Underfitting and Overfitting, Optimization

Unit 2Understanding Neural Networks with TensorFlow	**9**

How Deep Learning Works? – Activation Functions WhatsApp - +91-7530088009 – Illustrate Perceptron – Training a Perceptron – Important Parameters of Perceptron – What is TensorFlow? – TensorFlow code-basics – Graph Visualization – Constants, Placeholders, Variables – Creating a Model – Step by Step – Use-Case Implementation

Unit 3 Deep dive into Neural Networks with TensorFlow	**9**

Understand limitations of a Single Perceptron – Understand Neural Networks in Detail – Illustrate Multi-Layer Perceptron – Backpropagation – Learning Algorithm – Understand Backpropagation – Using Neural Network Example – MLP Digit-Classifier using TensorFlow – TensorBoard

Unit 4Master Deep Networks	**9**

Why Deep Networks – Why Deep Networks give better accuracy? – Use-Case Implementation on SONAR dataset – Understand How Deep Network Works? – How Backpropagation Works? – Illustrate Forward pass, Backward pass – Different variants of Gradient Descent – Types of Deep Networks

Unit 5 Convolutional Neural Networks (CNN)	**9**

Introduction to CNNs – CNNs Application – Architecture of a CNN – Convolution and Pooling layers in a CNN – Understanding and Visualizing a CNN

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1- understand the Deep Learning concepts

CO2-Understand the Neural Networks with TensorFlow
CO3-Understand theNeural Networks methods
CO4-classify the Master Deep Networks
CO5-apply Convolutional Neural Networks
TEXT BOOKS:
1.Antonio Gulli, Amita Kapoor, Sujit Pal, "Deep Learning with Tensorflow 2 and Keras", Second Edition, Packt Publishing, December 2019.
2.An R Companion for Introduction to Data Mining by Michael Hahsler, 2021.
3.R for Data Science by Garrett Grolemund and Hadley Wickham, 2017.
4.Data Visualization: A practical introduction by Kieran Healy, 2019.
REFERENCE BOOKS:
1.Yoshua Bengio and Ian J.Goodfellow and Aaron Courville, "Deep Learning", MIT Press, 2015.
2.Li Deng, Dong Yu, "Deep Learning: Methods and Applications", now publishers, 2014.
3.Special Issue on deep learning for speech and language processing, IEEE Transaction on Audio, Speech and Language Processing, vol. 18, iss. 5, 2010

PYTHON AND R PROGRAMMING FOR BIOTECHNOLOGISTS

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand basic elements of python and concepts on controlling program flow
- To solve problems by writing functions and using objects
- To explore fundamentals of bio python
- To handle data using R program
- To perform statistical analysis of biological data

Unit 1 R Introduction	**9**
Overview of R Programming-Downloading and installing-Help of Function-Viewing documentation-General issues in Rpackage Management.	
Unit 2 Data Inputing in R	**9**
Data Types-Subsetting-Writing data-Reading from csv files-Creating a vector and vector operation-Initializing data frame Control structure-Re-directing R Output	
Unit 3 Data Visualization	**9**
Creating bar chart and dot plot-Creating histogram and box plot-Plotting with base graphicsPlotting and coloring in R.	
Unit 4 Functions and Programming in R	**9**
Flow control: For loop-If condition-Debugging tools-List Management-Data Transformation-Merging Data Frames	
Unit 5 Statistical Modelling in R	**9**
Logical Regression-Hierarchical Clustering PCA for Dimensionality Reduction-Computing Basic Statistics-Comparing means of two samples-Testing a proportion-Data Munging Basics	

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1-Explain and use basic concepts in programming

CO2-Construct and execute basic programs in Python and R

CO3-Design and implement basic algorithms in Python and R

CO4-Use external libraries with Python and R-packages

CO5-Graphically 48isualize data and results of statistical calculations

TEXT BOOKS:

1.Stevens, T.J. and Boucher, W. (2005) Python Programming for Biology: Bioinformatics and Beyond,

Cambridge University Press; 1st edition, ISBN: 978-0521720090

2.Kinser, J., (2009), Python for Bioinformatics, Jones and Bartlett Learning, ISBN: 978-0763751869

3.Gardener, M., (2012). Beginning R: The Statistical Programming Language Wiley Publications(Wrox), ISBN: 978- 1-118-22616-2

REFERENCE BOOKS:

1.Jones, M. (2014), Advanced Python for Biologists. CreateSpace Independent Publishing Platform 1st edition. ISBN: 978-1495244377

2.Downey A. B. (2012), Think Python O'Reilly Media 1 edition ISBN: 978-1449330729

3.MacLean, D., R Bioinformatics Cookbook: Use R and Bioconductor to perform RNAseq, genomics, data visualization, and bioinformatic analysis, Packet Publishing, ISBN: 978-1789950694

Neural Networks and Deep Learning (NPTEL)					
Course Category : Programme Elective (NPTEL)	**Course Type: Theory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Week 1:					
Week 1: Introduction, human brain, models of a neuron, neural communication, neural networks as directed graphs, network architectures (feed-forward, feedback etc.), knowledge representation					
Week 2:					
Week 2: Learning processes, learning tasks, Perceptron, perceptron convergence theorem, relationship between perceptron and Bayes classifiers, batch perceptron algorithm					
Week 3					
Week 3: Modeling through regression, linear and logistic regression for multiple classes.					
Week 4:					
Week 4: Multilayer perceptron, batch and online learning, derivation of the back propagation algorithm, XOR problem, Role of Hessian in online learning, annealing and optimal control of learning rate					
Week 5:					
Week 5: Approximations of functions, cross-validation, network pruning and complexity regularization, convolution networks, non-linear filtering					
Week 6:					
Week 6: Cover's theorem and pattern separability, the interpolation problem, RBF networks, hybrid learning procedure for RBF networks, Kernel regression and relationship to RBFs.					
Week 7					
Week 7: Support vector machines, optimal hyperplane for linear separability, optimal hyperplane for nonseparable patterns, SVM as a kernel machine,design of SVMs, XOR problem revisted, robustness					
Week 8:					
Week 8: SVMs contd. Optimal solution of the linear regression problem, representer theorem and related discussions. Introduction to regularization theory					
Week 9:					
Week 9: Hadamard's condition for well-posedness, Tikhonov regularization, regularization networks, generalized RBF networks, estimation of regularization parameter etc					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to,					
CO1-Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.					
CO2-Implement deep learning algorithms and solve real-world problems.					
TEXT BOOKS					

T1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..

T2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCE BOOKS

R1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

R2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.

R3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004

INSTITUTE ELECTIVES

INTRODUCTION TO DATA STRUCTURES

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamental concepts of data structures and their applications
- Learn linear and non-linear data structures for efficient data organization
- Apply algorithms for searching, sorting, and manipulation of data
- Analyze time and space complexity of algorithms
- Develop problem-solving skills using appropriate data structures

UNIT 1: INTRODUCTION TO DATA STRUCTURES — **9**

Basic concepts – Data types – Abstract Data Types (ADT) – Algorithm analysis – Time and space complexity – Asymptotic notations (Big-O, Omega, Theta) – Arrays – Operations on arrays – Applications of arrays.

UNIT 2: STACKS AND QUEUES — **9**

Stack – Definition and operations (push, pop, peek) – Applications of stack (expression evaluation, recursion) – Queue – Types of queues (Simple queue, Circular queue, Priority queue, Deque) – Applications of queues – Implementation using arrays and linked lists.

UNIT 3: LINKED LISTS — **9**

Linked list – Types (Singly, Doubly, Circular) – Operations (insertion, deletion, traversal) – Applications of linked lists – Memory representation – Polynomial representation using linked lists.

UNIT 4: TREES — **9**

Tree terminology – Binary trees – Tree traversals (inorder, preorder, postorder) – Binary Search Tree (BST) – Operations on BST – Heap – Heap operations – Applications of trees.

UNIT 5: GRAPHS AND SORTING TECHNIQUES — **9**

Graph representation (adjacency matrix, adjacency list) – Graph traversal (BFS, DFS) – Shortest path algorithms – Sorting techniques (Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort) – Searching techniques (Linear search, Binary search).

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1:Understand the major objectives of database technology

CO2:Understand the relational model for databases

CO3: Design issues of Database

CO4: Identify the problems in Transaction

CO5:Analyze the issues involved in Implementation

TEXT BOOKS:

1. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C (2nd Edition)*, Pearson, **2014**
2. Reema Thareja, *Data Structures Using C (2nd Edition)*, Oxford University Press, **2014**
3. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, *Fundamentals of Data Structures in C*, Universities Press, **2008**
4. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, *Data Structures Using C*, Pearson, **2009**

REFERENCE BOOKS:

1. Thomas H. Cormen et al., *Introduction to Algorithms (3rd Edition)*, MIT Press, **2009**
2. Seymour Lipschutz, *Data Structures (Schaum's Outline Series)*, McGraw-Hill, **2017**
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, *Data Structures and Algorithms in C++*, Wiley, **2014**
4. Robert Lafore, *Data Structures and Algorithms in Java (2nd Edition)*, Sams Publishing, **2003**

INTRODUCTION TO ALGORITHMS

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamental concepts of algorithms and problem-solving techniques
- Learn various algorithm design strategies
- Analyze the efficiency of algorithms using time and space complexity
- Apply algorithms to solve real-world computational problems
- Develop logical thinking and optimization skills

UNIT 1: INTRODUCTION TO ALGORITHMS — **9**

Definition of algorithm – Characteristics – Algorithm design and analysis – Performance analysis – Time and space complexity – Best, average, worst cases – Asymptotic notations (Big-O, Omega, Theta) – Problem-solving techniques.

UNIT 2: ALGORITHM DESIGN TECHNIQUES — **9**

Divide and Conquer – Greedy method – Dynamic Programming – Backtracking – Branch and Bound – Comparison and applications of design techniques.

UNIT 3: SEARCHING AND SORTING ALGORITHMS — **9**

Linear search – Binary search – Bubble sort – Selection sort – Insertion sort – Merge sort – Quick sort – Heap sort – Performance analysis and comparison.

UNIT 4: GRAPH ALGORITHMS — **9**

Graph representation – BFS – DFS – Minimum Spanning Tree (Prim's and Kruskal's algorithms) – Shortest path algorithms (Dijkstra's algorithm) – Applications of graphs.

UNIT 5: ADVANCED ALGORITHMS — **9**

String matching algorithms – Introduction to NP problems – P, NP, NP-Complete – Approximation algorithms – Randomized algorithms – Introduction to parallel algorithms.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand algorithm design principles and complexity analysis

CO2: Apply suitable algorithm design techniques

CO3: Implement efficient searching and sorting algorithms

CO4: Solve problems using graph algorithms

CO5: Understand advanced algorithm concepts and complexity classes

TEXT BOOKS:

1. Introduction to Algorithms, MIT Press, 2022
2. Introduction to the Design and Analysis of Algorithms, Pearson, 2023
3. Algorithms, Addison-Wesley, 2011 (widely used current edition)
4. Algorithm Design Manual, Springer, 2020

REFERENCE BOOKS:

1. Algorithm Design, Pearson (latest reprint)
2. Algorithms Illuminated, Soundlikeyourself Publishing, 2017–2020
3. Algorithmics: The Spirit of Computing, Springer, 2020
4. Grokking Algorithms, Manning, 2024

SOFTWARE ENGINEERING

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamental principles of software engineering
- Learn software development life cycle (SDLC) models and methodologies
- Apply requirement analysis and design techniques
- Understand software testing and quality assurance practices
- Develop skills to manage software projects effectively

UNIT 1: INTRODUCTION TO SOFTWARE ENGINEERING — **9**

Software engineering – Definition – Software characteristics – Software crisis – Software process – Generic process framework – SDLC models (Waterfall, Incremental, Spiral, Agile) – Process maturity models – Introduction to DevOps.

UNIT 2: REQUIREMENT ENGINEERING — **9**

Requirement engineering process – Feasibility study – Requirement elicitation – Requirement analysis – Requirement specification (SRS) – Functional and non-functional requirements – Requirement validation – Requirement management.

UNIT 3: SYSTEM DESIGN — **9**

Design concepts – Design principles – Architectural design – Data design – Interface design – Component-level design – UML diagrams (Use case, Class, Sequence, Activity diagrams) – Design patterns.

UNIT 4: SOFTWARE TESTING — **9**

Testing fundamentals – Verification and validation – Levels of testing (Unit, Integration, System, Acceptance) – Testing techniques (Black-box, White-box) – Test case design – Debugging – Automated testing – Software quality assurance.

UNIT 5: SOFTWARE PROJECT MANAGEMENT — **9**

Project planning – Project scheduling – Risk management – Cost estimation models (COCOMO) – Software configuration management – Version control – Maintenance and evolution – Software metrics.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand software development processes and models

CO2: Perform requirement analysis and prepare SRS documents

CO3: Design software systems using appropriate techniques

CO4: Apply testing strategies to ensure software quality

CO5: Manage software projects and evaluate risks effectively

TEXT BOOKS:

1. Software Engineering: A Practitioner's Approach, McGraw-Hill, 2020
2. Software Engineering, Pearson, 2015
3. Fundamentals of Software Engineering, PHI Learning, 2018
4. Software Engineering, New Age International

REFERENCE BOOKS:

1. The Mythical Man-Month, Addison-Wesley
2. Clean Code, Prentice Hall
3. Design Patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley
4. Agile Software Development Principles Patterns and Practices, Pearson

BASICS OF SOFTWARE TESTING

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals and importance of software testing
- Learn various testing techniques and strategies
- Apply different levels and types of testing
- Understand test design techniques and test case development
- Analyze defects and ensure software quality

UNIT 1: INTRODUCTION TO SOFTWARE TESTING — **9**

Introduction – Definition and objectives – Software quality – Need for testing – Errors, faults, and failures – Principles of software testing – Testing lifecycle – Verification vs Validation – Overview of testing process.

UNIT 2: LEVELS AND TYPES OF TESTING — **9**

Levels of testing – Unit testing – Integration testing – System testing – Acceptance testing – Types of testing – Functional testing – Non-functional testing – Regression testing – Smoke and sanity testing.

UNIT 3: TEST DESIGN TECHNIQUES — **9**

Test case design – Black box testing – Equivalence partitioning – Boundary value analysis – Decision table testing – White box testing – Statement coverage – Branch coverage – Path testing.

UNIT 4: TEST MANAGEMENT AND TOOLS — **9**

Test planning – Test strategy – Test case preparation – Test execution – Defect life cycle – Bug tracking – Test documentation – Introduction to testing tools – Overview of automation testing.

UNIT 5: ADVANCED TOPICS IN TESTING — **9**

Performance testing – Load testing – Stress testing – Security testing – Usability testing – Introduction to automation tools – Basics of Selenium – Continuous testing – Agile testing concepts.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand the fundamentals and importance of software testing

CO2: Apply different levels and types of testing

CO3: Design test cases using various testing techniques

CO4: Manage testing activities and defect tracking

CO5: Understand advanced testing concepts and tools

TEXT BOOKS:

1. Software Testing: Principles and Practices, Second Edition, Pearson Education, 2011.
2. Foundations of Software Testing, Fourth Edition, Cengage Learning, 2018.

REFERENCE BOOKS:

1. Software Testing, Second Edition, Sams Publishing, 2005.
2. Effective Software Testing, Addison-Wesley, 2002.
3. Introduction to Software Testing, Second Edition, Cambridge University Press, 2016.
4. Agile Testing: A Practical Guide for Testers and Agile Teams, Addison-Wesley, 2009.

FOUNDATION OF BIG DATA ANALYTICS

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals and importance of big data analytics
- Learn big data technologies and distributed computing frameworks
- Apply data processing techniques using big data tools
- Analyze data using statistical and analytical methods
- Explore real-world applications of big data analytics

UNIT 1: INTRODUCTION TO BIG DATA — **9**

Introduction to Big Data – Characteristics of Big Data (5Vs) – Types of data – Sources of big data – Traditional data vs big data – Challenges in big data – Big data architecture – Overview of data analytics lifecycle – Applications of big data.

UNIT 2: BIG DATA TECHNOLOGIES AND FRAMEWORKS — **9**

Distributed computing concepts – Hadoop ecosystem – Hadoop Distributed File System (HDFS) – MapReduce framework – YARN architecture – Introduction to Apache Spark – Comparison of Hadoop and Spark – NoSQL databases (MongoDB, Cassandra)

UNIT 3: DATA PROCESSING AND ANALYTICS — **9**

Data ingestion – Data cleaning and preprocessing – Data transformation – Batch processing vs stream processing – Introduction to Spark RDD and DataFrames – Basic analytics using big data tools – Data visualization techniques.

UNIT 4: ADVANCED ANALYTICS AND MACHINE LEARNING — **9**

Statistical analysis – Descriptive and predictive analytics – Introduction to machine learning in big data – Classification and clustering – Regression techniques – Recommendation systems – Real-time analytics.

UNIT 5: BIG DATA APPLICATIONS AND SECURITY — **9**

Applications in healthcare, finance, social media, and e-commerce – Big data security and privacy issues – Data governance – Ethical issues in big data – Case studies – Future trends in big data analytics.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand concepts and characteristics of big data

CO2: Explain big data frameworks and technologies

CO3: Perform data processing and basic analytics

CO4: Apply analytical and machine learning techniques on big data

CO5: Analyze real-world applications and challenges in big data
TEXT BOOKS:
1. Tom White, *Hadoop: The Definitive Guide (4th Edition)*, O'Reilly, **2015** 2. Seema Acharya, Subhasini Chellappan, *Big Data Analytics*, Wiley, **2015** 3. Anand Rajaraman, Jeffrey David Ullman, *Mining of Massive Datasets*, Cambridge University Press, **2012** 4. Bill Chambers, Matei Zaharia, *Spark: The Definitive Guide*, O'Reilly, **2018**
REFERENCE BOOKS:

1. Nathan Marz, James Warren, *Big Data: Principles and Best Practices of Scalable Realtime Data Systems*, Manning, **2015**
2. Viktor Mayer-Schönberger, Kenneth Cukier, *Big Data: A Revolution That Will Transform How We Live, Work, and Think*, Eamon Dolan/Houghton Mifflin Harcourt, **2013**
3. Jules J. Berman, *Principles of Big Data: Preparing, Sharing, and Analyzing Complex Information*, Morgan Kaufmann, **2013**
4. Foster Provost, Tom Fawcett, *Data Science for Business*, O'Reilly, **2013**

FUNDAMENTALS OF DEEP LEARNING

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basic concepts and evolution of deep learning
- Learn neural network architectures and training mechanisms
- Apply optimization techniques for deep learning models
- Analyze convolutional and recurrent neural networks
- Explore real-world applications of deep learning

UNIT 1: INTRODUCTION TO DEEP LEARNING — **9**

Introduction to Deep Learning – History and evolution of neural networks – Biological neuron vs artificial neuron – Perceptron learning – Activation functions (Sigmoid, ReLU, Tanh) – Loss functions – Basics of neural network architecture – Forward propagation.

UNIT 2: NEURAL NETWORK TRAINING — **9**

Gradient descent optimization – Backpropagation algorithm – Learning rate and optimization techniques (SGD, Adam) – Overfitting and regularization – Dropout – Batch normalization – Weight initialization techniques – Training deep neural networks.

UNIT 3: CONVOLUTIONAL NEURAL NETWORKS (CNN) — **9**

Introduction to CNN – Convolution operation – Pooling layers – Feature maps – CNN architecture – Popular CNN models (LeNet, AlexNet, VGG) – Image classification using CNN – Transfer learning basics – Applications of CNN in computer vision.

UNIT 4: RECURRENT NEURAL NETWORKS (RNN) — **9**

Introduction to sequence data – RNN architecture – Vanishing and exploding gradients – LSTM (Long Short-Term Memory) – GRU (Gated Recurrent Unit) – Sequence modeling – Applications in NLP and time series prediction – Encoder-decoder models.

UNIT 5: ADVANCED DEEP LEARNING AND APPLICATIONS — **9**

Autoencoders – Generative models (GAN basics) – Deep Reinforcement Learning introduction – Transfer learning – Fine-tuning pre-trained models – Applications in healthcare, speech recognition, and computer vision – Ethical issues in deep learning.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand fundamentals of deep learning and neural networks

CO2: Apply optimization and training techniques

CO3: Design convolutional neural networks for image tasks

CO4: Analyze recurrent neural networks for sequence data

CO5: Apply deep learning techniques to real-world problems

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, **2016**
2. Charu C. Aggarwal, *Neural Networks and Deep Learning*, Springer, **2018**
3. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow (3rd Edition)*, O'Reilly, **2022**
4. Michael Nielsen, *Neural Networks and Deep Learning*, Determination Press, **2015**

REFERENCE BOOKS:

1. Francois Chollet, *Deep Learning with Python (2nd Edition)*, Manning, **2021**
2. Seth Weidman, *Deep Learning from Scratch*, O'Reilly, **2019**
3. Simon J.D. Prince, *Understanding Deep Learning*, MIT Press, **2023**
4. Kevin P. Murphy, *Probabilistic Machine Learning*, MIT Press, **2022**

COMPUTER VISION BASICS						
Course Category: Institute Elective	**Course Type: Theory**	**L**	**T**	**P**	**C**	
		3	**0**	**0**	**3**	
COURSE OBJECTIVES:						

- Understand fundamental concepts of computer vision and image processing
- Learn techniques for image representation, filtering, and feature extraction
- Apply algorithms for object detection and image segmentation
- Analyze motion, tracking, and pattern recognition methods
- Explore applications of deep learning in computer vision

UNIT 1: INTRODUCTION TO COMPUTER VISION	**9**

Introduction to Computer Vision – Applications of Computer Vision – Image formation and image models – Digital image representation – Sampling and quantization – Image acquisition – Color models (RGB, HSV, Grayscale) – Basic image operations – Introduction to OpenCV.

UNIT 2: IMAGE PROCESSING AND FILTERING	**9**

Image enhancement – Spatial domain filtering – Smoothing filters (mean, Gaussian) – Sharpening filters – Edge detection (Sobel, Prewitt, Canny) – Frequency domain concepts – Fourier transform – Noise removal techniques – Histogram equalization.

UNIT 3: FEATURE EXTRACTION AND TRANSFORMATION	**9**

Feature detection – Corner detection (Harris) – Blob detection – Scale-Invariant Feature Transform (SIFT) – Speeded-Up Robust Features (SURF) – Feature matching – Image transformations – Geometric transformations – Homography.

UNIT 4: IMAGE SEGMENTATION AND OBJECT DETECTION	**9**

Segmentation techniques – Thresholding – Region-based segmentation – Edge-based segmentation – Clustering methods (k-means) – Object detection – Template matching – Introduction to Haar cascades – Basics of object recognition.

UNIT 5: MOTION ANALYSIS AND DEEP LEARNING	**9**

Motion detection – Optical flow – Object tracking – Background subtraction – Introduction to Convolutional Neural Networks (CNN) – Image classification using CNN – Transfer learning – Applications of deep learning in computer vision.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand basic concepts of computer vision and image processing

CO2: Apply filtering and enhancement techniques on images

CO3: Extract and match image features

CO4: Perform image segmentation and object detection

CO5: Apply deep learning techniques for vision-based applications

TEXT BOOKS:

5. Richard Szeliski, *Computer Vision: Algorithms and Applications (2nd Edition)*, Springer, **2022**
6. Simon J. D. Prince, *Computer Vision: Models, Learning, and Inference (2nd Edition)*, Cambridge University Press, **2023**
7. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing (4th Edition)*, Pearson, **2018**
8. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly, **2012**

REFERENCE BOOKS:

5. David A. Forsyth, Jean Ponce, *Computer Vision: A Modern Approach (2nd Edition)*, Pearson, **2012**
6. Mark Nixon, Alberto Aguado, *Feature Extraction and Image Processing for Computer Vision (4th Edition)*, Academic Press, **2019**
7. Adrian Kaehler, Gary Bradski, *Learning OpenCV 4*, O'Reilly, **2017**
8. .Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, **2016**

MACHINE LEARNING FUNDAMENTALS

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basic concepts and applications of machine learning
- Learn different types of learning methods and algorithms
- Apply data preprocessing and feature engineering techniques
- Analyze model performance and evaluation metrics
- Develop simple machine learning models for real-world problems

UNIT 1: INTRODUCTION TO MACHINE LEARNING — **9**

Introduction – Definition and scope – Types of machine learning (Supervised, Unsupervised, Reinforcement learning) – Applications of machine learning – Data representation – Types of data – Introduction to Python for ML – ML workflow.

UNIT 2: DATA PREPROCESSING AND FEATURE ENGINEERING — **9**

Data cleaning – Handling missing values – Data transformation – Normalization and standardization – Feature selection – Feature extraction – Dimensionality reduction – Introduction to Principal Component Analysis (PCA).

UNIT 3: SUPERVISED LEARNING — **9**

Regression – Linear regression – Logistic regression – Classification – k-Nearest Neighbors (k-NN) – Decision Trees – Support Vector Machines (SVM) – Model training and validation.

UNIT 4: UNSUPERVISED LEARNING — **9**

Clustering – k-Means clustering – Hierarchical clustering – Density-based clustering (DBSCAN) – Association rule mining – Dimensionality reduction techniques – Applications of unsupervised learning.

UNIT 5: MODEL EVALUATION AND ADVANCED TOPICS — **9**

Model evaluation metrics (Accuracy, Precision, Recall, F1-score) – Confusion matrix – Cross-validation – Bias-variance tradeoff – Overfitting and underfitting – Introduction to Ensemble methods (Bagging, Boosting) – Basics of Neural Networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to,

CO1: Understand core concepts and types of machine learning

CO2: Apply preprocessing and feature engineering techniques

CO3: Implement supervised learning algorithms

CO4: Apply unsupervised learning techniques for data analysis

CO5: Evaluate model performance and understand advanced ML concepts

TEXT BOOKS:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Third Edition, O'Reilly Media, 2023.
2. Machine Learning with Python, Second Edition, Packt Publishing, 2019.
3. Introduction to Machine Learning with Python, First Edition, O'Reilly Media, 2016.

REFERENCE BOOKS:

1. Pattern Recognition and Machine Learning, First Edition, Springer, 2006.
2. The Elements of Statistical Learning, Second Edition, Springer, 2009.

3. Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
4. Deep Learning, MIT Press, 2016.