CARE COLLEGE OF ENGINEERING
(An Autonomous Institution)

Approved AICTE New Delhi | Affiliated to Anna University Chennai
No 27, Thayanur, Tiruchirappalli 620 009

Regulations 2024
Undergraduate Degree
B.Tech. Artificial Intelligence and Data Science
Full Time Programmes
Curriculum and Syllabus

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Chairperson
Board of Studies

HEAD
Dept. of AI & DS
CARE College of Engineering
Trichy - 620 009.

Principal

Principal
CARE College of Engineering (Autonomous)
No. 27, Thayanur, Trichy - 620 009.

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Department of Artificial Intelligence and Data Science

Institute Vision

Transform Lives through Education and Research.

Institute Mission

To impart quality education to students through critical thinking, creativity, leadership and spirit of entrepreneurship**.**

Institute Values

We develop in each member the ability and passion to work effectively for the betterment of humanity with cultural awareness, high ethical and moral values and a sense of social responsibility.

Department Vision

Produce globally recognized AI specialists and Data analysts.

Department Mission

1. To impart quality education and research in AI and Data Science.
2. To inculcate creative and leadership skills for solving real world problems.
3. To foster innovative professionals with values for the wellbeing society.

CARE COLLEGE OF ENGINEERING, TIRUCHIRAPPALLI 620 009

(AN AUTONOMOUS INSTITUTION)

REGULATION 2024 CURRICULUM AND SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Program Educational Objectives (PEOs)

PEO1: Design AI based solutions to solve critical real-world problems.
PEO2: Pursue higher education and research or have a successful carrier or as entrepreneur.
PEO3: Attain professional skills by ensuring lifelong learning with the sense of social values.

Knowledge and Attitude Profile (WK)

WK1 (**Natural Science):** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2 (Mathematics and Modelling): Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3 (Engineering Fundamentals): A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4 (Engineering Specialization): Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5 (Environmental impact on design and practice): Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6 (Newer Practical Knowledge): Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7 (Engineer role and responsibility in Society): Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8 (Critical Thinking and Creativity): Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9 (Ethics and Diversity): Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes: On completion of the program, the graduates will be able to

PO1 Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2 Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3 Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4 Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5 Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6 The Engineer and the World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7 Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8 Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9 Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10 Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11 Life-Long Learning: Recognize the need for, and have the preparation and ability for

(i) independent and life-long learning
(ii) adaptability to new and emerging technologies and
(iii) critical thinking in the broadest context of technological change (WK8).

Program Specific Outcomes (PSOs)

PSO1 : Applying AI principles and practices for developing innovative solutions to the society
PSO2: To adapt the emerging technologies and tools for solving the existing/novel problems.



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(AN AUTONOMOUS INSTITUTION)
REGULATIONS 2024
CHOICE BASED CREDIT SYSTEM
B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
CURRICULUM AND SYLLABI FOR I TO VIII SEMESTERS
SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MA111	Matrices and Calculus	BSC	3	1	0	4	4	40	60
2	U24GE111	Problem Solving using Python	ESC	3	0	0	3	3	40	60
3	U24HS111	Heritage of Tamils	HSMC	1	0	0	1	1	40	60
THEORY CUM PRACTICAL COURSES										
4	U24HS123	Communicative English for Engineers	HSMC	3	0	2	5	4	50	50
5	U24PH113	Engineering Physics	BSC	3	0	2	5	4	50	50
6	U24CY113	Engineering Chemistry	BSC	3	0	2	5	4	50	50
PRACTICAL COURSES										
7	U24GE122	Problem Solving using Python Laboratory	ESC	0	0	4	4	2	60	40
				16	**1**	**10**	**27**	**22**		

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MA221	Discrete Mathematics	BSC	3	1	0	4	4	40	60
2	U24PH221	Physics for Information Science	BSC	3	0	0	3	3	40	60
3	U24EC221	Digital Principles and Computer Organization	ESC	3	0	0	3	3	40	60
4	U24CS211	C Programming	ESC	3	0	0	3	3	40	60
5	U24HS211	Tamils and Technology	HSMC	1	0	0	1	1	40	60
THEORY CUM PRACTICAL COURSES										
6	U24HS223	Technical English for Engineers	HSMC	2	0	2	4	3	50	50
PRACTICAL COURSES										
7	U24EE232	Engineering Practices for Circuit Branches	ESC	0	0	4	4	2	60	40
8	U24CS222	C Programming Laboratory	ESC	0	0	4	4	2	60	40
9	U24EM212	Professional Development	EEC	0	0	2	2	1	100	NIL
				15	**1**	**12**	**28**	**22**		

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MA341	Probability and Statistics	BSC	3	1	0	4	4	40	60
2	U24CS321	Data Structures	PCC	3	0	0	3	3	40	60
3	U24AD311	Computer Networks	PCC	3	0	0	3	3	40	60
4	U24CS331	Object Oriented Programming using Java	PCC	3	0	0	3	3	40	60
THEORY CUM PRACTICAL COURSES										
5	U24AD323	Data Exploration and Visualization	PCC	3	0	2	5	4	50	50
PRACTICAL COURSES										
6	U24CS352	Data Structures Laboratory	PCC	0	0	4	4	2	60	40
7	U24CS362	Object Oriented Programming Laboratory	PCC	0	0	4	4	2	60	40
8	U24EM312	Design Thinking and Innovation	EEC	0	0	2	2	1	100	NIL
				15	**1**	**12**	**28**	**22**		

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MA411	Numerical Methods	BSC	3	1	0	4	4	40	60
2	U24AD411	Intelligent Systems	PCC	3	0	0	3	3	40	60
3	U24CS421	Data Base Management Systems	PCC	3	0	0	3	3	40	60
4	U24CS441	Design and Analysis of Algorithms	PCC	3	0	0	3	3	40	60
5	U24EM411	Aptitude and Reasoning – I	EEC	1	0	0	1	1	100	-
THEORY CUM PRACTICAL COURSES										
6	U24CS453	Web Technologies	PCC	1	0	4	5	3	50	50
PRACTICAL COURSES										
7	U24AD422	Intelligent Systems Laboratory	PCC	0	0	4	4	2	60	40
8	U24CS462	Data Base Management Systems Laboratory	PCC	0	0	4	4	2	60	40
9	U24CS482	Design and Analysis of Algorithms Laboratory	PCC	0	0	4	4	2	60	40
10	U24EM422	Soft skills and Personality Development – I	EEC	0	0	2	2	1	100	-
				14	**1**	**18**	**33**	**24**		

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24AD511	Machine Learning	PCC	3	0	0	3	3	40	60
2	U24AD521	Data Science and Analytics	PCC	3	0	0	3	3	40	60
3	U24AD531	Cryptography and Cyber Security	PCC	3	0	0	3	3	40	60
4	U24EM511	Aptitude and Reasoning- II	EEC	2	0	0	2	2	100	-
5	U24EM521	Leadership and Team Management	EEC	2	0	0	2	2	40	60
6		Professional Elective-I	PEC							
THEORY CUM PRACTICAL COURSES										
7	U24CS533	Embedded Systems and IoT System Design	PCC	1	0	4	5	3	50	50
PRACTICAL COURSES										
8	U24AD542	Machine Learning Laboratory	PCC	0	0	4	4	2	60	40
9	U24AD552	Data Science and Analytics Laboratory	PCC	0	0	4	4	2	60	40
10	U24EM532	Soft skill and Personality Development – II	EEC	0	0	2	2	1	100	-

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24CS611	Cloud Computing	PEC	3	0	0	3	3	40	60
2	U24AD611	Deep Learning	PCC	3	0	0	3	3	40	60
3	U24MG611	Project Management	HSMC	2	0	0	2	2	40	60
4	U24MG621	Entrepreneurship	EEC	2	0	0	2	2	40	60
5		Professional Elective-II	PEC							
6		Professional Elective-III	PEC							
7		Open Elective-I	OEC							
8		Mandatory Course-I*	MC	2	0	0	2	0	100	-
PRACTICAL COURSES										
9	U24CS632	Cloud Computing Laboratory	PCC	0	0	4	4	2	60	40
10	U24AD622	Deep Learning Laboratory	PCC	3	0	2	5	2	60	40

*** Mandatory Course (Non-CGPA Course)**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MG711	Human Values and Ethics	HSMC	2	0	0	2	2	40	60
2	U24MG721	Total Quality Management	HSMC	3	0	0	3	3	40	60
3		Professional Elective-IV	PEC	3	0	0	3	3	40	60
4		Professional Elective-V	PEC	3	0	0	3	3	40	60
5		Professional Elective-VI	PEC	3	0	0	3	3	40	60
6		Open Elective-II	OEC	3	0	0	3	3	40	60
7		Mandatory Course-II**	MC	2	0	0	2	0	100	-
PRACTICAL COURSES										
8	U24AD712	Mini Project	EEC	0	0	4	4	2	60	40
9	U24AD722	Summer Internship*	EEC	0	0	4	4	2	100	-

***During Summer Holidays (4 Weeks)**

**** Mandatory Course (Non-CGPA Course)**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
PRACTICAL COURSES										
1	U24AD812	Capstone Project /Industry Internship	EEC	0	0	16	16	8	60	40
				0	**0**	**16**	**16**	**8**		

PROFESSIONAL ELECTIVES

VERTICAL 1: FULL STACK DEVELOPMENT

(Common to B.E. Computer Science and Engineering)

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSFS01	Agile Software Development	PEC	3	0	0	3	3	40	60
2	U24CSFS02	UI and UX Design	PEC	1	0	4	5	3	50	50
3	U24CSFS03	App Development	PEC	1	0	4	5	3	50	50
4	U24CSFS04	Cloud Services Management	PEC	2	0	2	4	3	50	50
5	U24CSFS05	Devops	PEC	2	0	2	4	3	50	50
6	U24CSFS06	Web Application Security	PEC	2	0	2	4	3	50	50
7	U24CSFS07	Software Testing and Automation	PEC	2	0	2	4	3	50	50

VERTICAL 2: COMPUTATIONAL INTELLIGENCE

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSML03	Text and Speech Analysis	PEC	2	0	2	4	3	50	50
2	U24CSML04	Computer Vision	PEC	3	0	0	3	3	40	60
3	U24CSML05	Generative AI Fundamentals	PEC	3	0	0	3	3	40	60
4	U24CSML06	Game Theory	PEC	2	0	2	4	3	50	50
5	U24ADCI01	Recommender Systems	PEC	3	0	0	3	3	40	60
6	U24ADCI02	AI in Block Chain	PEC	3	0	0	3	3	40	60
7	U24ADCI03	Reinforcement Learning	PEC	2	0	2	4	3	50	50

VERTICAL 3: DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24ADDA01	Data warehousing	PEC	2	0	2	4	3	50	50
2	U24ADDA02	Social Network Analytics	PEC	3	0	0	3	3	40	60
3	U24ADDA03	Business Analytics	PEC	3	0	0	3	3	40	60
4	U24ADDA04	Cognitive Science and Analytics	PEC	3	0	0	3	3	40	60
5	U24ADDA05	Knowledge Engineering	PEC	2	0	2	4	3	50	50
6	U24ADDA06	Health Care Analytics	PEC	3	0	0	3	3	40	60
7	U24ADDA07	Stream Processing and Analytics	PEC	2	0	2	4	3	50	50

VERTICAL 4: EMERGING TECHNOLOGIES

(Common to B.E. Computer Science and Engineering)

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSET01	Game Development	PEC	2	0	2	4	3	50	50
2	U24CSET02	Augmented Reality/Virtual Reality	PEC	2	0	2	4	3	50	50
3	U24CSET03	Robotic Process Automation	PEC	2	0	2	4	3	50	50
4	U24CSET04	Quantum Computing	PEC	3	0	0	3	3	40	60
5	U24CSET05	Soft Computing	PEC	3	0	0	3	3	40	60
6	U24CSET06	Industrial IOT	PEC	3	0	0	3	3	40	60
7	U24CSET07	Digital marketing	PEC	1	0	4	5	3	50	50



OPEN ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24OECS001	Data Science Fundamentals	OEC	2	0	2	4	3	50	50
2	U24OECS002	Artificial Intelligence and Machine Learning Foundation	OEC	2	0	2	4	3	50	50
3	U24OECS003	AR/VR Fundamentals	OEC	3	0	0	3	3	40	60
4	U24OECS004	UI / UX Design Foundation	OEC	1	0	4	5	3	50	50
5	U24OECS005	App Development Fundamentals	OEC	1	0	4	5	3	50	50

MANDATORY COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24MC11	Disaster Risk Reduction and Management	MC	3	0	0	3	0	100	-
2	U24MC21	Environmental Science	MC	3	0	0	3	0	100	-
3	U24MC31	History of Science and Technology in India	MC	3	0	0	3	0	100	-
4	U24MC41	Personal Finance	MC	3	0	0	3	0	100	-
5	U24MC51	Well-Being with Traditional Practices- Yoga, Ayurveda and Siddha	MC	3	0	0	3	0	100	-

SUMMARY

B.Tech. Artificial Intelligence and Data Science										
S. No	Course Category	Credit per semester								Total Credit
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	5	4				2	5		16
2	BSC	12	7	4	4					27
3	ESC	5	10							15
4	PCC			17	18	16	7			58
5	PEC					3	9	9		21
6	OEC						3	3		6
7	EEC		1	1	2	5	2	4	8	23
Total		**22**	**22**	**22**	**24**	**24**	**23**	**21**	**8**	**166**

VERTICALS FOR MINOR DEGREE

VERTICAL – I BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24MNBA01	Statistics for Management	PEC	3	0	0	3	3	40	60
2	U24MNBA02	Datamining for Business Intelligence	PEC	3	0	0	3	3	40	60
3	U24MNBA03	Human Resource Analytics	PEC	3	0	0	3	3	40	60
4	U24MNBA04	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3	40	60
5	U24MNBA05	Operation and Supply Chain Analytics	PEC	3	0	0	3	3	40	60
6	U24MNBA06	Financial Analytics	PEC	3	0	0	3	3	40	60

VERTICAL – II PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24MNPA01	Principles of Public Administration	PEC	3	0	0	3	3	40	60
2	U24MNPA02	Constitution of India	PEC	3	0	0	3	3	40	60
3	U24MNPA03	Public Personnel Administration	PEC	3	0	0	3	3	40	60
4	U24MNPA04	Administrative Theories	PEC	3	0	0	3	3	40	60
5	U24MNPA05	Indian Administrative System	PEC	3	0	0	3	3	40	60
6	U24MNPA06	Public Policy Administration	PEC	3	0	0	3	3	40	60

CURRICULUM AND SYLLABI

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MA111	Matrices and Calculus	BSC	3	1	0	4	4	40	60
2	U24GE111	Problem Solving using Python	ESC	3	0	0	3	3	40	60
3	U24HS111	Heritage of Tamils	HSMC	1	0	0	1	1	40	60
THEORY CUM PRACTICAL COURSES										
4	U24HS123	Communicative English for Engineers	HSMC	3	0	2	5	4	50	50
5	U24PH113	Engineering Physics	BSC	3	0	2	5	4	50	50
6	U24CY113	Engineering Chemistry	BSC	3	0	2	5	4	50	50
PRACTICAL COURSES										
7	U24GE122	Problem Solving using Python Laboratory	ESC	0	0	4	4	2	60	40
				16	**1**	**10**	**27**	**22**		

ASSESSMENT SCHEME

Sl. No	Course Type	L	T	P	C	CIA Weightage (Theory)				CIA	ESE		CIA (W)	ESE (W)	Min. Marks to Pass for 100	
						T1	A1	T2	A2	Prac	Th	Prac			ESE	Total
1	U24MA111	3	1	0	4	60	40	60	40	-	100		40	60	45	50
2	U24GE111	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	U24HS111	1	0	0	1	60	40	60	40	-	100		40	60	45	50
4	U24HS123	3	0	2	4	60	40	60	40	100	70	30	50	50	45	50
5	U24PH113	3	0	2	4	60	40	60	40	100	70	30	50	50	45	50
6	U24CY113	3	0	2	4	60	40	60	40	100	70	30	50	50	45	50
7	U24GE122	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50

(W) – Weightage

U24MA111	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

Course Objective:

- To develop the use of matrix algebra techniques those are needed to engineers for practical applications.
- To familiarize the students with differential calculus.
- To introduce the methods of solving linear and nonlinear ordinary differential equations.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.

Detailed Syllabus

UNIT I MATRICES	**9+3**
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications : Stretching of an elastic membrane	
UNIT II DIFFERENTIAL CALCULUS	**9+3**
Functions of single variable – Limit of the function- Continuity and Differentiability - Mean value Theorems - Partial derivatives - Total derivative - Taylor series (in one and two variables) - Maxima and Minima (in one and two variables).	
UNIT III ORDINARY DIFFERENTIAL EQUATION	**9+3**
Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.	
UNIT IV INTEGRAL CALCULUS	**9+3**
Evaluation of definite and improper integrals - Change of order of integration - Double integrals in polar coordinates - Area enclosed by plane curves - Triple integrals.	
UNIT V VECTOR CALCULUS	**9+3**
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.	
	Total Periods:60

Learning Resources

1	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 44th Edition, New Delhi, 2015.
2	Erwin Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016
3	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016

4	Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply the matrix algebra methods for solving practical problems.	Apply
CO2	Apply differential calculus tools in solving various Engineering problems.	Apply
CO3	Apply various techniques in solving differential equations.	Apply
CO4	Apply double and triple integration techniques in solving areas and volumes.	Apply
CO5	Evaluate of line, surface and volume integrals using Gauss, Stokes and Green's Theorems.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24GE111	**PROBLEM SOLVING USING PYTHON**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- 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.

Detailed Syllabus

UNITI 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, flowchart, 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 sorted cards, guess an integer number in a range, Towers of Hanoi.	
UNIT II 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 III 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 IV 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 V FILES,MODULES,PACKAGES	**9**
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).	
	Total Periods:45

Learning Resources

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	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 2021.
4	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
5	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data",MIT Press , 2021
6	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
7	Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.



Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Develop algorithmic solutions to simple computational problems	Apply
CO2	Write simple python programs using the basic datatypes, expressions and Statements.	Apply
CO3	Write simple Python programs using conditionals and loops for solving problems and decompose a Python program into functions.	Apply
CO4	Represent compound datatypes using Python lists, tuples, & dictionaries	Apply
CO5	Read and write data from /to files in Python programs.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24HS111	**தமிழர்மரபு / HERITAGE OF TAMILS**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

Course Objective:

- Recognize Tamil literature and its significance in Tamil culture.
- Introduce the Tamils' rich artistic and cultural legacy.
- Familiarize the different types of folk and martial arts that are unique to Tamil Nadu.
- Acquaint the concept of Thinai in Tamil literature and culture.
- Comprehend the significance of Tamil in developing Indian culture.

Detailed Syllabus

UNIT I LANGUAGE AND LITERATURE **3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3 Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.
UNIT III FOLK AND MARTIAL ARTS 3 Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.
UNIT IV THINAI CONCEPT OF TAMILS 3 Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.
UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND IND CULTURE 3 Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.
Total Periods:15

Learning Resources

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

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe the various types of Tamil Literature.	Understand
CO2	Discuss about Tamil Arts and Sculpture.	Understand
CO3	Explain the Tamil Folks and Martial Arts.	Understand

CO4	Summarize the Thinai Concepts of Tamil.	Understand
CO5	Review the contribution of Tamil Culture to Indian Culture and National Movements.	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24HS123	COMMUNICATIVE ENGLISH FOR ENGINEERS	L	T	P	C
		3	0	2	4

Course Objective:

- To learn to use basic grammatical structures in suitable contexts.
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text.
- To help learners use language effectively in both informal and professional contexts.
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

Detailed Syllabus

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why / Yes or No / and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing; Short Report on an event

(field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.
UNIT III DESCRIPTION OF A PROCESS / PRODUCT 9 Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).
UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9 Reading – Newspaper articles; Journal reports –and Non-Verbal Communication (tables, pie charts etc.). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non-verbal (chart, graph etc., to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.
UNIT V EXPRESSION 9 Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative), Dialogue-writing. Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.
Total Periods:45

LIST OF EXPERIMENTS

SL. NO.	LIST OF EXPERIMENTS
1	Listening comprehension
2	Telephone conversation & Introductions (listening & speaking)
3	Mock Interviews
4	Narrating personal experiences
5	Short Oral Presentations
6	Advertising a product
7	Situational conversation – 3 in a team
8	Creating educational videos
9	Group discussion
10	ICT based presentations
	Total Periods:30
	Total: 45+30 = 75 Periods

Learning Resources

1	Communication Book, Portfolio Penguin, 2018. Authored by Mikael Krogerus, Roman Tschäppeler. ISBN-13 : 978-0241982280.
2	English for Science & Technology, Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3	Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
4	English For Technical Communication (With CD), Aysha Viswamohan, McGraw Hill Education, ISBN : 0070264244, 2008.

5	How to win at Interviews & Group Discussions, Abhishek Publications, 2014. Authored by D.S. Cheema, ISBN: 9788182475175, 8182475171.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain different points of view during discussions.	Apply
CO2	Prepare for formal ICT based presentations and video creation.	Apply
CO3	Construct English sentences in both formal and informal contexts.	Apply
CO4	Interpret technical texts, audio materials and visual representation.	Understand
CO5	Write letters, definitions, descriptions, narrations and essays on various topics.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24PH113	**ENGINEERING PHYSICS**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Course Objective:

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves, optics and its applications.
- To introduce the basics knowledge of lasers and fibre optics.
- Equipping the students to successfully understand the importance of quantum mechanics.
- To make the students understand the basics of crystal structure and its importance in studying materials properties.

Detailed Syllabus

UNIT I MECHANICS **9**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM Rotation of rigid bodies: Rotational kinematics – Theorems of M .I –moment of inertia of continuous bodies – torque – rotational dynamics of rigid bodies —- gyroscope - torsional pendulum – double pendulum.

UNIT II ELECTROMAGNETIC WAVES AND OPTICS **9**

Maxwell's equations – wave equation; Conditions on the wave field – properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter – Producing electromagnetic waves – Cell-phone reception.

Reflection and refraction of light waves – interference –Michelson interferometer –Theory of air wedge and experiment.

UNIT III LASERS AND FIBRE OPTICS	**9**
Theory of laser – characteristics – Spontaneous and stimulated emission – Einstein's coefficients – population inversion – Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry. Fiber optics: Principle, Numerical aperture and acceptance angle –types of optical fibers (material, refractive index, mode)- fibre optic communication- losses associated with optical fibers- fibre optic sensors: pressure and displacement- medical endoscope.	
UNIT IV QUANTUM MECHANICS	**9**
Photons and light waves – Electrons and matter waves –Compton effect – The Schrodinger equation (Time dependent and time independent forms) – meaning of wave function – Normalization – particle in a infinite potential well: 1D- particle in a infinite potential well:2D and 3D Boxes (Qualitative).	
UNIT V CRYSTAL PHYSICS	**9**
Crystal structures: Crystal structures: BCC, FCC and HCP – crystal imperfections- edge and screw dislocations – grain and twin boundaries – Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials and Miller indices –distance between successive planes – crystalline and non-crystalline material.	
	Total Periods:45

LIST OF EXPERIMENTS

Sl. No.	List of Experiments (Any Seven Experiments)
1	Determination of rigidity modulus – Torsion pendulum
2	Determination of Young's modulus by non-uniform bending method
3	Determination of wavelength using Laser.
4	Determination of Numerical aperture and acceptance angle in an optical fiber.
5	Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6	Determination of thickness of a thin wire – Air wedge method
7	Determination of band gap of a semiconductor
8	Determination of Young's modulus by uniform bending method.
9	Compact disc- Determination of width of the groove using laser.
10	Simple harmonic oscillations of cantilever.
11	Spectrometer – Determination of wavelength of Mercury Spectrum using diffraction grating.
12	Michelson's interferometer -Determine the wave length of monochromatic light.
13	Melde's Experiment – Determine the Frequency of a tuning fork.
	Total Periods:30
	Total: 45+30 = 75 Periods

Learning Resources

1	D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2	E.M. Purcell and D.J. Morin, Electricity and Magnetism, Cambridge Univ. Press, 2013.

3	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw- Hill (Indian Edition), 2017.
4	Gaur R K and Gupta S L, "Engineering Physics", Dhanpat Rai Publications, 2018.
5	Charles Kittel, "Introduction to Solid State Physics", Wiley India Pvt. Ltd, 7th ed., 2017.
6	D. K. Mynbaev and Lowell L. Scheiner, Fiber Optic Communication Technology, 2011,1st Edition, Pearson, USA.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply the principles of mechanics to solve problems.	Apply
CO2	Apply the knowledge of the Maxwell's equations for electromagnetic waves and optics.	Apply
CO3	Apply the knowledge on the concepts of laser and their applications in fiber optics.	Apply
CO4	Apply quantum mechanical principles towards the formation of energy bands.	Apply
CO5	Describe the basics of crystals, their structures and defects.	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CY113	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Course Objective:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.



Detailed Syllabus

UNIT I WATER AND ITS TREATMENT **9** Water: Sources and impurities, Water quality parameters – color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water-Reverse Osmosis. Boiler troubles – Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and □abell conditioning) and External treatment – Ion exchange demineralization and zeolite process.
UNIT II NANOCHEMISTRY **9** Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.
UNIT III PHASE RULE AND COMPOSITES **9** **Phase rule:** Introduction, definition of terms with examples. One component system – water system; Reduced phase rule; Construction of a simple eutectic phase diagram – Thermal analysis; Two component system: lead-silver system – Pattinson process. **Composites:** Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Nano Composites:** Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites – definition and examples.
UNIT IV FUELS AND COMBUSTION **9** **Fuels:** Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking – octane number, diesel oil – cetane number; Power alcohol and biodiesel. **Combustion of fuels:** Introduction: Calorific value – higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis – ORSAT Method.
UNIT V ENERGY SOURCES AND STORAGE DEVICES **9** **Nuclear energy**: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of Silicon (si) Solar cell, Wind energy, Geo thermal energy. **Batteries:** Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium- ion battery; Electric vehicles – working principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Super capacitors: Storage principle, types and examples.
Total Periods:45

LIST OF EXPERIMENTS

Sl. No.	List of experiments (Any Seven experiments)
1	Determination of types and amount of alkalinity in a water sample. – Split the first experiment into two.
2	Determination of total, temporary & permanent hardness of water by EDTA method.
3	Determination of DO content of water sample by Winkler's method.



4	Determination of chloride content of water sample by Argentometric method.
5	Determination of strength of given hydrochloric acid using pHmeter.
6	Determination of strength of acids in a mixture of acids using conductivity meter.
7	Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
8	Conductometric titration of strong acid vs strong base.
9	Estimation of iron content of the given solution using potentiometer.
10	Estimation of sodium/potassium present in water using a flame photometer.
	Total Periods:30
	Total: 45+30 = 75 Periods

Learning Resources

1	P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3	Mary Francisca.L.J, Engineering Chemistry-I, 1, 2004.
4	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe the water treatment processes and Calculate the quality parameters of different types in Water Samples and Apply the appropriate method to find the PH, conductance and potential values of various solutions	Understand
CO2	Apply the concepts of nanoscience in Engineering Applications.	Apply
CO3	Apply the knowledge of phase rule and composites for material selection requirements	Apply
CO4	Identify the types of fuels and calculate the calorific value, explosive range for engineering processes.	Understand
CO5	Apply suitable energy resources for Engineering sectors.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24GE122	PROBLEM SOLVING USING PYTHON LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To learn about Variables, Operators available and how to write loops and decision statements in Python.
- To learn and Implement programs using non recursive and recursive functions.
- To Learn and execute a program using different Data Types – String, List, advance List, Dictionary, Tuple, Sets, Python Modules and packages.
- To learn how to read and write files in Python and also learn to use exception handling in Python applications for error handling.
- To build a mini project using fundamental programming constructs like variables, conditional logic, looping, and function and other required modules.

List of Experiments

Sl. No.	List of Experiments
1	Environment Setup and execute Basic Exercise to learn about Variables, Operators available in python.
2	Execute programs using Python Control Flow – Python Loops and Control Statements
3	Implement programs using String and array in python.
4	Write functions and pass arguments [Non Recursive, Recursive] in Python
5	Execute program to learn different Data Types in python – String, List, advance List, Dictionary, Tuple, Sets
6	Learn and execute programs using Python Modules and packages.
7	Execute program using Python Directory and Files Management.
8	Implement program to learn about python exception handling
9	Mini project [Group project-demo and presentation]
	Total Periods: 60

Learning Resources

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	Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
4	G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
	Reema Thareja, “Python Programming using problem solving approach”, 2019, Oxford University Press.
5	John V Guttag, “Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021
6	Eric Matthes, “Python Crash Course, A Hands – on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.https://www.python.org/
7	Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.



Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Understand and make use of variables, operators available and how to write loops, and decision statements in Python.	Apply
CO2	Execute programs to implement recursive and non-recursive functions in Python.	Apply
CO3	Write Python programs using core data structures such as arrays, strings, lists, sets, dictionaries, and tuples.	Apply
CO4	Use and carry out examples to handle File Systems and exception handling in Python.	Apply
CO5	Deconstruct exemplary applications in Python.	Analyze

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE – GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MA221	Discrete Mathematics	BSC	3	1	0	4	4	40	60
2	U24PH221	Physics for Information Science	BSC	3	0	0	3	3	40	60
3	U24EC221	Digital Principles and Computer Organization	ESC	3	0	0	3	3	40	60
4	U24CS211	C Programming	ESC	3	0	0	3	3	40	60
5	U24HS211	Tamils and Technology	HSMC	1	0	0	1	1	40	60
THEORY CUM PRACTICAL COURSES										
6	U24HS223	Technical English for Engineers	HSMC	2	0	2	4	3	50	50
PRACTICAL COURSES										
7	U24EE232	Engineering Practices for Circuit Branches	ESC	0	0	4	4	2	60	40
8	U24CS222	C Programming Laboratory	ESC	0	0	4	4	2	60	40
9	U24EM212	Professional Development	EEC	0	0	2	2	1	100	NIL
				15	**1**	**12**	**28**	**22**		

ASSESSMENT SCHEME

Sl. No	Course Type	L	T	P	C	CIA Weightage (Theory)				CIA	ESE		CIA (W)	ESE (W)	Min. Marks to Pass for 100	
						T1	A1	T2	A2	Prac	Th	Prac			ESE	Total
1	U24MA221	3	1	0	4	60	40	60	40	-	100		40	60	45	50
2	U24PH221	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	U24EC221	3	0	0	3	60	40	60	40	-	100		40	60	45	50
4	U24CS211	3	0	0	3	60	40	60	40	-	100		40	60	45	50
5	U24HS211	1	0	0	1	60	40	60	40	-	100		40	60	45	50
6	U24HS223	2	0	2	3	60	40	60	40	100	50	50	50	50	45	50
7	U24EE232	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
8	U24CS222	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
9	U24EM212	0	0	2	1	-	-	-	-	-	-	-	100	-	-	50

(W) – Weightage

U24MA221	DISCRETE MATHEMATICS	L	T	P	C
		3	1	0	4

Course Objective:

- To extend a student's logical and mathematical maturity and ability to deal with abstraction problems.
- To understand the basic concepts of combinatory.
- To introduce graph models and their basic concepts.
- To familiarize the applications of algebraic structures.
- To understand the concepts of sets, relation, function and Boolean algebra which are widely used in computer science and engineering.

Detailed Syllabus

UNIT I LOGIC	**9+3**
Propositional logic – Propositional equivalences – Predicates and quantifiers – Rules of inference – Introduction to proofs – Proof methods and strategy.	
UNIT II COMBINATORICS	**9+3**
Mathematical induction – The basics of counting – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions– Inclusion and exclusion principle and its applications.	
UNIT III GRAPHS	**9+3**
Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.	
UNIT IV ALGEBRAIC STRUCTURES	**9+3**
Algebraic systems – Semi groups and monoids – Groups – Subgroups – Normal subgroup and cosets – Lagrange's theorem.	
UNIT V SETS,RELATION, FUNCTION AND BOOLEAN ALGEBRA	**9+3**
Basic concepts of Set theory – Laws of Set theory – Partition of set, Relations – Types of Relations: Equivalence relation, Partial ordering relation – Functions: Injective, Surjective, Bijective functions, Compositions of functions, Identity and Inverse functions– Boolean algebra.	
	Total Periods :60

Learning Resources

1	Rosen. K.H., "Discrete Mathematics and its Applications", 7thEdition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2017.
2	Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30thReprint, 2011.
3	Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction'', 5thEdition, Pearson Education Asia, Delhi, 2013.
4	Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.



Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply truth tables to evaluate logical propositions.	Apply
CO2	Apply basic counting techniques to solve combinatorial problems.	Apply
CO3	Apply graph matching ideas in various matching related problems.	Apply
CO4	Apply the concepts and properties of algebraic structures to solve the Problem.	Apply
CO5	Apply the concepts of set theory and Boolean algebra in computer science and engineering.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24PH221	PHYSICS FOR INFORMATION SCIENCE	L	T	P	C
		3	0	0	3

Course Objective:

- Ascertain about the concepts and properties of semiconductor materials.
- Describe about semiconductor devices and its applications.
- Understand basics of magnetic behaviour of materials and its applications.
- Apply optical properties of materials to the optoelectronics devices.
- Interpret the basics of quantum structures and their applications in Nano devices.

Detailed Syllabus

UNIT I SEMICONDUCTOR PHYSICS **9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in P-type semiconductors – Variation of carrier concentration with temperature –– Carrier transport in Semiconductor: drift and diffusion – Ohmic contacts – Schottky diode.

UNIT II SEMICONDUCTOR DEVICES **9**

Semiconductor diodes and logic gates – PN Junction diode and its characteristics – Zener diode and its characteristics – Varacter diode – Transistors – FET – JFET – MOSFET – BJT – Basic logic gates (OR, NOT, AND, NAND, NOR) CNOT gate.

UNIT III MAGNETIC PROPERTIES OF MATERIALS **9**

Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility – Magnetic material classification: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses–Magnetic principle in computer data storage – Magnetic hard disc (GMR sensor).

UNIT IV OPTICAL PROPERTIES OF MATERIALS	**9**
Classification of optical materials – carrier generation and recombination processes – photo current in a P-N diode – solar cell – Ohmic contacts and Schottky diodes – LED – Organic LED – LCD – Laser diodes – Optical data storage techniques.	
UNIT V NANODEVICES AND QUANTUM COMPUTING	**9**
Introduction – quantum confinement – quantum structures: quantum wells, wires and dots — band gap of nanomaterials. Tunnelling – Single electron phenomena: Coulomb blockade – resonant- tunnelling diode – single electron transistor – quantum cellular automata – Quantum system for information processing – quantum states – classical bits – quantum bits or qubits – multiple qubits – Bloch sphere – quantum gates – advantage of quantum computing over classical computing.	
	Total Periods: 45

Learning Resources

1	Jasprit Singh, “Semiconductor Devices: Basic Principles”, Wiley (Indian Edition), 2007.
2	S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.
3	Parag K. Lala, Quantum Computing: A Beginner’s Introduction, McGraw-Hill Education (Indian Edition), 2020.
4	Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
5	R. Murugasen, Modern Physics, S. Chand & Company, 2018.
6	R.F. Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.
7	B. Rogers, J. Adams and S. Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe the basic knowledge of semiconductor physics and its applications.	Understand
CO2	Describe the mechanism involved in construction and working of semiconductor diodes.	Understand
CO3	Discuss the knowledge of Magnetic Properties of Materials.	Understand
CO4	Illustrate the Optical properties of Materials.	Understand
CO5	Describe the basics of Quantum Structures and Quantum Computing.	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24EC221	DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION	L	T	P	C
		3	0	0	3

Course Objective:

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

Detailed Syllabus

UNIT I COMBINATIONAL LOGIC	**9**
Combinational Circuits – Karnaugh Map – Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder – Magnitude Comparator – Decoder – Encoder – Multiplexers – Demultiplexers.	
UNIT II SYNCHRONOUS SEQUENTIAL LOGIC	**9**
Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation – Registers – Counters.	
UNIT III COMPUTER FUNDAMENTALS	**9**
Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language.	
UNIT IV PROCESSOR	**9**
Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.	
UNIT V MEMORY AND I/O	**9**
Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA	
	Total Periods: 45

Learning Resources

1	M. Morris Mano, Michael D. Ciletti, “Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Sixth Edition, Pearson Education, 2018.
2	David A. Patterson, John L. Hennessy, “Computer Organization and Design, The Hardware / Software Interface”, Sixth Edition, Morgan Kaufmann/Elsevier, 2020.
3	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, “Computer Organization and Embedded Systems”, Sixth Edition, Tata McGraw-Hill, 2012.
4	William Stallings, “Computer Organization and Architecture – Designing for Performance”, Tenth Edition, Pearson Education, 2016.
5	M. Morris Mano, “Digital Logic and Computer Design”, Pearson Education, 2016.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Design various combinational digital circuits using logic gates.	Apply
CO2	Design sequential circuits and analyze the design procedures.	Apply
CO3	Explain the fundamentals of computer systems and analyze the execution of an instruction.	Analyze
CO4	Analyze different types of control design and identify hazards.	Analyze
CO5	Describe the characteristics of various memory systems and I/O communication.	Understand

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	-	-	1	1	-	1	3	2
CO2	3	3	3	3	2	-	-	1	1	-	1	3	1
CO3	3	3	3	3	2	-	-	1	1	-	1	3	2
CO4	3	3	3	3	1	-	-	1	1	-	1	2	1
CO5	3	3	3	3	1	-	-	1	1	-	1	2	1
Avg.	**3**	**3**	**3**	**3**	**1.8**	**-**	**-**	**1**	**1**	**-**	**1**	**2.6**	**1.4**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS211	C PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objective:

- To develop C Programs using basic programming constructs.
- To develop C programs using arrays and strings.
- To develop applications in C using functions, and pointers.
- To develop applications in C using structures.
- To do input/output and file handling in C.

Detailed Syllabus

UNIT I BASICS OF C PROGRAMMING **9**

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

UNIT II ARRAYS AND STRINGS **9**

Introduction to Arrays: Declaration, Initialization – One dimensional array – Example Program**:** Computing Mean, Median and Mode – Two dimensional arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) – String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT III FUNCTIONS AND POINTERS **9**

Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion – Example Program: Computation of Sine series, Scientific calculator using built-in functions, Binary Search using recursive functions – Pointers –Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example

Program: Sorting of names – Parameter passing: Pass by value, Pass by reference – Example Program: Swapping of two numbers and changing the value of a variable using pass by reference.
UNIT IV STRUCTURES **9** Structure – Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Self-referential structures – Dynamic memory allocation – Singly linked list – typedef.
UNIT V FILE PROCESSING **9** Files – Types of file processing: Sequential access, Random access – Sequential access file – Example Program: Finding average of numbers stored in sequential access file – Random access file – Example Program: Transaction processing using random access files – Command line arguments.
Total Periods: 45

Learning Resources

1	Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2021.
2	Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2022.
3	Paul Deitel and Harvey Deitel, “C How to Program”, Seventh edition, Pearson Publication.
4	Juneja, B. L and Anita Seth, “Programming in C”, CENGAGE Learning India Pvt. Ltd., 2011.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Develop simple applications in C using basic constructs.	Apply
CO2	Design and implement applications using arrays and strings.	Apply
CO3	Develop and implement applications in C using functions and pointers.	Apply
CO4	Develop applications in C using structures.	Apply
CO5	Design applications using sequential and random access file processing.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	2	2				1		1	3	
CO2	3	2	1	2	2				1		1	2	
CO3	3	3	1	2	3				1		1	2	
CO4	3	1		1	1				2		1	2	
CO5	3	2	1	2	2				1		1	3	
Avg.	**3**	**2.2**	**1**	**1.8**	**2**				**1.2**		**1**	**2.4**	

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24HS211	தமிழரும் தொழில்நுட்பமும் / TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

Course Objective:

- To facilitate the student to understand weaving and technology of sangam age.
- To create an awareness on structural design of Tamils during sangam age.
- To help students to distinguish between all the levels of manufacturing technology in ancient period.
- To understand the ancient knowledge of agriculture and irrigation technology.
- To enable the students to understand the digitalization of Tamil Language.

Detailed Syllabus

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

Learning Resources

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

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

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Review the Weaving and Ceramic Technology during Tamil Sangam Age.	Understand
CO2	Describe the Construction Technology and various Architecture during Tamil Sangam Age.	Understand
CO3	Discuss the Manufacturing Technology with Archaeological Evidences.	Understand
CO4	Explain the Agriculture and Irrigation Technology during Tamil Sangam Age.	Understand
CO5	Describe Tamil Software and Digitalization Tamil Literatures.	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24HS223	**TECHNICAL ENGLISH FOR ENGINEERS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

Course Objective:

- To engage learners in meaningful language activities to improve their LSRW skills.
- To enhance learners' awareness of general rules of writing for specific audiences.
- To help learners understand the purpose, audience, contexts of different types of writing.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To demonstrate an understanding of job applications and interviews for internship and placements.

Detailed Syllabus

UNIT I MAKING COMPARISONS **6**

Reading – Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette – Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases.

UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING **6**

Reading – Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing – Writing responses to complaints. Grammar – Active Passive Voice transformations, Infinitive and Gerunds

UNIT III PROBLEM SOLVING	**6**
Reading – Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences	
UNIT IV REPORTING OF EVENTS AND RESEARCH	**6**
Reading –Newspaper articles; Writing –Proposal writing- Picture description – Accident Report, Survey Report. Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions.	
UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY	**6**
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.	
	Total Periods: 30

List of Experiments

Sl. No.	List of Experiments
1	Role Play Exercises Based on Workplace Contexts
2	Understanding lexical items via movie clippings – Individual task
3	Discussing news stories
4	Dialogues (with cue cards)-Understanding common technology terms
5	Pronunciation, Intonation, Stress and Rhythm (Level 1)
6	Pronunciation, Intonation, Stress and Rhythm (Level 2)
7	Public Speech: Talking about self in a Professional Setting, Introduction of Speakers, Vote of thanks – 3 in a team
8	Writing a short article (Can be compiled as a magazine)
9	Verbal ability exercises for competitive examinations
10	Visume
	Total Periods: 30
	Total: 30+30 = 60 Periods

Learning Resources

1	English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2	English for Science & Technology Cambridge University Press 2021 Authored by Dr.Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3	Better English Pronunciation, (2005), J.D. O'Connor, Second Edition,ISBN-13:978-0521682589.
4	Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.

5	Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
6	A Modern Approach to Verbal & Non-Verbal Reasoning – Includes Latest Questions and their Solutions, Revised Edition, R.S. Aggarwal, January 2018.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Articulate English with proper pronunciation, intonation, stress and rhythm.	Apply
CO2	Develop verbal ability skills for attending competitive examinations.	Apply
CO3	Employ speaking and writing skills in professional contexts.	Apply
CO4	Write effective resumes in the context of job search.	Apply
CO5	Interpret the denotative and connotative meanings of technical texts.	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24EE232	**ENGINEERING PRACTICES FOR CIRCUIT BRANCHES**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Course Objective:

- To gain practical experience in characterizing electronic devices
- To solder and test simple electronic circuits on PCB
- To verify KVL and KCL using series and parallel circuits
- To perform various electrical joints in common household electrical wire work.
- To measure of electrical quantities in different electrical circuits

List of Experiments

Sl. No.	List of Experiments
Electronic Engineering Practices	
1	Study of Electronic Components and Equipment.
2	Resistor Value using Colour coding.

3	Generation of AC signal using Function Generator and Measurement of its parameter using CRO / DSO.
4	Study of logic gates – AND, OR, NOT, NOR, NAND and XOR.
5	Soldering simple electronic circuits and checking continuity.
6	Verification of KVL and KCL using series and parallel circuits.
7	Controlling smart devices using Mobile phone.
8	Study of troubleshooting steps in Mobile Repairing.
Electrical Engineering Practices	
1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2	Fluorescent lamp wiring.
3	Stair case wiring.
4	Measurement of electrical quantities – voltage, current, power and power factor in RLC circuit.
5	Measurement of energy using a single-phase energy meter.
6	Measurement of resistance to earth of electrical equipment.
	Total Periods: 60

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Analyze the characteristics of basic electronic devices	Analyze
CO2	Perform simple electronic circuits on PCB	Apply
CO3	Solve KVL and KCL using series and parallel circuits	Apply
CO4	Perform various electrical joints in common household electrical wire work.	Apply
CO5	Calculate electrical quantities in different electrical circuits	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3						2	3	2		2	
CO2	3	2	2					2	3	2		2	
CO3	3	3	3					2	3	2			
CO4	3	2				2		2	3	2		3	
CO5	3	2	2			2		2	3	2		3	
Avg.	**3**	**2.4**	**2.3**			**2**		**2**	**3**	**2**		**2.5**	

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS222	C PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To develop programs in C using basic constructs.
- To develop applications in C using strings.
- To develop applications in C using pointers, functions.
- To develop applications in C using structures.
- To develop applications in C using file processing.

List of Experiments

Sl. No.	List of Experiments
1	Programs using, I/O statements and expressions.
2	Programs using decision-making constructs.
3	Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
4	Check whether a given number is Armstrong number or not?
5	Given a set of numbers like <10, 36, 54, 89, 12, 27>, find sum of weights based on the following conditions. • 5 if it is a perfect cube. • 4 if it is a multiple of 4 and divisible by 6. • 3 if it is a prime number. Sort the numbers based on the weight in the increasing order as shown below <10,its weight>,<36,its weight><89,its weight>
6	Populate an array with height of persons and find how many persons are above the average height.
7	Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
8	From a given paragraph perform the following using built-in functions: a. Find the total number of words. b. Capitalize the first word of each sentence. c. Replace a given word with another word.
9	Solve towers of Hanoi using recursion.
10	Sort the list of numbers using pass by reference.
11	Generate salary slip of employees using structures and pointers.
12	Compute internal marks of students for five different subjects using structures andfunctions.
13	Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
14	Count the number of account holders whose balance is less than the minimum balance using sequential access file.
15	Create a “Railway reservation system” with the following modules: Booking, Availability checking, Cancellation and Prepare chart
	Total Periods: 60

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Develop C programs for simple applications.	Apply
CO2	Develop C programs for constructs, arrays and strings.	Apply
CO3	Develop C programs involving functions and recursion	Apply
CO4	Develop C programs involving pointers, and structures.	Apply
CO5	Design applications using sequential and random-access file processing.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	1	2	2	1	1		1	2	1	3	
CO2	1	2	1	2	2				1	1	1	2	
CO3	2	3	1	2	3				1	1	1	2	
CO4	2	1		1	1				2	1	1	2	
CO5	1	2	1	2	2	1	1		1	2	1	3	
Avg.	**1.6**	**2.2**	**10**	**1.8**	**2**	**1**	**1**		**1.2**	**1.4**	**1**	**2.4**	

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24EM212	PROFESSIONAL DEVELOPMENT	L	T	P	C
		0	0	2	1

Course Objective:

- To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.
- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

List of Experiments

Sl. No.	List of Experiments	No. of periods
1	**MS WORD** • Create and format a document • Working with tables • Working with Bullets and Lists • Working with styles, shapes, smart art, charts • Inserting objects, charts and importing objects from other office tools • Creating and Using document templates • Inserting equations, symbols and special characters	10

	• Working with Table of contents and References, citations • Insert and review comments • Create bookmarks, hyperlinks, endnotes footnote • Viewing document in different modes • Working with document protection and security • Inspect document for accessibility	
2	**MS EXCEL** • Create worksheets, insert and format data • Work with different types of data: text, currency, date, numeric etc. • Split, validate, consolidate, Convert data • Sort and filter data • Perform calculations and use functions: • (Statistical, Logical, Mathematical, date, Time etc.,) • Work with Lookup and reference formulae • Create and Work with different types of charts • Use pivot tables to summarize and analyse data • Perform data analysis using own formulae and functions • Combine data from multiple worksheets using own formulae and built-in functions to generate results • Export data and sheets to other file formats • Working with macros • Protecting data and Securing the workbook	10
3	**MS POWERPOINT** • Select slide templates, layout and themes • Formatting slide content and using bullets and numbering • Insert and format images, smart art, tables, charts • Using Slide master, notes and handout master • Working with animation and transitions • Organize and Group slides • Import or create and use media objects: audio, video, animation • Perform slideshow recording and Record narration and create presentable videos	10
		Total Periods: 30

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Create quality documents, by structuring and organizing content for their day to day technical and academic requirements using MS Word.	Apply
CO2	Perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding using MS Excel.	Apply
CO3	Create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects using MS Power Point.	Apply



CO4	Prepare an effective report using MS Word and MS Excel on any subject content.	Apply
CO5	Present the report using MS Power Point.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1									2	2		2	
CO2									2	2		2	
CO3									2	2		2	
CO4									2	2		2	
CO5									2	2		2	
Avg.									**2**	**2**		**2**	

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE – GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MA341	Probability and Statistics	BSC	3	1	0	4	4	40	60
2	U24CS321	Data Structures	PCC	3	0	0	3	3	40	60
3	U24AD311	Computer Networks	PCC	3	0	0	3	3	40	60
4	U24CS331	Object Oriented Programming using Java	PCC	3	0	0	3	3	40	60
THEORY CUM PRACTICAL COURSES										
5	U24AD323	Data Exploration and Visualization	PCC	3	0	2	5	4	50	50
PRACTICAL COURSES										
6	U24CS352	Data Structures Laboratory	PCC	0	0	4	4	2	60	40
7	U24CS362	Object Oriented Programming Laboratory	PCC	0	0	4	4	2	60	40
8	U24EM312	Design Thinking and Innovation	EEC	0	0	2	2	1	100	NIL
				15	**1**	**12**	**28**	**22**		

ASSESSMENT SCHEME

Sl. No	Course Type	L	T	P	C	CIA Weightage (Theory)				CIA	ESE		CIA (W)	ESE (W)	Min. Marks to Pass for 100	
						T1	A1	T2	A2	Prac	Th	Prac			ESE	Total
1	U24MA341	3	1	0	4	60	40	60	40	-	100		40	60	45	50
2	U24CS321	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	U24AD311	3	0	0	3	60	40	60	40	-	100		40	60	45	50
4	U24CS331	3	0	0	3	60	40	60	40	-	100		40	60	45	50
5	U24AD323	3	0	2	3	60	40	60	40	100	70	30	50	50	45	50
6	U24CS352	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
7	U24CS362	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
8	U24EM312	0	0	2	1	-	-	-	-	-	-	-	100	-	-	50

(W) – Weightage

U24MA341	PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

Course Objective:

- To provide the required skills to apply statistical tools to engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two-dimensional random variables.
- To acquaint with knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which play a very important role in the fields of agriculture and statistical quality control

Detailed Syllabus

UNIT I PROBABILITY AND RANDOM VARIABLES	**9+3**
Axioms of probability – Conditional probability – Baye's theorem – Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.	
UNIT II TWO – DIMENSIONAL RANDOM VARIABLES	**9+3**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables.	
UNIT III ESTIMATION THEORY	**9+3**
Unbiased estimators – Efficiency – Consistency – Sufficiency – Robustness – Method of moments – Method of maximum Likelihood – Interval estimation of Means – Differences between means, variations and ratio of two variances.	
UNIT IV NON- PARAMETRIC TESTS	**9+3**
Introduction – The Sign test – The Signed – Rank test – Rank – sum tests – The U test – The H test – Tests based on Runs – Test of randomness – The Kolmogorov Tests.	
UNIT V STATISTICAL QUALITY CONTROL	**9+3**
Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (c, p and np charts).Tolerance limits – Acceptance sampling.	
Total Periods :60	

Learning Resources

1	Johnson. R.A., Miller. I.R and Freund. J.E, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2022.
2	Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2019.
3	Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5thEdition, 2016.
4	T. Veerarajan "Probability, Statistics and Random Process" 3rdEdition, Tata McGraw Hill Publishing Company limited, 2008.
5	Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
6	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
7	Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.
8	Grewal. B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44thEdition, 2018.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply discrete and continuous distribution to solve the problems.	Apply
CO2	Calculate probabilities, marginal and conditional distributions of bivariate random variables.	Apply
CO3	Evaluate the properties of estimators.	Apply
CO4	Apply various method of non-parametric test to solve the problems.	Apply
CO5	Apply the concept of statistical quality control to identify the problems through data analysis.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS321	**DATA STRUCTURES (Common to B.E. Computer Science and Engineering)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To insights the concepts of ADTs.
- To learn linear data structures–list, stack and queue.
- To apply sorting, searching and hashing algorithms.
- To apply tree data structures.
- To apply Graph structures.

Detailed Syllabus

UNIT I LISTS **9**

Abstract Data Types (ADTs)– List ADT – Array-based implementation – Linked list implementation– Singly linked lists–Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT– Radix Sort– Multilists.

UNIT II STACK AND QUEUE **9**

Stack ADT – Operations– Applications – Balancing Symbols– Evaluating arithmetic expressions - Infix to Postfix conversion–Function Calls– Queue ADT–Operations–Circular Queue–DeQueue– Applications of Queues.

UNIT III SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching– Linear Search– Binary Search. Sorting– Merge Sort – Quick Sort – Insertion sort– Bubble sort– Selection sort– Shell sort—Hashing–Hash Functions– Separate Chaining –Open Addressing– Rehashing–Extendible Hashing.

UNIT IV TREE	**9**
Tree ADT – Tree Traversals-Binary Tree ADT – Expression trees – Binary Search Tree ADT –AVL Trees–B-Tree– B^+ Tree – Priority Queue(Heaps)– Binary Heap	
UNIT V GRAPH	**9**
Graph Definition–Representation of Graphs–Types of Graph-Breadth- first traversal–Depth-first traversal— Bi-connectivity–Euler circuits– Topological Sort–Dijkstra's algorithm–Minimum Spanning Tree–Prim's algorithm–Kruskal's algorithm	
	Total Periods: 45

Learning Resources

1	Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, Data Structures & Algorithms in Python", John Wiley & Sons Inc., 2021.
2	Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015.
3	Thomas H. Cormen, Charles E Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms" Fourth Edition, PHI, 2022
4	Kruse, "Data Structures and Program Design", Pearson Education, 2006
5	https://nptel.ac.in/courses/106/102/106102064/
6	https://nptel.ac.in/courses/106/106/106106133/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply linked list including singly, double and circular list for solving Problems	Apply
CO2	Apply linear data structure including stack, queue and dequeue to solve a given problem	Apply
CO3	Analyze the various searching and sorting algorithms.	Apply
CO4	Apply appropriate algorithms for tree applications	Apply
CO5	Apply appropriate algorithms for graph applications	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD311	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

Course Objective:

- To explain the protocol layering , Architecture of the Internet and Physical Layer.
- To learn the node-to -node data flow in Data link layer
- To examine network layer protocols and the functions of various routing protocols using a simulator tool.
- To familiarize the functions and protocols of the Transport layer.
- To learn the functions of Application layer and fundamentals in Network Security.

Detailed Syllabus

UNIT I INTRODUCTION	**9**
Data communication System-Network Types-Network Topologies- Protocol Layering-TCP/IP Protocol suite – OSI Reference Model- Internet Architecture- Physical Layer: Data and Signals-Performance-wireless transmission, the public switched telephone networks, mobile telephone system.	
UNIT II DATA LINK LAYER	**8**
Data Link Layer-Framing-Flow Control-Error Control-Data Link Layer Protocols: HDLC-PPP-Media Access Control, Ethernet Basics: CSMA/CD-Virtual LAN – Wireless LAN (802.11) Simulation of an error correction code using NS simulator.	
UNIT III NETWORK LAYER	**10**
Internet protocol – IPV4 – IP Addressing -Forwarding of IP Packets -Subnetting – IPV6, Address Mapping- ARP, RARP, ICMP, DHCP. Routing and protocols: Unicast routing – Distance Vector Routing – RIP – Link State Routing – OSPF – Path-vector routing – BGP – Multicast Routing: DVMRP – PIM – Packet Capturing and its examination using WireShark, Simulation of routing algorithms using NS simulator.	
UNIT IV TRANSPORT LAYER	**9**
Introduction-Transport Layer Protocols -Services – Port Numbers – User Datagram Protocol - Transmission Control Protocol – Quality of Service(QoS)-Congestion Control: Leaky Bucket and Token Bucket Algorithm- Congestion avoidance (DECbit, RED).	
UNIT V APPLICATION LAYER AND NETWORK SECURITY	**9**
Introduction to sockets-Application Layer Protocols: DNS, EMAIL, FTP, HTTP Concepts of symmetric and asymmetric key cryptography. Sharing of symmetric keys – Diffie Hellman. Firewalls.	
	Total Periods: 45

Learning Resources

1	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022.
2	AS Tanenbaum, DJ Wetherall, Computer Networks, 5th Ed., Prentice-Hall, 2010
3	JF Kurose, KW Ross, Computer Networking: A Top-Down Approach, 5th Ed., Addison-Wesley, 2009.
4	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
5	W Stallings, Cryptography and Network Security, Principles and Practice, 5th Ed., Prentice-Hall, 2010

6	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill, 2012.
7	Teerawat Issariyakul and Ekram Hossain, Introduction to Network Simulator NS2, Springer Publisher, 2009

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the basic layers functionalities and working of Physical Layer	Apply
CO2	Illustrate the basics of data flow in data link layer	Apply
CO3	Illustrate the network layer protocols and evaluate different routing algorithms using NS simulator.	Analyze
CO4	Determine various Transport Layer protocols & parameters for congestion control using different algorithms.	Apply
CO5	Illustrate the basics of data flow in data link layer	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	3	-	-	3	3	-	3	3	2
CO2	3	3	-	-	2	-	-	3	3	-	3	2	2
CO3	2	2	-	-	2	-	-	3	3	-	3	2	2
CO4	2	3	-	-	2	-	-	3	3	-	3	2	3
CO5	3	2	-	-	2	-	-	3	3	-	3	3	2
Avg.	**2 .6**	**2 .4**	**-**	**-**	**2 .2**	**-**	**-**	**3**	**3**	**-**	**3**	**2 .4**	**2 .2**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS331	OBJECT ORIENTED PROGRAMMING USING JAVA (Common to B. E. CSE)	L	T	P	C
		3	0	0	3

Course Objective:

- To understand Object Oriented Programming concepts and basics of Java programming language.
- To learn the principles of packages, inheritance and interfaces
- To apply a java application with threads and an exception handling mechanism
- To apply generic classes and use I/O streams and string classes
- To design and build Graphical User Interface Application using JAVAFX

Detailed Syllabus

UNIT I INTRODUCTION TO OOP AND JAVA 9 Overview of OOP-Features of Object Oriented Programming –Java Buzzwords – Overview of Java–Data Types, Variables and Arrays –Operators – Control Statements – Programming Structures in Java -Defining classes in Java – Constructors-Methods -Access specifiers – Static members- Java Doc comments.
UNIT II INHERITANCE , PACKAGES AND INTERFACES 9 Overloading Methods –Objects as Parameters- Returning Objects-Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages –Packages and Member Access –Importing Packages – Interfaces.
UNIT III EXCEPTION HANDLING AND MULTITHREADING 9 Exception Handling basics – T r y a n d C a t c h – Multiple catch – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication-Suspending –Resuming, and Stopping Threads –Multithreading.
UNIT IV I/O, GENERICS, STRING HANDLING 9 I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.
UNIT V JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS 9 JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, Toggle Button – Radio Buttons – List View – Combo Box – Choice Box – Text Controls – Scroll Pane. Layouts – Flow Pane – Hbox and Vbox – Border Pane – Stack Pane – Grid Pane. Menu- Menu bars-Menu Item.
Total Periods: 45

Learning Resources

1	Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2021.
2	Herbert Schildt, "Introducing JavaFX 8 Programming", 1st Edition, McGraw Hill Education, New Delhi, 2021.
3	Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018.
4	K. Arnold and J. Gosling, "The JAVA programming language", Third edition, Pearson Education,2000.
5	https://nptel.ac.in/courses/106/105/106105191/
6	https://onlinecourses.nptel.ac.in/noc21_cs56/preview
7	https://www.hackerrank.com/domains/java
8	https://www.codechef.com/wiki/java

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply the basic concepts of OOP.	Apply
CO2	Apply the principles of packages , inheritance and interfaces	Apply

CO3	Apply the exception handling mechanisms and multithreaded model to solve real world problems	Apply
CO4	Develop Java applications with I/O packages , string classes , Collections and generics concepts	Apply
CO5	Implement the concepts of event handling and JavaFX components and controls for developing GUI based applications	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD323	DATA EXPLORATION AND VISUALIZATION	L	T	P	C
		3	0	2	4

Course Objective:

- To outline an overview of exploratory data analysis.
- To implement data visualization using Matplotlib.
- To perform univariate data exploration and analysis.
- To apply bivariate data exploration and analysis.
- To use Data exploration and visualization techniques for multivariate and time series data.

Detailed Syllabus

UNIT I 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 II 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 III UNIVARIATE ANALYSIS **9**

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

UNIT IV BIVARIATE ANALYSIS **9**

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

UNIT V 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 Periods: 45

List of Experiments

Sl. No.	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 frames , 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 Periods: 60	
Total: 15+60 = 75 Periods	

Learning Resources

1	Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020.
2	Jake Vander Plas, “Python Data Science Handbook: Essential Tools for Working with Data”, Oreilly, 1st Edition, 2016.
3	Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.
4	Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
5	Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly Publications, 2019.
6	Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC Press, 2015.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Understand the fundamentals of exploratory data analysis.	Understand
CO2	Implement the data visualization using Matplotlib.	Apply
CO3	Perform univariate data exploration and analysis.	Apply

CO4	Apply bivariate data exploration and analysis.	Apply
CO5	Apply Data exploration and visualization techniques for multivariate and time series data.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2				2	2		2	2	2
CO2	3	2	2	3				2	2		2	2	2
CO3	3	2	2	2	2			2	2		2	2	2
CO4	3	2	2	3				2	2		2	2	2
CO5	3	2	2	2	2			2	2		2	2	2
Avg.	**3**	**2**	**2**	**2.4**	**2**			**2**	**2**		**2**	**2**	**2**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS352	DATA STRUCTURES LABORATORY (Common to B.E. CSE)	L	T	P	C
		0	0	4	2

Course Objective:

- To demonstrate array implementation of linear data structure algorithms.
- To implement the applications using Stack.
- To implement the applications using Linked list
- To implement Binary search tree and AVL tree algorithms.
- To implement the Heap algorithm.
- To implement Dijkstra's algorithm.
- To implement Prim's algorithm
- To implement Sorting, Searching and Hashing algorithms

List of Experiments

Sl. No.	List of Experiments
1	Design and develop a Python-based application that implements Stack, Queue, and Circular Queue using arrays. Apply these data structures to solve practical problems such as browser history navigation (Stack), customer service ticketing system (Queue), and a circular buffer for real-time data streaming (Circular Queue).
2	Design and develop an application that utilizes a linked list to manage dynamic data efficiently. Apply it to real-world scenarios such as contact management in a phonebook, playlist management in a music player.
3	Design and develop an application that implements Stack and Queue Abstract Data Types (ADTs) to solve practical problems such as expression evaluation (infix to postfix conversion).
4	Design and develop an application that demonstrates the real-world use of List, Stack, and Queue ADTs. Implement scenarios such as task management using a Queue, expression evaluation using a Stack, and dynamic data storage using a List in a contact management system or social media feed.
5	Design and develop an application that implements Binary Search Trees (BST) to efficiently manage and retrieve data. Apply BST to solve real-world problems such as contact management in a phonebook, auto-suggestion in search engines.

6	Develop an application that implements AVL Trees to maintain balanced and efficient data retrieval. Apply AVL Trees to real-world scenarios such as optimizing database indexing, managing dynamic leaderboards in gaming applications, or implementing auto-balancing dictionaries for fast search operations.
7	Implement heaps using priority queues, applying them to problems like task scheduling and resource allocation.
8	Develop an application that implements Dijkstra's Algorithm to find the shortest path in a network. Apply this algorithm to real-world scenarios such as GPS-based navigation systems, network routing optimization, or emergency response route planning.
9	Develop an application that implements Prim's Algorithm to find the Minimum Spanning Tree (MST) of a network. Apply this algorithm to solve real-world problems such as optimizing road networks, minimizing wiring costs in circuit design, or designing efficient communication networks.
10	Develop an application that implements Linear Search and Binary Search to efficiently retrieve data from a dataset. Apply these searching techniques to real-world scenarios such as product search in an e-commerce platform, student record retrieval in a database, or keyword search in a text document.
11	Develop an application that implements Insertion Sort and Selection Sort to efficiently organize and manage data. Apply these sorting techniques to real-world scenarios such as ranking student grades, arranging customer transaction records, or sorting a list of product prices in an e-commerce platform.
12	Develop an application that implements Merge Sort to efficiently sort large datasets. Apply Merge Sort in real-world scenarios such as sorting customer transaction records in an e-commerce platform, organizing log files in a server, or optimizing search results in a database system.
13	Develop an application that implements Open Addressing techniques, including Linear Probing and Quadratic Probing, for efficient hash table management. Apply these techniques to solve real-world problems such as fast data retrieval in database indexing, caching mechanisms in web browsers, or duplicate detection in large datasets.
	Total Periods: 60

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply Linear data structure –Linked lists.	Apply
CO2	Apply Stacks and Queue for real time applications.	Apply
CO3	Apply Binary Search tree and AVL tree operations.	Apply
CO4	Develop applications using graph algorithms.	Apply
CO5	Analyze the various searching and sorting algorithms.	Analyze

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)



U24CS362	OBJECT ORIENTED PROGRAMMING LABORATORY (Common to B.E. CSE)	L	T	P	C
		0	0	4	2

Course Objective:

- To build real-world applications using java.
- To understand and apply the concepts of classes, packages, interfaces, inheritance, Exception handling and file processing.
- To develop applications using multithreading
- To Build applications using generic programming
- To Develop the java application using JavaFX controls and events programming

List of Experiments

Sl. No.	List of Experiments
1	Develop a Java application that allows users to search and sort data efficiently. Implement sequential search and binary search to find specific records (e.g., student details, product inventory). Integrate selection sort and insertion sort to organize datasets, such as sorting customer orders by date or arranging exam scores in ascending order.
2	Develop a Java application that implements Stack and Queue data structures using classes and objects. Apply these structures to real-world scenarios such as managing browser history (Stack) and handling customer requests in a service center (Queue).
3	Develop a Java application that demonstrates multilevel inheritance by simulating a realworld scenario, such as a company's employee management system. Implement a class hierarchy where a base class Person is extended by Employee, which is further extended by specialized roles like Manager or Developer. Include methods to display employee details and calculate salaries based on roles.
4	Create an abstract class Shape with two integer attributes and an abstract method print Area(). Implement three subclasses: Rectangle, Triangle, and Circle, each overriding print Area() to calculate and display their respective areas.
5	Develop a Java application that demonstrates the use of the extends keyword with interfaces. Implement a real-world scenario such as a payment system where multiple payment methods (Credit Card, PayPal, UPI) extend a common payment interface to ensure seamless transactions.
6	Develop a Java application that demonstrates exception handling by creating user-defined exceptions. Apply this in a real-world scenario, such as validating user input in a banking system, handling insufficient balance exceptions in an ATM simulation, or managing invalid login attempts in an authentication system.
7	Develop a Java-based multi-threaded application to simulate the Producer-Consumer problem using Threads. Implement synchronization techniques to ensure proper coordination between producers and consumers, such as managing a shared buffer for real-world applications like job scheduling in an operating system or message queues in a communication system.
8	Develop a Java application that performs essential file operations such as creating, reading, writing, and deleting files. Implement real-world use cases like logging system activities, managing user data, or handling configuration files for an application.
9	Develop Java applications to demonstrate the features of generic classes.
10	Develop a JavaFX-based desktop application using various controls, layouts, and menus to create an interactive UI. Implement features such as a To-Do List Manager, Student Record System, or Inventory Management System. Ensure responsive design.



11	Write a Java program that connects to a database using JDBC. Implement functionality to insert, manage, and delete user data (e.g., Library Registration, HR records, Inventory Management).
	Total Periods: 60

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply java programs using object-oriented programming concepts	Apply
CO2	Apply object-oriented concepts such as package, exceptions for simple applications.	Apply
CO3	Apply multithreading concept for simple java program.	Apply
CO4	Develop Simple application using generic classes.	Apply
CO5	Create GUIs and event driven programming applications for real world problems.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24EM312	**DESIGN THINKING AND INNOVATION (Common to B.E. Civil, CSE and Mechanical and B.Tech. AIDS in Third Semester and B.E. ECE in Fifth Semester)**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objective:

- Empathizing with users to uncover their real problems and desires.
- Promoting out-of-the-box thinking to develop unique and effective solutions.
- Using prototyping, testing, and refining ideas to ensure the best outcome.
- Testing assumptions early to prevent costly mistakes and enhance decision-making.
- Creating innovative products, services, or processes that improve market competitiveness.

List of Experiments

Sl. No.	List of Experiments	No. of periods
1	Design Thinking – models–Why design thinking? Case Studies. Innovation– 7Cs of Innovation. Identify a case study.	4
2	Empathize– tools – customer Journey map –case studies– Empathize the identified case study	4

3	Analyze – tools, multi-whys, case study, conflict of interest. Analyze the identified case study	4
4	Ideate and solve – brainstorming– TRIZ method, trial and error method– Solve the identified case study	4
5	Prototype/process and test – tools and methods– create a prototype for the identified case study	4
6	Iterate to improve the prototype/process – revisit the methods to improve the prototype.	8
7	Submit the report and final prototype/process of the case study.	2
		Total Periods: 60

Learning Resources

1	Pavan Soni, Design your thinking, Penguin Random House India Pvt, Ltd., India, 2022
2	Don Norman, The Design of everyday things, Basic Books, New York, 2013
3	B.K. Chakravarthy, Janaki Krishnamoorthi, Innovation by Design Lessons from Post Box Design & Development, Springer, New Delhi 2013
4	Balaramadurai, Karmic Design Thinking, 2020
5	Design by Innovation NPTEL Course B.K. Chakravarthy IIT Bombay https://nptel.ac.in/courses/107_101086
6	Design Thinking and Innovation NPTEL Course Ravi Poovaiah, IIT Bombay https://onlinecourses.swayam2.ac.in/aic23_ge17/preview

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply the tools to empathize the identified case study	Apply
CO2	Analyze the data and information to conceptualize the solution for the case study	Analyze
CO3	Ideate and solve the case study using appropriate tools	Apply
CO4	Create a prototype/process of the case study	Create
CO5	Iterate to improvise the prototype/process of the case study	Analyze

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MA411	Numerical Methods	BSC	3	1	0	4	4	40	60
2	U24AD411	Intelligent Systems	PCC	3	0	0	3	3	40	60
3	U24CS421	Data Base Management Systems	PCC	3	0	0	3	3	40	60
4	U24CS441	Design and Analysis of Algorithms	PCC	3	0	0	3	3	40	60
5	U24EM411	Aptitude and Reasoning – I	EEC	1	0	0	1	1	100	
THEORY CUM PRACTICAL COURSES										
7	U24CS453	Web Technologies	PCC	1	0	4	5	3	50	50
PRACTICAL COURSES										
7	U24AD422	Intelligent Systems Laboratory	PCC	0	0	4	4	2	60	40
8	U24CS462	Data Base Management Systems Laboratory	PCC	0	0	4	4	2	60	40
9	U24CS482	Design and Analysis of Algorithms Laboratory	PCC	0	0	4	4	2	60	40
10	U24EM422	Soft skills and Personality Development – I	EEC	0	0	2	2	1	100	NIL
				14	**1**	**18**	**33**	**24**		

ASSESSMENT SCHEME

Sl. No	Course Type	L	T	P	C	CIA Weightage (Theory)				CIA	ESE		CIA (W)	ESE (W)	Min. Marks to Pass for 100	
						T1	A1	T2	A2	Prac	Th	Prac			ESE	Total
1	U24MA411	3	1	0	4	60	40	60	40	-	100		40	60	45	50
2	U24AD411	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	U24CS421	3	0	0	3	60	40	60	40	-	100		40	60	45	50
4	U24CS441	3	0	0	3	60	40	60	40	-	100		40	60	45	50
5	U24EM411	1	0	0	1	-	-	-	-	-	-	-	100	-	-	50
6	U24CS453	1	0	4	3	-	-	60	40	100	-	100	50	50	45	50
7	U24AD422	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
8	U24CS462	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
9	U24CS482	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
10	U24EM422	0	0	2	1	-	-	-	-	-	-	-	100	-	-	50

(W) – Weightage

U24MA411	NUMERICAL METHODS	L	T	P	C
		3	1	0	4

Course Objective:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To understand techniques of interpolation and polynomial fitting.
- To understand methods too numerical differentiation and integration.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

Detailed Syllabus

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations – Fixed Point iteration – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method.

UNIT II INTERPOLATION AND APPROXIMATION 9+3

Lagrange's interpolation – Interpolation with unequal intervals: Newton's divided difference interpolation – Interpolation with equal intervals: Newton's forward and backward difference formulae – Cubic Splines.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods – Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations – Multi step methods – Milne's and Adams – Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+3

Finite difference methods for solving second order two – point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

Total Periods :60

Learning Resources

1	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2	Burden, R.L and Faires, J.D, "Numerical Analysis", 9thEdition, Cengage Learning, 2016.
3	Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2021.
4	Richard L. B and Douglas J. F, "Numerical Analysis", Thomas Learning, New York, 2017.
5	Sastry. S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5thEdition, 2015.
6	Gerald. C.F. and Wheatley. P.O., "Applied Numerical Analysis", Pearson Education, Asia, 7thEdition, New Delhi, 2006.
7	Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rdEdition, New Delhi, 2007.
8	Veerarajan T, Ramachandran R, "Numerical Methods with Programs in C", Tata McGraw Hill, 2ndEdition, New Delhi, 2008.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Determine the numerical solution of algebraic, transcendental and system of linear equations.	Apply
CO2	Apply appropriate numerical methods to solve the interpolation with equal and unequal intervals.	Apply
CO3	Apply the numerical techniques of differentiation and integration for engineering problems.	Apply
CO4	Determine the solution of ordinary differential equation of first order by Euler, Taylor and Runge-Kutta methods.	Apply
CO5	Determine the Solution of partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD411	**INTELLIGENT SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- Explain the architecture and behavior of intelligent agents and describe uninformed search strategies for solving problems.
- Describe heuristic and local search techniques used in solving optimization problems.
- Explain the application of game search and constraint satisfaction in solving strategic and combinatorial problems.
- Illustrate the use of propositional and first-order logic in representing knowledge and inference.
- Explain the concepts of Bayesian inference and their use in AI systems.

Detailed Syllabus

UNIT I 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 II PROBLEM SOLVING **9**

Heuristic Search Strategies – Heuristic Functions. 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

UNIT III LOGICAL REASONING	**9**
Logic- Propositional Logic – Propositional Theorem Proving – Propositional model checking – First Order Logic-Syntax and Semantics – Inference in First order logic– Forward Chaining – Backward Chaining– Resolution.	
UNIT IV 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 – Structure Of CSP.	
UNIT V PROBABILISTIC REASONING AND APPLICATION	**9**
Acting Under Uncertainty– Bayesian Inference – Navie Bayes Models– Probabilistic Reasoning–Semantics of Bayesian Networks– Exact Inference in BN – Approximate Inference in BN. Application – Natural Language Processing – Large Language Models – Fuzzy Logic	
	Total Periods: 45

Learning Resources

1	S. Russel and P. Norvig, “Artificial Intelligence–A Modern Approach”, Fourth Edition, Pearson Education, 2023.
2	David Poole, Alan Mackworth, Randy Goebel, “Computational Intelligence: a logical approach”, Oxford University Press, New Delhi 2006.
3	G.Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Sixth Edition, Pearson Education, New Delhi Reprint 2021.
4	J. Nilsson, “Artificial Intelligence: A new Synthesis”, Elsevier Publishers, New Delhi Reprint 2023.
5	An Introduction to Artificial Intelligence NPTEL Course Prof. Mausam, IIT Delhi https://nptel.ac.in/courses/106102220
6	www.ics.uci.edu/~smyth/courses/cs271/topic0_introduction.ppt
7	Mawww.cs.utexas.edu/users/ear/nsc110/.../DSMirrorsArtificialIntelligence.ppt
8	www.pafkiet.edu.pk/coe/Artificial_Intelligence.ppt

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply intelligent agent architecture and uninformed search strategies to solve defined problems.	Apply
CO2	Apply heuristic and local search methods to solve optimization problems.	Apply
CO3	Apply game search and constraint satisfaction techniques to solve decision-making problems.	Apply
CO4	Apply propositional and first-order logic to perform reasoning using inference techniques.	Apply
CO5	Apply probabilistic reasoning methods such as Bayesian inference in AI systems.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	3	2	-	-	2	3	3	2	-	-
CO2	2	2	2	2	2	-	-	2	2	3	2	-	-
CO3	2	2	2	2	2	-	-	2	2	2	3	-	-
CO4	2	2	2	2	2	-	-	2	2	2	2	-	-
CO5	3	2	2	2	2	-	-	3	2	2	2	-	-
Avg.	**2.4**	**2**	**2.2**	**2.2**	**2**	**-**	**-**	**2.2**	**2.2**	**2.4**	**2.2**	**-**	**-**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS421	DATABASE MANAGEMENT SYSTEMS (Common to B. E. CSE)	L	T	P	C
		3	0	0	3

Course Objective:

- To introduce the fundamental concepts of database systems and help students model real-world data and relationships using Entity-Relationship (ER) diagrams.
- To develop the ability to formulate and solve data retrieval and manipulation problems using relational algebra and SQL, including complex query operations.
- To provide a strong foundation in database design by applying normalization techniques to eliminate data redundancy and update anomalies in relational databases.
- To explain the concepts of transaction management and concurrency control, enabling students to handle concurrent transactions and implement recovery mechanisms in database applications.
- To expose students to advanced database technologies, including distributed databases, NoSQL systems, and database security mechanisms, for building scalable and secure applications.

Detailed Syllabus

UNIT I INTRODUCTION TO DATABASE SYSTEMS **9**

Introduction to Databases– File System Vs Database System – Data Models – Schemas and Instances – DBMS Architecture – Centralized – Client Server – Database Applications–Entity-Relationship Model – Entity-Relationship Diagrams – Enhanced-ER Model

UNIT II RELATIONAL DATABASES **9**

Relational Model – Constraints – Keys – Dependencies – Relational Algebra – Unary, Binary, Set and Extended Relational Algebra operations – SQL– Data Definition – Data Manipulation and Retrieval Queries – Nested Queries – Joins – Views– Cursors – Procedures – Functions – Triggers – Embedded and Dynamic SQL

UNIT III DATABASE DESIGN **9**

Dependencies and Normal forms, - functional dependencies, 1NF, 2NF, 3NF and BCNF, 4NF, and 5NF, Domain Key Normal Form, Query processing and Query optimization

UNIT IV TRANSACTIONS **9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm

UNIT V ADVANCED DATABASE CONCEPTS **9**

Distributed Databases-Architecture-Transaction Processing-XML Database – NOSQL Databases: Introduction – CAP Theorem – Document Based systems – Key value Stores –

Column Based Systems – Graph Databases- Database Security: Security issues – Access control based on privileges – Role Based access control – SQL Injection
Total Periods: 45

Learning Resources

1	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, 7th Edition, Tata McGraw Hill, 2019
2	Ramez Elmasri and Navathe, “Fundamentals of Database Systems”, 7th Ed., Pearson, 2021
3	C. J. Date, A. Kannan and S. Swamynathan, “An Introduction to Database Systems”, 8th ed, Pearson Education, 2006
4	Andreas Meier, Michael Kaufmann, “SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management”, 1st Edition 2019.
5	https://nptel.ac.in/courses/106105175
6	https://onlinecourses.nptel.ac.in/noc25_cs40/
7	https://www.scaler.com/topics/course/dbms/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply data and relationship among data of a real time application using ER model	Apply
CO2	Formulate solutions to a broad range of query problems using relational algebra/ SQL	Apply
CO3	Apply normalization theory to normalize the relations in RDBMS to avoid redundancy and anomalies	Apply
CO4	Explain the impact and consequences of concurrent transactions, deadlock and their recovery in a realistic database application.	Understand
CO5	Describe advanced database concepts including distributed databases, NoSQL models, and database security techniques to design and manage scalable, secure data systems.	Understand

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	3	2	-	2	-	2	2	3	3
CO2	3	3	3	2	3	2	-	2	-	2	2	3	3
CO3	3	3	3	2	2	2	-	2	-	2	2	3	3
CO4	3	2	2	2	2	2	-	2	-	2	2	3	3
CO5	3	2	2	2	3	2	-	2	-	2	2	3	3
Avg.	**3**	**2.6**	**2.6**	**2**	**2.6**	**2**	**-**	**2**	**-**	**2**	**2**	**3**	**3**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS441	DESIGN AND ANALYSIS OF ALGORITHMS (Common to B. E. CSE)	L	T	P	C
		3	0	0	3

Course Objective:

- Understand the fundamental concepts of algorithms and their efficiency analysis.
- Apply various algorithm design techniques across different paradigms.
- Develop skills to analyze and optimize algorithm performance in diverse scenarios.
- Evaluate the theoretical limitations of algorithmic approaches and computational power.
- Apply appropriate strategies for solving complex and hard computational problems.

Detailed Syllabus

UNIT I INTRODUCTION **9**

Notion of an Algorithm–Fundamentals of Algorithmic Problem Solving–Important Problem Types–Fundamentals of the Analysis of Algorithm Efficiency–Analysis Framework-Asymptotic Notations and their properties – Empirical analysis – Mathematical analysis of Recursive and Non-recursive algorithms – Visualization

UNIT II BRUTE FORCE AND DIVIDE-AND-CONQUER **9**

Brute Force – String Matching-Exhaustive Search-Traveling Salesman- Problem-Knapsack Problem-Assignment problem. Divide and Conquer Methodology– Multiplication of Large Integers and Strassen's Matrix Multiplication– Closest-Pair and Convex-Hull Problems. Decrease and Conquer- Topological Sorting – Transform and Conquer: Presorting – Heaps and Heap Sort.

UNIT III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE **9**

Dynamic programming –Principle of optimality-Coin changing problem– Warshall's and Floyd's algorithms –Optimal Binary Search Trees – Multistage graph – Knapsack Problem and Memory functions. Greedy Technique – Dijkstra's algorithm – Huffman Trees and codes – 0/1 Knapsack problem.

UNIT IV ITERATIVE IMPROVEMENT **9**

The Simplex Method-The Maximum-Flow Problem–Maximum Matching in Bipartite Graphs – The Stable marriage Problem

UNIT V BACKTRACKING AND BRANCH AND BOUND **9**

Lower – Bound Arguments – P, NP, NP-Complete and NP Hard Problems. Backtracking– N-Queen problem—Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound –LIFO Search and FIFO search – Assignment Problem- Knapsack Problem–Traveling Salesman Problem.

Total Periods: 45

Learning Resources

1	Anany Levitin, ''Introduction to the Design and Analysis of Algorithms '', 3rd Edition, Pearson Education, Reprint 2021
2	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, ''Computer Algorithms / C++ '', Second Edition , Universities Press, 2019
3	Thomas H Cormen, Charles Eleiserson, Ronald L Rivest , Clifford Stein, ''Introduction to Algorithms'', 4th Edition, PHI Learning Private Limited, 2022.
4	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ''Data Structures and Algorithms'',Pearson Education, Reprint 2013.
5	S. Sridhar, ''Design and Analysis of Algorithms'', Oxford University Press, Second Edition, 2023.



6	https://nptel.ac.in/courses/106/101/106101060/
7	https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/
8	https://www.classcentral.com/course/swayam-design-and-analysis-of-algorithms-3984
9	https://www.coursera.org/learn/analysis-of-algorithms

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply mathematical techniques to analyze the efficiency of recursive and non-recursive algorithms.	Apply
CO2	Solve algorithmic problems using brute force, divide – and – conquer strategies.	Apply
CO3	Implement and apply dynamic programming and greedy techniques to develop efficient solutions.	Apply
CO4	Employ iterative improvement methods to address optimization problems.	Apply
CO5	Apply backtracking and branch-and-bound techniques to solve problems with computational limitations.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	2			2	2		3	3	3
CO2	3	3	3	2	2			2	2		3	3	3
CO3	3	3	3	2	2			2	2		3	3	3
CO4	3	3	3	2	2			2	2		3	3	3
CO5	3	3	3	2	2			2	2		3	3	3
Avg.	**3**	**3**	**2.8**	**2.2**	**2**			**2**	**2**		**3**	**3**	**3**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24EM411	**APTITUDE AND REASONING – I**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

Course Objective:

- Enhance analytical and logical reasoning skills to solve problems efficiently.
- Strengthen understanding of basic arithmetic, algebra, geometry, and data interpretation.
- Train students to approach problems systematically and apply suitable techniques.
- Foster quick thinking and reduce error rates through practice and time-bound exercises.

Detailed Syllabus

Topic titles	No. of periods
Quantitative Aptitude: • Numbers: Number series, arithmetic progression, geometric progression • HCF and LCM: Highest common factor – split method, division method, Least Common Multiples – prime factor method, division method. • Simplification – BODMAS rule • Average and Percentage • Simple and Compound Interest	20

• Profit, loss and discounts • Ratio and proportion: Ratio – compound ratio, inverse ratio. Proportion – direct proportion, inverse proportion • Mixture and □abelling□: Mixture, □abelling□, mean concentration • Problems based on ages • Partnerships: Simple partnership, compound partnership	
Reasoning: • Number series and letter series • Odd one out • Coding and decoding • Missing characters/numbers and analogies • Blood relations problems • Direction sense tests • Sequencing and ranking test	10
	Total Periods: 30

Learning Resources

1	R.V. Praveen, "Quantitative Aptitude and Reasoning", 3rd Edition , Eastern Economy Edition, PHI Learning, New Delhi, 2016
2	Dr. R.S. Aggarwal, " Quantitative Aptitude", S Chand Publishing, New Delhi 2017
3	Dr. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S Chand Publishing, New Delhi 2017
4	https://www.indiabix.com/
5	https://www.geeksforgeeks.org/
6	https://faceprep.in/
7	https://prepinsta.com/
8	https://www.javatpoint.com/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Solve quantitative aptitude problems involving arithmetic, algebra, percentages, ratios, etc., using logical approaches.	Apply
CO2	Analyze problems and apply reasoning strategies such as deduction, inference, and pattern recognition.	Analyze
CO3	Solve problems in simple and compound interest, profit, loss and discount	Apply
CO4	Solve problems based on ages and partnership	Apply
CO5	Demonstrate improved performance in time-bound aptitude tests through consistent practice.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS453	WEB TECHNOLOGIES (Common to B.E. CSE)	L	T	P	C
		1	0	4	3

Course Objective:

- Develop structured web pages using HTML5 and CSS 3 by incorporating control elements
- Understand and apply modern client-side technologies
- Develop basic server-side web applications that integrate front-end forms with back-end processing
- Develop PHP applications that interact with XML in web systems
- Develop web application using frameworks and tool

Detailed Syllabus

UNIT I WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0

Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Drag and Drop – Audio – Video controls – CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.

UNIT II CLIENT SIDE PROGRAMMING

Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation-Built-in-objects-Event Handling- DHTML with JavaScript, Jquery Introduction- JSON Introduction.

UNIT III SERVER SIDE PROGRAMMING

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies and End points concepts – DATABASE CONNECTIVITY: JDBC.

UNIT IV PHP AND XML

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL.

UNIT V INTRODUCTION TO ANGULAR AND WEB APPLICATIONS FRAMEWORKS

Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Forms, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- Django, UI & UX.

Total Periods: 15

List of Experiments

Sl. No.	List of Experiments
1	Design an interactive web page for a travel agency using HTML image maps. Embed a world map image and define hot spots on specific countries. When each hot spot is clicked, display related information such as tourist attractions or travel packages for that country.
2	Design a personal web page to showcase profile, hobbies, and contact information. To demonstrate your understanding of web design principles, create the web page using inline, internal, and external CSS styles. Ensure that each type of CSS is clearly applied and visually reflected in different sections of the page.
3	Design an online registration form for a student portal. The form should validate user inputs such as name, email, password, and mobile number on the client side using DHTML (JavaScript + HTML + CSS). Create a dynamic web page that displays real-time validation feedback without reloading the page.



4	You have joined as a trainee web administrator at a software company. Your first task is to set up an Apache Tomcat web server on a Windows/Linux system to deploy Java-based web applications. Document the complete installation steps, configuration process, and how to verify the server is running successfully.
5	Develop a college portal using Java Servlets. a. Create a web application where users can submit data through an HTML form, and the data should be processed using a Servlet. ii) Implement session tracking to maintain user information (like username or login status) across multiple pages.
6	Design and implement a three-tier web application using Java, JSP, and a MySQL database to conduct an online examination. The application should include features for student login, question retrieval, answer submission, and result generation.
7	Develop a dynamic website using PHP for a small business. The site should handle form submissions, perform server-side validation, and interact with a MySQL database to store user data. Create and test PHP programs that demonstrate these features effectively.
8	Design a data exchange format for a college admission system. Use XML to store student data, define the structure using XML Schema (XSD), and format the output using XSLT. Demonstrate how XML and XSLT can be used to separate data from presentation and ensure validation through schema.
	Total Periods: 60
	Total: 15+60 = 75 Periods

Learning Resources

1	Internet and World Wide Web: How to Program by Paul Deitel, Harvey Deitel, and Abbey Deitel 5th Edition, Pearson , 2021
2	Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing.
3	Uttam K. Roy, “Web Technologies”, Oxford University Press, 2011.
4	Learning Angular – 3rd Edition by Aristeidis Bampakos & Pablo Deeleman , 2020
5	Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2017
6	Stephen Wynkoop and John Burke “Running a Perfect Website”, QUE, 2nd Edition,1999
7	Gopalan N.P. and Akilandeswari J., “Web Technology”, Prentice Hall of India, 2011.
8	Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, 1st edition, O′Reilly
9	https://developer.mozilla.org/en-US/
10	https://www.freecodecamp.org/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Construct a basic website using HTML and Cascading Style Sheets	Apply
CO2	Construct a dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.	Apply
CO3	Develop server side programs using Servlets and JSP	Apply
CO4	Construct simple web pages in PHP and to represent data in XML format.	Apply
CO5	Develop interactive web applications	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	3	3	3	3	2	3	3	3	3	3
CO2	3	2	2	3	2	3	3	2	3	2	3	3	3
CO3	3	3	3	3	3	2	3	2	2	3	3	2	3
CO4	3	3	3	3	2	2	2	2	3	3	3	2	3
CO5	3	2	3	3	2	2	2	2	2	3	3	3	3
Avg.	**3**	**2.4**	**2.8**	**3**	**2.4**	**2.4**	**2.6**	**2**	**2.6**	**2.8**	**3**	**2.6**	**3**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD422	INTELLIGENT SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To apply basic search algorithms such as those used in solving classical AI problems like the8-puzzle, 8-queens, and crypt arithmetic.
- To implement informed search algorithms like A* and memory-bounded A* for solving path finding and optimization problems.
- To apply game-playing algorithms and CSP techniques using Minimax, alpha-beta pruning, backtracking, and constraint propagation for strategic and combinatorial problems.
- To implement reasoning techniques in propositional and first-order logic, including model checking, forward and backward chaining, and resolution.
- To construct and use probabilistic models, including I Bayes and Bayesian Networks, for inference in uncertain environments.

List of Experiments

Sl. No.	List of Experiments
1	Implement and analyze basic search strategies (Breadth-First Search, Depth-First Search, Backtracking, etc.) to solve classical AI problems such as 8-Puzzle, 8-Queens,and Crypt Arithmetic.
2	Implement and analyze A* and Memory Bounded A* (such as Simplified Memory Bounded A* – SMA*) algorithms for solving heuristic search problems.
3	Implement and analyze propositional logic model checking algorithms to verify whether a given propositional formula is satisfied in all possible models (truth assignments).
4	Implement forward chaining inference for first-order logic (FOL) and automatically derive conclusions from a given knowledge base of facts and rules.
5	Implement backward chaining inference for first-order logic (FOL) to determine if a goal can be derived from a given knowledge base of facts and rules.
6	Implement resolution-based reasoning in first-order logic (FOL) to check the satisfiability of knowledge base and derive conclusions automatically.
7	Implement Minimax algorithm for game playing(Alpha-Beta pruning)
8	Implement and analyze the solution of real-world problems such as map coloring, Sudoku, or 8-Queens using the Constraint Satisfaction Problem (CSP) framework.



9	Implement a I Bayes probabilistic model for classification and apply it to real-world datasets to predict outcomes based on prior probabilities and likelihoods.
10	Implement a Bayesian Network for a real-world scenario and perform probabilistic inference to compute the likelihood of events given evidence.
	Total Periods: 60

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply uninformed search algorithms to solve classical AI problems such as the 8-puzzle, 8-queens, and crypt arithmetic.	Apply
CO2	Implement informed search strategies such as A* and memory-bounded A* to solve path finding and optimization problems.	Apply
CO3	Apply game search algorithms and constraint satisfaction techniques to solve strategic decision-making and combinatorial problems.	Apply
CO4	Apply propositional and first-order logic to implement reasoning methods such as model checking, forward chaining, backward chaining, and resolution.	Apply
CO5	Implement probabilistic reasoning techniques using I Bayes models and Bayesian Networks for exact and approximate inference in uncertain environments.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	3	-	-	-	2	3	3	3	3
CO2	3	3	3	2	3	-	-	-	2	3	3	3	3
CO3	3	3	3	2	3	-	-	-	2	3	3	3	3
CO4	3	3	2	2	3	-	-	-	2	3	3	3	3
CO5	3	3	2	2	3	-	-	-	2	3	3	3	3
Avg.	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**2**	**3**	**3**	**3**	**3**

For PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS462	**DATABASE MANAGEMENT SYSTEMS LABORATORY (Common to B.E. CSE)**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Course Objective:

- To enable students to understand and use SQL commands for data definition, manipulation, and control to manage database tables effectively.
- To train students in writing SQL queries, including simple, nested, and join queries with aggregate functions, for efficient data retrieval and report generation.
- To introduce techniques for optimizing and simplifying database access, including the creation and use of Views, Indexes, and Synonyms for real-time applications and reporting.
- To expose students to advanced SQL features, such as stored procedures, functions, triggers, and exception handling, and demonstrate how to integrate them within applications.
- To provide practical knowledge in developing GUI-based database applications, enabling real-time interaction with backend databases.

List of Experiments

Sl. No.	List of Experiments
1	Create a database to manage student admissions. Design SQL tables using Data Definition Language (DDL) commands with appropriate integrity constraints like PRIMARY KEY, FOREIGN KEY, NOT NULL, and UNIQUE. Ensure data consistency and relational integrity among Student, Department, and Course tables.
2	Write DML queries to perform data manipulation by inserting new student details, update their phone number, address based on student request, and delete records of students those who have graduated.
3	Demonstrate the use of DCL (GRANT, REVOKE) and TCL (COMMIT, ROLLBACK, SAVEPOINT) to manage permissions and control transactions effectively in the students' management system.
4	Write SQL queries to retrieve required information using simple queries, nestequeries, subqueries, and different types of joins for the student management reports. Demonstrate how each query type helps in fetching meaningful data for academic analysis and reporting.
5	Write SQL queries using aggregation operators (like SUM, AVG, MAX, MIN, COUNT) to summarize students' marks and use GROUP BY to group results by department or subject, and apply ORDER BY to display the results in a meaningful order. Generate reports such as average marks per department, highest marks in each subject, and total number of students per batch.
6	A college database manages student records, admission numbers, and frequently accessed data from multiple tables. To improve performance and simplify access, create indexes for tables, implement Views for reporting, and Synonyms to simplify object names. Demonstrate the creation and usage of Views, indexes, and Synonyms in this scenario with appropriate SQL queries.
7	Write simple PL/SQL programs to automate repetitive database operations like inserting records, validating student marks, and calculating totals using conditional and loop constructs. Create and test PL/SQL blocks using variables, IF conditions, and loops to perform basic database tasks.
8	Create stored procedures to calculate total and average marks and a function to determine the result status (Pass/Fail) for students' academic assessment system. Demonstrate the use of both procedures and functions with sample data.
9	Create SQL triggers for the automatic update of student's arrear count status based on end semester results.
10	Implement exception handling to ensure that the test marks should be between 0 and 100 else catch and handle these errors gracefully without crashing.
11	Create an XML-based database to store student details such as name, roll number, department, and email. Design the XML file and validate it using an appropriate XML Schema Definition (XSD) to ensure data integrity. Ensure the XML follows the correct structure and all fields meet the defined constraints.
12	Develop a student record system for a training institute. The system must store data such as student name, course, contact info, and □abelling status using a NoSQL database like MongoDB. Design and create a simple NoSQL database with appropriate collections and insert sample documents to represent at least 5 students.
13	Develop a simple GUI based database application and incorporate all the above-mentioned features a. Inventory management system



	b. Library Management system c. Ticket reservation system d. Food ordering system e. Examination registration system
	Total Periods: 60

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply SQL data definition, manipulation, and control commands to create, manage, and maintain relational database tables	Apply
CO2	Perform efficient data retrieval operations using Views, simple, nested, and join queries, along with aggregate functions to generate meaningful reports.	Apply
CO3	Optimize and simplify database access in real-time applications by creating and using Views, Indexes, and Synonyms for better performance and easier reporting.	Apply
CO4	Develop and use advanced SQL features, such as stored procedures, functions, triggers, and exception handling, and integrate them within database applications.	Apply
CO5	Design and develop GUI-based applications that interact with relational databases for real-time data operations and user interface integration.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS482	DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY (Common to B.E. CSE)	L	T	P	C
		0	0	4	2

Course Objective:

- Apply algorithmic techniques to solve computational problems using recursion and non-recursive methods.
- Apply divide-and-conquer, decrease-and-conquer, and transform-and-conquer strategies to develop efficient solutions for standard algorithmic problems.
- Apply dynamic programming and greedy techniques to design solutions for optimization problems.
- Apply iterative improvement methods such as the Simplex Method to model and solve real-world optimization scenarios.
- Apply backtracking and branch-and-bound techniques to solve combinatorial and computationally hard problems.

List of Experiments

Sl. No.	List of Experiments
1	Develop a Python program that implements both recursive and non-recursive versions of factorial and Fibonacci algorithms. Compare their execution times and demonstrate how computational growth progresses from O(log n) to O(n!), helping analysts understand algorithmic efficiency and scalability in real-world data processing.
2	Create a Python program that multiplies two matrices using Strassen's Algorithm (Divide and Conquer method). Compare its execution time with the standard matrix multiplication approach to determine which is more efficient for large image or data matrix computations.
3	Write a Python program that accepts a Directed Acyclic Graph (DAG) representing task dependencies and produces a topological ordering of tasks using the DFS algorithm. Demonstrate how this approach ensures proper task scheduling without violating dependencies.
4	Develop a Python program that sorts a list of integers (e.g., product prices or student marks) using Heap Sort (Transform and Conquer method). Allow the user to visualize the heap construction process and the sorted output, illustrating how sorting algorithms enhance search efficiency in real-world applications.
5	Develop a Python program using Dynamic Programming to solve the following optimization problems: b. Coin Change Problem – Compute the minimum number of coins required to make a given amount (e.g., optimizing ATM withdrawal denominations). (ii) Floyd's Algorithm – Find shortest paths between all pairs of cities in a transportation network. (iii) Knapsack Problem – Maximize total profit/value of selected items under a given budget or weight constraint (e.g., investment portfolio optimization).
6	Develop a Python program using the Greedy Technique to solve the following problems: c. Dijkstra's Algorithm – Determine the shortest route from a source city to all other cities in a transportation or logistics network. (ii) Huffman Coding – Implement data compression for transmitting large files efficiently, displaying the generated Huffman Tree and encoded values. The program should allow the user to input data and visualize the results.
7	Develop a Python program using the Simplex Method to solve a real-world production optimization problem. For example, a factory producing two types of products wants to maximize profit while considering constraints on labor hours and raw materials.

	The program should allow the user to input the objective function and constraints, and display step-by-step tableau iterations leading to the optimal production plan.
8	Develop a Python program using the Backtracking technique to solve the following problems that simulate real-world game and puzzle logic generation: N-Queen Problem – Display all possible safe arrangements of N queens on an N×N chessboard, ensuring that no two queens attack each other. (This mimics the decision-making process in chess AI for positioning pieces safely.) Subset Sum Problem – Display all subsets of a given set that sum up to a target value. (This is useful for designing puzzle games or scenarios involving optimal subset selection, such as matching resources or scores.) The program should allow user input for each problem and display all valid configurations clearly.
9	Develop a Python program using Branch and Bound to solve the following problems: d. Assignment Problem – Assign workers to tasks so that the total cost is minimized (applicable in workforce scheduling). (ii) Traveling Salesman Problem (TSP) – Determine the optimal route for a delivery truck visiting multiple cities exactly once with minimum total distance. The program should take user input for costs or distances and clearly display the optimal path and total cost.
	Total Periods: 60

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Develop Python programs implementing recursive and non-recursive algorithms and compare their efficiency in terms of execution time and space usage.	Apply
CO2	Apply brute-force, divide-and-conquer, decrease-and-conquer, and transform-and-conquer techniques to solve standard algorithmic problems.	Apply
CO3	Apply dynamic programming and greedy techniques to solve optimization problems efficiently.	Apply
CO4	Apply iterative improvement methods to develop solutions for real-world optimization scenarios.	Apply
CO5	Implement backtrackingand branch-and-bound to handle problems with computational limitations or intractability.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24EM422	SOFT SKILLS AND PERSONALITY DEVELOPMENT – I	L	T	P	C
		0	0	2	1

Course Objective:

- To understand and interpret human perception and behavior, enhancing interpersonal awareness.
- To enhance self-management, including habit formation, stress regulation, and personal productivity
- Develop conflict resolution skills, aiming for win win outcomes through structured strategies.
- Strengthen communication abilities—active listening, telephone etiquette, and overcoming listening barriers.

List of Exercises

Sl. No.	List of Exercises
1	Introduction: A New Approach to Learning, Planning and Goal-Setting
2	Human Perceptions: Understanding People
3	Aiming for Excellence: Developing Potential and Self-Actualisation
4	Self-Management Skills- Time management & Self-motivation
5	Self-Management Skills- Stress management & Adaptability
6	Conflict Resolution Skills
7	Using The Zeigarnik Effect for Productivity and Personal Growth, Forming Habits of Success
8	Communication: Significance of Listening, Active Listening, Barriers to Active Listening
9	Telephone Communication: Basic Telephone Skills, Advanced Telephone Skills , Essential Telephone Skills
10	Profile Building
	Total Periods: 30

Learning Resources

1	Dorch, Patricia. What Are Soft Skills? New York: Execudress Publisher, 2013.
2	Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3	Klaus, Peggy, Jane Rohman & Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4	Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Develop an actionable growth plan aligning self-development with objectives.	Apply
CO2	Analyze the habit loop; design personal interventions to break bad habits.	Analyze
CO3	Analyze examples of interpersonal conflict; propose dual solutions using conflict-model frameworks.	Analyze
CO4	Apply stress management strategies: reframing, planning, relaxation exercises.	Apply
CO5	Apply techniques to rectify the barriers in active listening	Apply



Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATE – GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24AD511	Machine Learning	PCC	3	0	0	3	3	40	60
2	U24AD521	Data Science and Analytics	PCC	3	0	0	3	3	40	60
3	U24AD531	Cryptography and Cyber Security	PCC	3	0	0	3	3	40	60
4	U24EM511	Aptitude and Reasoning – II	EEC	2	0	0	2	2	100	NIL
5	U24EM521	Leadership and Team Management	EEC	2	0	0	2	2	40	60
6		Professional Elective-I	PEC							
THEORY CUM PRACTICAL COURSES										
7	U24CS533	Embedded Systems and IoT System Design	PCC	1	0	4	5	3	50	50
PRACTICAL COURSES										
8	U24AD542	Machine Learning Laboratory	PCC	0	0	4	4	2	60	40
9	U24AD552	Data Science and Analytics Laboratory	PCC	0	0	4	4	2	60	40
10	U24EM532	Soft skill and Personality Development – II	EEC	0	0	2	2	1	100	NIL
				17	**0**	**14**	**31**	**24**		

Assessment Scheme

Sl. No	Course Type	L	T	P	C	CIA Weightage (Theory)				CIA	ESE		CIA (W)	ESE (W)	Min. Marks to Pass for 100	
						T1	A1	T2	A2	Prac	Th	Prac			ESE	Total
1	U24AD511	3	0	0	3	60	40	60	40	-	100		40	60	45	50
2	U24AD521	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	U24AD531	3	0	0	3	60	40	60	40	-	100		40	60	45	50
4	U24EM511	2	0	0	2	-	-	-	-	-	-	-	100	-	-	50
5	U24EM521	2	0	0	2	60	40	60	40	-	100		40	60	45	50
6	PEC – I														45	50
7	U24CS533	1	0	4	3	-	-	60	40	100	-	100	50	50	45	50
8	U24AD542	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
9	U24AD552	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
10	U24EM532	0	0	2	1	-	-	-	-	-	-	-	100	-	-	50

(W) – Weightage

U24AD511	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objective:

- Understand the fundamental concepts, types, and modelling approaches of Machine Learning.
- Analyze and apply classification techniques such as Decision Trees, Support Vector Machines, and regularization methods.
- Explore and implement ensemble methods, clustering algorithms, and dimensionality reduction techniques.
- Examine and apply probabilistic learning models including Bayesian methods, graphical models, and Markov processes.
- Design and develop machine learning models using Artificial Neural Networks and Reinforcement Learning techniques.

Detailed Syllabus

UNIT I 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 II 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 III 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 IV PROBABILISTIC LEARNING MODEL 9 Bayesian Learning – I 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 V 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 Periods: 45

Learning Resources

1	Ameet V Joshi, “Machine Learning and Artificial Intelligence”, Springer Publications, 2023.
2	Sridhar S. and Vijayalakshmi M., “Machine Learning”, Oxford University Press, 2022.
3	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer Publications, 2016.

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
5	Tom Mitchell, "Machine Learning", McGraw-Hill, 1997
6	Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial Intelligence: A Modern Approach, Prentice Hall, 2020
7	Machine Learning Dummies, John Paul Muller, Luca Massaron, Wiley Publications, 2021
8	Jerome Friedman, Robert Tibshirani, Trevor Hastie, "The Elements of Statistical Learning", Springer, 2017.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe and differentiate the fundamental concepts, types, and basic models of Machine Learning.	Understand
CO2	Apply and evaluate classification techniques such as Decision Trees, Support Vector Machines, and regularization methods to solve real-world problems.	Apply
CO3	Implement ensemble methods, clustering algorithms, and dimensionality reduction techniques for improved model performance.	Apply
CO4	Analyze and construct probabilistic models using Bayesian methods, graphical models, and Markov processes for inference and prediction.	Analyze
CO5	Develop intelligent systems using Artificial Neural Networks and Reinforcement Learning techniques.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	1	-	-	2	2	-	2	2	1
CO2	3	3	2	2	2	-	-	2	2	-	2	2	2
CO3	3	3	3	2	3	-	-	2	2	-	2	3	2
CO4	3	3	2	2	2	-	-	2	2	-	2	2	2
CO5	3	3	3	2	3	-	-	2	2	-	2	3	3
Avg.	**3**	**2.8**	**2.2**	**2**	**2.2**	**-**	**-**	**2**	**2**	**-**	**2**	**2.4**	**2**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD521	DATA SCIENCE AND ANALYTICS	L	T	P	C
		3	0	0	3

Course Objective:

- Understand and apply data collection, pre-processing, and data cleaning techniques in data science.
- Analyze and summarize data using descriptive statistics and visualization methods.
- Apply machine learning techniques for regression and classification tasks.
- Evaluate models using appropriate data handling strategies and performance metrics.
- Analyze and interpret data analytics methods such as feature selection, error measurement, and predictive modelling.

Detailed Syllabus

UNIT I INTRODUCTION TO DATA SCIENCE	**9**
Introduction to Data Science – Overview of Data – Sources of Data – Types of Data – data distribution –Data Collection methods-User studies in Lab and Field-Web Scrapping-Categories of Data Cleaning -Tools for Data Science.	
UNIT II DESCRIPTIVE DATA ANALYSIS	**9**
Dataset Construction – Sampling of data – Stem and Leaf Plots – Frequency table – Time Series data – Central Tendency Measures of the location of data – Dispersion measures – Correlation analysis – basics of Principal Component analysis (PCA) – Independent component analysis – Hypothesis testing – Statistical Tests.	
UNIT III PREDICTIVE MODELLING: REGRESSION AND CLASSIFICATION	**9**
Overview of Machine learning concepts – Rules for data splitting – Model construction using regression and Classification models – Linear regression and multiple regression models – KNN classification models –Comparison Models- Regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.	
UNIT IV DATA HANDLING AND MODEL EVALUATION	**9**
Data aggregation – Data Transformation: merging datasets, reshaping data – Data enrichment: missing values ,Normalization-Model Evaluation – Cross-validation techniques – Accuracy metrics – Model Performance Analysis: Contingency table, ROC curve, Precision-recall curves	
UNIT V DATA ANALYTICS	**9**
Introduction- Information-based learning- Handling alternative feature selection – Impurity metrics - Continuous descriptive features and targets- Similarity-based learning- Feature space- Predicting continuous targets-Error based learning- Measuring Error.	
	Total Periods :45

Learning Resources

1	Davy Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2	Grus, Joel, “Data science from scratch: first principles with python”, O’Reilly Media, 2nd Edition, 2019.
3	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
4	Peter Bruce, Andrew Bruce, Peter Gedeck,” Practical Statistics for Data Scientists”, O′Reilly; 2nd edition, 2020.



Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply data collection, inspection, and pre-processing techniques for data cleaning.	Apply
CO2	Analyze and summarize datasets using descriptive statistical methods.	Analyze
CO3	Apply regression and classification models to solve real-world data science problems using programming tools.	Apply
CO4	Evaluate model performance using data handling strategies and validation techniques.	Evaluate
CO5	Analyze and interpret data analytics methods to improve model accuracy and insights.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	2	-	-	2	2	-	2	2	1
CO2	3	3	2	2	2	-	-	2	2	-	2	2	2
CO3	3	3	3	2	3	-	-	2	2	-	2	3	3
CO4	3	3	2	2	3	-	-	2	2	-	2	2	2
CO5	3	3	2	2	2	-	-	2	2	-	2	3	2
Avg.	**3**	**2.8**	**2**	**2**	**2.4**	**-**	**-**	**2**	**2**	**-**	**2**	**2.4**	**2**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD531	**CRYPTOGRAPHY AND CYBER SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- Understand and analyze fundamental concepts of computer security, security models, and cryptographic systems.
- Apply mathematical foundations and symmetric key cryptographic techniques for secure communication.
- Analyze and implement asymmetric cryptographic algorithms and key exchange mechanisms.
- Evaluate authentication, integrity, and digital signature schemes used in secure systems.
- Understand and assess cyber threats, cybercrimes, and security mechanisms in modern computing environments.

Detailed Syllabus

UNIT I INTRODUCTION TO SECURITY **9**

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

UNIT II SYMMETRIC CIPHERS **9**

Number theory – Algebraic Structures – Modular Arithmetic – Euclid‘s algorithm – Congruence and matrices – Group, Rings, Fields, Finite Fields SYMMETRIC KEY CIPHERS: SDES – Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis – Block cipher design

principles – Block cipher mode of operation – Evaluation criteria for AES – Pseudorandom Number Generators – RC4 – Key distribution.
UNIT III ASYMMETRIC CRYPTOGRAPHY 9 Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem – Chinese Remainder Theorem – Exponentiation and logarithm ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange – Elliptic curve arithmetic – Elliptic curve cryptography.
UNIT IV INTEGRITY AND AUTHENTICATION ALGORITHMS 9 Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords, Challenge Response protocols – Authentication applications – Kerberos MUTUAL TRUST: Key management and distribution – Symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates.
UNIT V CYBER CRIMES AND CYBER SECURITY 9 Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security.
Total Periods: 45

Learning Resources

1	William Stallings, "Cryptography and Network Security – Principles and Practice", Seventh Edition, Pearson Education, 2017.
2	Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives", First Edition, Wiley India, 2011.
3	Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata Mc Graw Hill, 2015
4	Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe and differentiate security concepts, types of attacks, and fundamental cryptographic principles.	Understand
CO2	Apply symmetric key cryptographic techniques and mathematical foundations for secure communication.	Apply
CO3	Implement asymmetric cryptographic algorithms and key exchange mechanisms.	Apply
CO4	Evaluate authentication, integrity, and digital signature schemes for secure systems.	Evaluate
CO5	Analyze cyber threats and apply appropriate cybersecurity measures to mitigate risks.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	1			2	2		2	2	1
CO2	3	3	2	2	2			2	2		2	2	2
CO3	3	3	3	2	2			2	2		2	3	2
CO4	3	3	2	2	2			2	2		2	2	2
CO5	3	3	2	2	3			2	2		2	3	3
Avg.	**3**	**2.8**	**2**	**2**	**2**			**2**	**2**		**2**	**2.4**	**2**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight(Low)

U24EM4511	APTITUDE AND RESONING – II	L	T	P	C
		2	0	0	2

Course Objective:

- Enhance analytical and logical reasoning skills to solve problems efficiently.
- Strengthen understanding of basic arithmetic, algebra, geometry, and data interpretation.
- Train students to approach problems systematically and apply suitable techniques.
- Foster quick thinking and reduce error rates through practice and time-bound exercises**.**
- Understand data interpretation using bar chart, pie chart and table chart

Detailed Syllabus

Topic titles	No of periods
Quantitative aptitude • Time and work • Pipes and Cistern • Chain Rule and wages • Time speed and distance • Train problems • Boats and streams • Races and games • Permutations and Combinations • Probability • Heights and distance • Logarithms • Surds and indices • Mensuration – 2D, 3D • Date interpretation – pie chart, bar chart, table chart. Data sufficiency in logical reasoning	20
Reasoning: • Symbols and notations • Mathematical operators and Venn diagrams • Puzzles • Cubes and Dice	10

• Clocks and Calendars • Critical Reasoning • Non-verbal reasoning • Verbal Ability	
	Total Periods: 30

Learning Resources

1	R.V. Praveen, "Quantitative Aptitude and Reasoning", 3rd Edition, Eastern Economy Edition, PHI Learning, New Delhi, 2016
2	Dr. R.S. Aggarwal, "Quantitative Aptitude", S Chand Publishing, New Delhi 2017
3	Dr. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", S Chand Publishing, New Delhi 2017
4	https://www.indiabix.com/
5	https://www.geeksforgeeks.org/
6	https://faceprep.in/
7	https://prepinsta.com/
8	https://www.javatpoint.com/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Solve quantitative aptitude problems involving time & work, chain rule and wages etc., using logical approaches.	Apply
CO2	Analyze problems and apply reasoning strategies such as deduction, inference, and pattern recognition.	Analyse
CO3	Solve problems on data interpretation, including bar charts, pie charts, tables, and graphs.	Apply
CO4	Solve problems in probability, height and distance and logarithms logically	Apply
CO5	Demonstrate improved performance in time-bound aptitude tests through consistent practice.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24MG511	LEADERSHIP AND TEAM MANAGEMENT	L	T	P	C
		2	0	0	2

Course Objective:

- To introduce students to fundamental leadership theories, models, and frameworks for understanding leadership effectiveness.
- To develop the ability to analyze leadership styles, personality traits, emotional intelligence, and ethical values in organizational contexts.
- To enhance students' competence in evaluating leadership behaviour, decision-making, and crisis management in diverse environments.
- To equip students with skills to lead groups and teams through effective communication, delegation, conflict management, and motivation.
- To enable students to design and apply strategies for developing high-performance, multicultural, and virtual teams using contemporary leadership practices.

Detailed Syllabus

UNIT I INTRODUCTION TO LEADERSHIP & TEAM MANAGEMENT	**6**
Leadership Myths; Interactional Framework for analyzing leadership; Leadership Development: The First 90 Days as a Leader; Leader Development- The Action-Observation-Reflection Model. LMX Theory and Normative Decision Model; Situational Leadership Model; Contingency Model and Path Goal Theory.	
UNIT II LEADERSHIP TYPES AND ATTRIBUTES	**6**
Emotional Approach Charismatic and Transformational Leadership; Leadership for Tomorrow, Leadership Attributes; Personality Traits and Leadership; Personality Types and Leadership; Intelligence and Leadership; Emotional Intelligence and Leadership. Power and Leadership; The art of influence in leadership; Leadership and "Doing the Right Things; Character-Based Approach to Leadership; Role of Ethics and Values in Organisational Leadership	
UNIT III LEADERSHIP BEHAVIOUR	**6**
Leadership Behaviour, Assessing Leadership Behaviour: Multi-rater feedback instruments, The Dark Side of Leadership -Destructive Leadership, Managerial Incompetence and Derailment, Negotiation and Leadership, Leadership in Crisis Situation, The Situation and The Environment, Culture and Leadership, Global Leadership, Motivation and Leadership	
UNIT IV INTRODUCTION TO GROUPS AND TEAMS	**6**
Characteristics of Leaders, Followers and Situation, Group Dynamics, Team Formation, Delegation and Empowerment, Leading Teams: Enhancing Teamwork Within a Group, The Leader's Role in Team-Based Organizations, Leader Actions That Foster Team Effectiveness, Offsite Training and Team Development, Understanding Team Processes and Team Coaching, Team Decision Making and Conflict Management, Virtual Teams	
UNIT V MANAGING MULTICULTURAL TEAMS	**6**
Building Great Teams, Experiential Learning, Action Learning, Developmental Planning: Gaps Analysis, Coaching and Mentoring, Women in Leadership Roles, Building Effective Relationship with Subordinates and Peers, Fostering Followers Satisfaction, The Art of Communication, Setting Goals and Providing Constructive Feedback, Enhancing Creativity Problem Solving Skill, Building High-Performance Teams: The Rocket Model, Building Credibility and Trust, Skills for Developing others.	
TotalPeriods:30	

Learning Resources

1	Peter G. Northouse, "Leadership: Theory and Practice", 8th Edition, Sage Publications, 2019.

2	Stephen P. Robbins and Timothy A. Judge, “Organizational Behavior”, 18th Edition, Pearson Education, 2019.
3	Robert N. Lussier and Christopher F. Achua, “Leadership: Theory, Application, and Skill Development”, 6th Edition, Cengage Learning, 2016.
4	Jon R. Katzenbach and Douglas K. Smith, “The Wisdom of Teams”, Harvard Business School Press, 2005.
5	Daniel Goleman, “Emotional Intelligence”, Bantam Books, 2006.
6	Leadership and Team Effectiveness, Dr. Santosh Rangnekar, IIT Roorkee (NPTEL Course) https://onlinecourses.nptel.ac.in/noc22_mg39/preview

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain and compare major leadership theories, models, and frameworks.	Understand
CO2	Describe leadership styles, attributes, personality, and emotional intelligence in organizational situations.	Understand
CO3	Discuss leadership behaviour, ethics, power, and decision-making in complex and crisis situations.	Understand
CO4	Illustrate leadership principles to manage groups, teams, conflicts, and motivation effectively.	Understand
CO5	Explain leadership development and team-building strategies for high-performance, multicultural, and virtual teams.	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CS533	EMBEDDED SYSTEMS AND IOT SYSTEM DESIGN (Common to B.E. CSE)	L	T	P	C
		1	0	4	3

Course Objective:

- To understand the architecture and operation of 8-bit microcontrollers for embedded applications.
- To develop programs using Embedded C for real-time operations and multitasking.
- To evaluate the operation and interfacing of various sensors used in IoT environments.
- To analyze and implement sensor integration using Arduino and Raspberry Pi with appropriate communication protocols.
- To analyze real-time IoT case studies and assess the potential of IoT solutions in various application domains

Detailed Syllabus

UNIT I 8-BIT EMBEDDED PROCESSOR 8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling.
UNIT II EMBEDDED C PROGRAMMING Memory and I/O Devices Interfacing – Programming Embedded Systems in C – Need for RTOS – Multiple Tasks and Processes – Context Switching – Priority-Based Scheduling Policies
UNIT III SENSORS Introduction and need for sensors in IoT – Classification of sensors – active and passive – Analog and digital sensors – working principles – Ultrasonic sensor: operation and interfacing – Temperature and humidity sensor: operation and interfacing.
UNIT IV SENSOR INTEGRATION AND CLOUD PLATFORM Sensor data acquisition using Arduino & Raspberry Pi – Data communication protocols – MQTT & HTTP – IoT cloud platforms Overview: ThingSpeak, Blynk, AWS IoT – Uploading sensor data to cloud – Real-time monitoring and data visualization.
UNIT V CASE STUDIES Smart home automation using IoT – Smart city applications and traffic monitoring – IoT-based environmental monitoring system – Smart agriculture and irrigation system – Industrial IoT applications – Future trends and challenges in IoT.
Total Periods: 15

List of Experiments

Sl. No.	List of Experiments
1	Write 8051 Assembly Language experiments using simulator.
2	Test data transfer between registers and memory.
3	Perform ALU operations.
4	Write Basic and arithmetic Programs Using Embedded C.
5	Introduction to Arduino platform and programming
6	Explore different communication methods with IoT devices(Zigbee, GSM, Bluetooth)
7	Introduction to Raspberry PI platform and python programming

8	Interfacing sensors with Raspberry PI
9	Communicate between Arduino and Raspberry PI using any wireless medium
10	Setup a cloud platform to log the data
11	Log Data using Raspberry PI and upload to the cloud platform Design an IOT based system
12	Mini Projects: Design an IOT based system. (i) Smart Home Automation using IoT (ii) IoT-based Smart Agriculture System (iii) IoT-based Environmental Monitoring System (iv) IoT-based Smart Parking System (v) IoT-based Industrial Application System (vi) IoT-based EV Charging & Fleet Monitoring System
	Total Periods: 60
	Total: 15+60 = 75 Periods

Learning Resources

1	Peter Waher, "Mastering the Internet of Things: Design and Deploy Solutions Using IoT Platforms",Packt Publishing,2nd Edition, 2023
2	David Hanes et al., "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, First Edition 2022.
3	"Introduction to Internet of Things", Prof.SudipMisra,IIT Kharagpur, NPTEL. https://nptel.ac.in/courses/106105166
4	"Components and Applications of Internet of Things", Prof. Sanjoy Kumar Parida, IIT Patna-, Swayam. https://onlinecourses.swayam2.ac.in/arp19_ap52/preview

Course Outcomes

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

CO	Course outcome Statement	Knowledge Level
CO1	Describe the architecture, instruction set, and programming of 8-bit embedded processors.	Analyze
CO2	Develop embedded C programs for interfacing peripherals and managing multiple tasks using RTOS concepts.	Apply
CO3	Integrate multiple sensors with Arduino and Raspberry Pi using appropriate communication protocols to create functional IoT prototypes.	Evaluate
CO4	Develop cloud-enabled IoT systems for real-time data monitoring and visualization.	Create
CO5	Design IoT-based solutions for domains such as smart homes, agriculture, industries, and environment monitoring..	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3			2	3	3		2	3	3
CO2	3	3	3	3		3	2	3	3	3	2	3	3
CO3	3	3	3	3		3	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	2	3	3	3	2	3	3
CO5	3	3	3	3	3	3	2	3	3	3	2	3	3
Avg.	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**3.0**	**3.0**	**3.0**	**2.0**	**3.0**	**3.0**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD542	MACHINE LEARNING LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- Apply data pre-processing and visualization techniques to prepare datasets for analysis.
- Develop machine learning models for classification, regression, and clustering tasks.
- Employ ensemble techniques and methods to improve model performance and avoid overfitting.
- Design and implement Artificial Neural Networks for solving machine learning problems.
- Apply machine learning algorithms to solve practical problems in real-world scenarios.

List of Experiments

Sl. No.	List of Experiments
1	Explore datasets like Iris or MNIST to understand data patterns, distributions, and detect missing values, using plots like histograms, scatter plots, and pair plots to visualize key characteristics.
2	Implement the ID3 decision tree algorithm to classify data based on features, such as predicting student performance or species type, and visualize the decision tree to interpret predictions.
3	Apply techniques like train-test split, cross-validation, and regularization to handle overfitting and ensure the model generalizes well for real-world predictions.
4	Use Support Vector Machines (SVM) to classify complex datasets, such as distinguishing spam emails from non-spam, creating robust decision boundaries.
5	Apply ensemble methods like Bagging, Boosting, and DECORATE to improve accuracy and reduce variance in predictions, useful in real-world problems such as crop disease or customer behavior prediction.
6	Implement k-Nearest Neighbour (KNN) to classify or recommend items based on similarity to existing data points, ideal for recommendation systems or pattern recognition tasks.
7	Use k-Means clustering to group similar data points, for example segmenting customers by purchasing patterns, supporting real-time decision-making in marketing and analytics.
8	Apply I Bayes to classify text or categorical data efficiently, such as abelling reviews as positive or negative, which is simple yet effective for sentiment analysis and spam detection.
9	Use linear regression to predict continuous outcomes like sales, temperature, or stock prices from input features, useful for forecasting and trend analysis.
10	Train an Artificial Neural Network (ANN) with backpropagation to recognize patterns such as handwritten digits or classification tasks, optimizing network weights for accuracy.
11	Build a facial recognition system using ANN to detect and recognize faces in images or video streams, applicable in attendance systems or security applications.



12	Apply Random Forest to analyze social media posts or reviews, classify sentiment as positive, negative, or neutral, and generate insights for marketing and customer feedback.
	Total Periods: 60

Learning Resources

1	Ameet V Joshi, “Machine Learning and Artificial Intelligence”, Springer Publications, 2020.
2	Sridhar S. and Vijayalakshmi M., “Machine Learning”, Oxford University Press, 2021.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply techniques to analyze datasets, identify patterns, distributions, and missing values using visualization tools.	Apply
CO2	Develop and implement machine learning models for classification, regression, and prediction tasks.	Apply
CO3	Employ ensemble methods and overfitting prevention techniques to improve model accuracy and generalization.	Apply
CO4	Implement Artificial Neural Networks for pattern recognition, facial recognition, and related applications.	Apply
CO5	Apply machine learning algorithms to solve real-world problems such as fraud detection and sentiment analysis.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	2	2	2	2	2	2	3	2
CO2	3	2	3	2	2	2	2	2	2	2	2	3	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	2	2	2	2	3	2
CO5	3	3	3	2	2	2	2	2	2	2	2	3	3
Avg.	**2.8**	**2.2**	**2.6**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.8**	**2.2**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD552	DATA SCIENCE AND ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- Apply the pre-processing techniques to prepare data for analysis.
- Apply the Exploratory data analysis to the datasets.
- Analyze the data using multiple regression techniques.
- Apply the data normalization and evaluate the model performance.
- Apply the feature selection techniques and implement the data analysis using similarity-based learning method.

List of Experiments

Sl No	List of Experiments
1	Explore the features of NumPy, SciPy, Jupyter, Stats models and Pandas packages.
2	A business analyst is preparing a comprehensive sales performance report for her organization. The required data comes from multiple sources: e. monthly sales logs stored as text files, f. detailed customer records stored in Excel sheets g. real-time market data available on the web. Read the data from text files, Excel and the web.
3	Exploring various commands for doing descriptive analytics on the Iris data set.
4	Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following: h. 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.
5	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
6	Apply the data aggregation operations such as grouping and summarizing values in the dataset.
7	A healthcare analytics company is developing a predictive model to identify patients at high risk of developing a chronic disease. The dataset collected from multiple hospitals contains several numerical and categorical features, but some entries are missing due to incomplete patient records. To Handle missing values, apply data normalization, and perform appropriate data transformation techniques.
8	Apply cross-validation to evaluate the performance of a predictive model, and use accuracy metrics such as ROC curves and precision-recall curves to assess the model's effectiveness.
9	Analyze the classifier performance using the precision –recall curves.
10	Analyze the different data normalization techniques for the data enrichment.
11	A real-estate company wants to predict house prices using a dataset containing both continuous and categorical features. Apply feature selection techniques to identify the most relevant predictors for the continuous target.
12	Implement a similarity-based learning method and evaluate the model's performance by measuring errors to refine the model's accuracy.

13	Calculate Gini Impurity and Entropy using a Decision Tree Classifier
	Total Periods: 60

Learning Resources

1	Davy Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2	Grus, Joel, “Data science from scratch: first principles with python”, O’Reilly Media, 2019.
3	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
4	Peter Bruce, Andrew Bruce, Peter Gedeck,” Practical Statistics for Data Scientists”, O′Reilly; 2nd edition, 2020.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply the pre-processing techniques for the data analysis.	Apply
CO2	Apply the Regression and correlation of the variables of the data.	Apply
CO3	Analyze and interpret univariate and bivariate data using appropriate visualization techniques to identify patterns, relationships, and trends.	Analyze
CO4	Apply the aggregation, normalization of the data and evaluate the model performance.	Apply
CO5	Apply the feature selection techniques and the learning methods for data analysis by identifying key features and accurately predicting or grouping data points.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	3	2	3	2	2	2	2	1		3	2
CO2	2	3	3	3	3	2	2	2	2	1		3	2
CO3	2	3	3	3	3	2	2	2	2	2		3	3
CO4	3	3	3	3	3	2	2	2	2	1	1	3	3
CO5	3	3	3	3	3	2	2	2	3	2	1	3	3
Avg.	**2.4**	**2.8**	**3**	**2.8**	**3**	**2**	**2**	**2**	**2.2**	**1.4**	**1**	**3**	**2.6**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24EM522	**SOFT SKILLS AND PERSONALITY DEVELOPMENT – II**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objective:

- To improve written communication etiquette, covering email principles, netiquette, and proper messaging practices.
- To communicate effectively with clarity, active listening, and overcoming sender–receiver barriers.
- To develop non-verbal awareness, interpreting body language and cues, especially in high-stakes contexts (interviews, presentations).

- To enhance public speaking and presentation skills using visuals, confidence building, and anxiety management.
- To cultivate integrity-driven human relations, emphasizing listening, trust, and ethical communication

List of Exercises

Sl. No.	List of Exercises
1	Technology and Communication: Technological Personality, Mobile Personality?
2	Communication Skills: Effective Communication
3	Barriers to Communication: Arising out of Sender/Receiver's Personality, Interpersonal Transactions, Miscommunication
4	Nonverbal Communication: Introduction And Importance, Issues and Types, Basics and Universals
5	Body Language: For Interviews, For Group Discussions
6	Presentation Skills: Overcoming Fear, Becoming A Professional, The Role of Body Language
7	Presentation Skills: Using Visuals
8	Reading Skills: Effective Reading
9	Human Relations: Developing Trust and Integrity
10	Visume
	Total Periods: 30

Learning Resources

1	Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2	Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3	Klaus, Peggy, Jane Rohman & Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4	Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
5	Enhancing Soft Skills and Personality, Dr. T. Ravichandran, IIT Kanpur NPTEL Course: https://onlinecourses.nptel.ac.in/noc26_hs47/preview
6	Developing Soft Skills and Personality, Dr. T. Ravichandran, IIT Kanpur NPTEL Course: https://nptel.ac.in/courses/109104107

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Write effective emails using email principles and etiquette	Apply

CO2	Design visuals using principles of clarity, readability, and relevance (graphs, slides, props).	Apply
CO3	Apply the communication model to real-world situations, accounting for tone, style, barriers	Apply
CO4	Compare self-assessed nonverbal behaviours to standardized benchmarks.	Understand
CO5	Apply confident body language techniques in interviews and group discussion simulations.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATE – GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24CS611	Cloud Computing	PEC	3	0	0	3	3	40	60
2	U24AD611	Deep Learning	PCC	3	0	0	3	3	40	60
3	U24MG611	Project Management	HSMC	2	0	0	2	2	40	60
4	U24MG621	Entrepreneurship	EEC	2	0	0	2	2	40	60
5		Professional Elective-II	PEC							
6		Professional Elective-III	PEC							
7		Open Elective-I	OEC							
8		Mandatory Course-I*	MC	3	0	0	3	0	100	NIL
PRACTICAL COURSES										
9	U24CS632	Cloud Computing Laboratory	PCC	0	0	4	4	2	60	40
10	U24AD622	Deep Learning Laboratory	PCC	0	0	4	4	2	60	40

*Mandatory Course (Non-CGPA Course)

Assessment Scheme

Sl. No	Course Type	L	T	P	C	CIA Weightage (Theory)				CIA	ESE		CIA (W)	ESE (W)	Min. Marks to Pass for 100	
						T1	A1	T2	A2	Prac	Th	Prac			ESE	Total
1	U24CS611	3	0	0	3	60	40	60	40	-	100		40	60	45	50
2	U24AD611	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	U24MG611	2	0	0	2	60	40	60	40	-	100		40	60	45	50
4	U24MG621	2	0	0	2	60	40	60	40	-	100		40	60	45	50
5	PEC – II														45	50
6	PEC – III														45	50
7	OEC – I														45	50
8	MC	3	0	0	3	-	-	-	-	-	-	-	100	-	-	50
9	U24CS632	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
10	U24AD622	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50

(W) – Weightage

U24CS611	CLOUD COMPUTING (Common to B.E. CSE)	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

Detailed Syllabus

UNIT I CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	**9**
Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges	
UNIT II VIRTUALIZATION BASICS	**9**
Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.	
UNIT III VIRTUALIZATION INFRASTRUCTURE AND DOCKER	**9**
Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.	
UNIT IV CLOUD PLATFORMS AND INFRASTRUCTURE AUTOMATION	**9**
Infrastructure as Code (IaC), Introduction to Terraform, Benefits of IaC in cloud provisioning, Programming Support for Google App Engine Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.	
UNIT V CLOUD SECURITY	**9**
Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyper jacking. Cloud Security and risk: Types of risks- Data Security and Storage; Identity and Access Management (IAM) – IAM Challenges – IAM Architecture and Practice.	
	Total Periods :45

Learning Resources

1	Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, 2nd Edition, Elsevier 2018
2	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Para Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
3	Docker Deep Dive: Zero to Docker in a Single Book (3rd Ed) — A 2024 edition by Nigel Poult
4	Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi, Mastering Cloud Computing McGrawHill Education, 1st Edition, 2017.
5	Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy: an enterprise perspective on risks and compliance”, O’Reilly Media, Inc., 2009.
6	https://www.nist.gov/itl/cloud
7	https://docs.aws.amazon.com/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain cloud architecture, models, and NIST framework.	Understand
CO2	Describe and analyze virtualization fundamentals	Understand
CO3	Experiment with virtualization of hardware resources and Docker.	Apply
CO4	Develop and deploy services on the cloud and set up a cloud environment.	Apply
CO5	Apply security mechanisms, including IAM, to protect cloud systems against various threats.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	2	-	-	2	3	2	3	2	3
CO2	3	2	2	-	2	-	-	2	2	2	3	3	3
CO3	3	3	2	-	2	-	-	3	2	2	3	3	3
CO4	3	2	3	-	3	-	-	3	3	2	2	3	3
CO5	2	3	3	-	3	-	-	2	2	2	2	3	2
Avg.	2.8	2.6	2.4	-	2.4	-	-	2.4	2.4	2	2.6	2.8	2.8

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD611	DEEP LEARNING	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the mathematical foundations, machine learning basics, and architecture of deep feedforward networks.
- To learn regularization and optimization techniques, including hyperparameter tuning and model evaluation metrics.
- To understand the principles and design of Convolutional Neural Networks (CNNs) for image and visual data.
- To comprehend Recurrent Neural Networks (RNNs) and their variants for sequential and time-dependent data.
- To understand autoencoders and generative models, including PCA, variational autoencoders (VAE), and generative adversarial networks (GANs), for dimensionality reduction and data generation.

Detailed Syllabus

UNIT I BASICS FOR DEEP LEARNING **9**

Mathematical Preliminaries of Deep learning:Linear Algebra: Scalars -- Vectors -- Matrices and tensors; Probability Distributions -- Gradient-based Optimization: Gradient Descent algorithm -- Delta Rule and Learning Rate – Backpropagation -- Stochastic and Minibatch Gradient -- Machine Learning Basics: Capacity -- Overfitting Vs underfitting -- Training set, Test set and validation set, Estimators, Bias and variance -- Deep feed forward networks: Introduction, Shallow Neural Network, Deep Neural Network: Learning XOR -- Deep learning software Libraries.

UNIT II REGULARIZATION AND OPTIMIZATION TECHNIQUES **9**

Regularization: Activation functions and Cost functions- Batch Normalization- Regularization for Deep learning, Early Stopping, Drop out. Optimization Techniques: Linear Neurons and their

Limitations – Sigmoid, Tanh and Relu Functions – Softmax Output Layers-- Other Optimization Algorithms: Adagrad, RMSProp, Adadelta, Adam-- Data Augmentation -- Optimizer Selection. Model Evaluation: Performance metrics -- Baseline Models -- Hyperparameters: Manual Hyperparameter -- Automatic Hyperparameter -- Grid search -- Random search -- Debugging strategies.
UNIT III CONVOLUTIONAL NEURAL NETWORKS 9 Neurons in Human Vision -- 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 IV 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 V AUTOENCODERS AND GENERATIVE MODELS 9 Dimensionality Reduction Techniques: Principal Component Analysis (PCA) **--** Autoencoders: Undercomplete autoencoders -- Regularized autoencoders -- Stochastic encoders and decoders -- Learning with autoencoders; Deep Generative Models: Variational autoencoders – Generative adversarial networks.
Total Periods: 45

Learning Resources

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning'', MIT Press, 2016.
2	Andrew Glassner, “Deep Learning: A Visual Approach”, No Starch Press, 2021.
3	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.
4	Yoav Goldberg, ``Neural Network Methods for Natural Language Processing'', Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.
5	Francois Chollet, ``Deep Learning with Python'', Manning Publications Co, 2018.
6	Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook'', Springer International Publishing, 2018.
7	Josh Patterson, Adam Gibson, ``Deep Learning: A Practitioner's Approach'', O'Reilly Media, 2017.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply mathematical and algorithmic foundations to implement deep learning models.	Apply
CO2	Apply regularization, optimization, and hyperparameter tuning techniques to improve neural network performance.	Apply
CO3	Apply Convolution Neural Network for image processing.	Apply
CO4	Apply Recurrent Neural Network and its variants for text analysis.	Apply
CO5	Apply PCA, Autoencoders and Generative models for suitable applications.	Apply



Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-	-	2	2
CO2	2	2	2	2	2	-	-	-	-	-	-	2	2
CO3	3	2	2	2	2	-	-	-	-	-	-	3	2
CO4	2	2	2	2	1	-	-	-	-	-	-	2	2
CO5	2	2	2	2	2	-	-	-	-	-	-	2	3
Avg.	2.4	2	2	2	1.6	-	-	-	-	-	-	2.2	2.2

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24MG611	PROJECT MANAGEMENT	L	T	P	C
		2	0	0	2

Course Objective:

After completing this course, the students will be able to:

- Understand the fundamentals of project management including project characteristics, life cycle phases, and key managerial issues involved in projects.
- Identify, screen, and evaluate projects using qualitative techniques and quantitative financial appraisal methods under certainty and uncertainty conditions.
- Understand project organizational structures and leadership concepts and analyze the roles and responsibilities of a project manager in different organizational settings.
- Apply project planning and control techniques for effective scope, time, and cost management using tools such as WBS, network diagrams, CPM, PERT, and earned value analysis.
- Recognize the importance of quality management in projects and apply quality assurance, quality control, and continuous improvement techniques for successful project execution.

Detailed Syllabus

UNIT I INTRODUCTION TO PROJECT MANAGEMENT	**6**
Concept of project management - project definition and key features of projects - project life cycle phases - typical project management issues - basic project activities.	
UNIT II PROJECT IDENTIFICATION AND SELECTION	**6**
Identification and screening (brainstorming, strength and weakness in the system, Environmental opportunities and threats) - Project evaluation methods - Payback period - Net present value - internal rate of return and project evaluation under uncertainty.	
UNIT III PROJECT ORGANIZATION	**6**
Roles and responsibilities of a project manager, Project Organization- The project as Part of the Functional Organization - Pure Project Organization - The Matrix organization - leadership styles	
UNIT IV SCOPE, TIME AND COST MANAGEMENT	**6**
Scope Management-define the project-SOW, WBS - Time Management-Network diagram-forward and backward pass - critical path - PERT and CPM - AOA and AON methods - tools for project network - Cost management - earned value method.	
UNIT V QUALITY MANAGEMENT	**6**
Quality assurance and quality control - quality audit- methods of enhancing quality.	
	Total Periods: 30

Learning Resources

1	R. Panneerselvam and P. Senthil Kumar (2013), Project Management, PHI Learning Private Limited

2	Prasanna Chandra (2014), Projects: Planning, Analysis, Selection, Financing, implementation and Review
3	A Guide to the Project Management Body of Knowledge: (PMBOK Guide) by Project Management Institute, 2013.
4	Gopala Krishnan & Rama Murthy, A Text book of Project Management, McMillan India
5	S. Choudhary (2004), Project Management, Tata McGraw Hill Publication.
6	Clifford F Gray (2014), Project Management: The Managerial Process, (Special Indian Edit.), Oregon State University.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the concepts, characteristics, life cycle phases, and managerial issues of projects.	Understand
CO2	Identify, screen, and evaluate projects using financial appraisal techniques such as Payback Period, NPV, IRR, and evaluation under uncertainty.	Apply
CO3	Analyze different project organizational structures and leadership styles and assess the role of a project manager in achieving project objectives.	Understand
CO4	Develop project plans by defining scope, scheduling activities, identifying critical paths, and controlling cost using CPM, PERT, and earned value techniques.	Analyze
CO5	Apply quality management principles, quality assurance, quality control, and auditing techniques to enhance project performance and outcomes.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24MG621	ENTREPRENEURSHIP	L	T	P	C
		2	0	0	2

Course Objective:

- Understand the fundamentals of entrepreneurship including motivation, leadership, social entrepreneurship, and the role of women entrepreneurs in economic development.
- Analyze the entrepreneurial process involved in identifying, evaluating, and selecting viable business opportunities through market research.
- Formulate innovative business ideas using creative problem-solving techniques and understand legal and ownership structures of business organizations.
- Develop and evaluate comprehensive business plans incorporating marketing, financial, organizational, and implementation strategies.
- Acquire knowledge of MSMEs and institutional support systems including government policies, incentives, subsidies, and industrial infrastructure for entrepreneurship development.

Detailed Syllabus

UNIT I INTRODUCTION **6**

Understanding entrepreneurship- need for entrepreneurship development - Theory of Entrepreneurial Motivation - Barriers to entrepreneurship - Qualities of a successful entrepreneur - Types of entrepreneurs, Entrepreneurial Leadership- Development of women entrepreneurs and the Future of entrepreneurship- Social Entrepreneurship.

UNIT II ENTREPRENEURIAL PROCESS **6**

Identification – Selection of a good Business opportunity - Market survey and Research – developing a business plan -Entrepreneurship Development Programme- Meaning - Objectives - Phases of EDP - Course contents, Target groups.

UNIT III FORMULATION OF BUSINESS IDEA **6**

Sources for new ideas & evaluation of new idea for doing business - Creative problem-solving techniques used in entrepreneurial decision making. Formalities for registration of business units - Types of ownership in Business- merits and demerits - business incubators - types by valuation.

UNIT IV THE BUSINESS PLAN **6**

Nature and scope of Business plan - Writing Business Plan - Evaluating Business plans - sing and implementing business plans. Application BMC - Marketing plan - financial plan and the organizational plan - Launching formalities

UNIT V MICRO SMALL MEDIUM ENTERPRISE (MSME) **6**

Procedures and formalities for registration of business units and its benefits. Types of ownership in Business & its merits and demerits - Reason for business failures - causes and preventive measures. Institutional support to Entrepreneurship - Central and State Level Institutional support for business units. Industrial Estates & Special Economic Zones in India. Incentives and subsidies & bounties for businesses - Policy initiatives.

Total Periods: 30

Learning Resources

1	Anshuja Tiwari, (2015), Entrepreneurship Development in India, Himalaya Publishing House, New Delhi.
2	Nagaraja Prakasam, (2025) Back to Bharath in search of sustainable future, Penguin Business Published, New Delhi.
3	Vasant Desai, Dynamics of Entrepreneurial Development and Management Principles. Projects, Policies, Programmes – 2005, Himalaya Publishing House, New Delhi.
4	Poornima M Charantimath, (2016), Entrepreneurship Development Small Business Enterprises, Dorling Kindersley India Pvt. Ltd, New Delhi.
5	Anshuja Tiwari, (2015), Women Entrepreneurship and Economic Development, Himalaya Publishing House, New Delhi.



6	S. Anil Kumar, (2015), Small Businesses and Entrepreneurship, International Publishing House Private Ltd, New Delhi.
7	Dr. S.S. Khanka, (2012), Entrepreneurial Development, S. Chand & Co, New Delhi.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the concepts, theories, and motivation behind entrepreneurship, including social and women entrepreneurship, and assess the qualities required for successful entrepreneurs.	Understand
CO2	Explain and evaluate business opportunities using market survey and research techniques and outline the stages of the entrepreneurial process	Understand
CO3	Describe innovative business ideas, apply creative problem-solving tools, and select appropriate ownership and registration procedures for business ventures.	Apply
CO4	Discuss a viable business plan using tools such as the Business Model Canvas, marketing, financial, and organizational plans.	Understand
CO5	Examine MSME policies, institutional support mechanisms, incentives, and causes of business failure to recommend strategies for sustainable entrepreneurial growth.	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24S632	CLOUD COMPUTING LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To understand and implement virtualization concepts by installing and configuring virtual machines and operating systems.
- To develop isolated software environments and perform application development using compilers and cloud platforms.
- To explore cloud computing platforms such as Google App Engine and simulate cloud environments using CloudSim tools. To analyze and design resource scheduling algorithms in cloud and multi-cloud environments.
- To implement distributed computing frameworks and containerization technologies like Hadoop and Docker.

List of Experiments

Sl No	List of Experiments
1	VirtualBox/VMware Installation Install VirtualBox on your host machine. Then install two guest operating systems (for example Ubuntu 20.04 LTS and Windows 10) inside separate virtual machines. Provide the names of the OS versions, how much RAM and disk you allocated to each, and show that each OS boots successfully.
2	C Compiler Installation on Virtual Machine Develop software inside an isolated environment to avoid dependency conflicts. Create a virtual machine using VirtualBox, install a C compiler, and write a simple program to test compilation and execution. Show how isolation improves software development and testing.
3	Google App Engine (GAE) Setup and Hello World Application Install the Google App Engine SDK. Create a “Hello World” web application in Python and another in Java. Provide the directory structure, code files, configuration files (such as app.yaml or web.xml), and show how can run them locally.
4	Launching Applications using GAE Launcher Using the App Engine development server (or dev_appserver.py for Python, or the App Engine plugin for Java), launch each of your web applications locally. Provide the exact command(s) you used, show the local URL (e.g., http://localhost:8080), and provide screenshot/log of successful access to the web pages.
5	Simulating Cloud Environment with CloudSim Design and implement a custom scheduling algorithm not provided by CloudSim (for example a Priority-based scheduler, Shortest-Job-First (SJF) for cloudlets). Demonstrate the simulation results using custom scheduler and compare the metrics (makespan, resource utilisation, load-balancing) to the baseline scheduler.
6	Simulate Multi-Cloud Resource Scheduling Using CloudSim Plus Design, implement, and evaluate a custom scheduling algorithm for multi-cloud environments using CloudSim Plus that outperforms default scheduling policies in terms of performance metrics.
7	File Transfer between Virtual Machines Your company maintains multiple virtual servers and needs to automate file sharing between them. Create two virtual machines on VirtualBox and demonstrate file transfer using a secure or shared folder method (SCP or network folder). Analyze performance and security aspects of the transfer.
8	Hadoop Single Node Cluster Setup A data analyst team wants to process large datasets efficiently. Set up a Hadoop single-node cluster on a Linux VM, run a WordCount program on a sample dataset, and display the output. Explain how Hadoop simplifies large-scale data processing using the MapReduce model.
9	Creating and Executing Your First Docker Container Create your own Dockerfile for a simple web application. Provide the Dockerfile, build command (docker build -t myapp:latest .), and run command (docker run -p 8080:8080 myapp:latest). Show that you can access the web app via a browser or curl.
10	Running a Container from Docker Hub Deploy a pre-built application quickly using container technology. Pull a public image from Docker Hub. Run the container with appropriate port mappings and environment variables. Provide the commands, show docker ps output, and demonstrate connecting to the service inside the container (using redis-cli or mysql client).



11	Deploy a Web Application Using Docker and Expose It to the Host System Design and implement a Dockerfile that builds a container image for the given Flask web application. Include necessary commands to install dependencies, set up the working directory, expose ports, and run the application. Execute the container with port mapping and provide proof of successful access from the host browser.
	Total Periods: 60

Learning Resources

1	Hands-On Virtual Computing — Ted Simpson & Jason Novak; 2nd Edition published in 2017.
2	Cloud Computing Technology — Huawei Technologies Co., Ltd.; published in 2022 (softcover 06 Oct 2022) by Springer.
3	The Docker Book: Containerization Is the New Virtualization — James Turnbull; first published in 2014 (July 12th 2014).
4	Cloud Computing: Automating the Virtualized Data Center — Venkata (Josh) Josyula, Malcolm Orr & Greg Page; published November 2011.
5	Cloud Computing and Virtualization — Dac-Nhuong Le, Raghvendra Kumar, Nguyen Gia Nhu, Jyotir Moy Chatterjee; published 2018.
6	https://www.virtualbox.org/wiki/Documentation
7	https://cloud.google.com/appengine/docs

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Install and configure virtual machines and operating systems, and demonstrate isolated computing environments.	Understand
CO2	Develop and execute programs in virtualized environments and deploy simple applications using cloud platforms like Google App Engine.	Apply
CO3	Simulate cloud computing environments and implement custom scheduling algorithms using CloudSim and CloudSim Plus.	Analyze
CO4	Perform secure file transfer between virtual machines and evaluate performance and security aspects.	Apply
CO5	Set up and use distributed systems and container platforms (Hadoop, Docker) to deploy and manage applications efficiently.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	2	-	2	3	2	3	2	2
CO2	3	2	2	2	2	2	-	2	2	2	3	3	3
CO3	2	3	2	3	2	2	-	3	2	2	3	3	3
CO4	2	2	3	3	3	2	-	3	3	2	2	3	3
CO5	2	3	3	2	3	2	-	2	2	2	2	3	2
Avg.	2.4	2.4	2.4	2.4	2.4	2	-	2.4	2.4	2	2.6	2.8	2.6

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD622	DEEP LEARNING LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To understand and implement fundamental optimization techniques—including various forms of Gradient Descent—and analyze their convergence behavior on different machine learning tasks.
- To design, train, and evaluate neural network architectures such as Deep Neural Networks, RNNs/LSTMs, and CNNs using different activation functions, loss functions, and optimization algorithms.
- To apply essential machine learning practices such as dataset splitting, error estimation, regularization, and bias–variance analysis to improve model performance and generalization.
- To develop and compare deep learning models for a variety of applications including classification, sentiment analysis, sequence modeling, machine translation, and image generation (GANs).
- To implement advanced dimensionality reduction and deep learning–based techniques from scratch or using frameworks like NumPy and TensorFlow/Keras, and apply them in real-world mini-projects.

List of Experiments

Sl No	List of Experiments
1	Write a program to implement Gradient Descent from scratch to minimize the function $f(x) = x^2 - 4x + 5$and demonstrate the effect of using different learning rates by plotting the convergence curves.
2	Implement Batch Gradient Descent, Stochastic Gradient Descent, and Mini-Batch Gradient Descent for a given dataset and compare their convergence speeds and stability.
3	Split a given dataset into Training, Validation, and Test sets and write a program to compute training error, validation error, and test error. Analyze the results to discuss bias–variance tradeoff.
4	Implement a Deep Neural Network (DNN) with two hidden layers to solve the XOR problem using different hidden layer activation functions (Sigmoid, Tanh, ReLU, Leaky ReLU).
5	Implement and visualize different cost/loss functions (Mean Squared Error, Cross-Entropy) and Train a neural network using different optimizers (SGD, Adagrad, RMSProp, Adadelta, Adam) on the same dataset and compare training loss curves and accuracy.
6	Write a program to train a classification model to classify emails as Spam or Not Spam using a publicly available dataset (e.g., Spam base or any CSV dataset). Evaluate the trained model using performance metrics and compare it with a baseline model.
7	Build a simple CNN from scratch using NumPy to perform handwritten digit classification on the MNIST dataset and analyze training performance with different non-linearity activation functions (ReLU, Leaky ReLU, Tanh, Sigmoid) in a CNN for image classification.
8	Train a Convolutional Neural Network (CNN) using Keras/TensorFlow for image classification on the CIFAR-10 dataset. Apply regularization techniques such as Dropout and L2 weight decay, and evaluate their effect on overfitting and model performance.
9	Write a program to perform character-level language modeling using a simple RNN and predict the next character in a given text sequence.
10	Implement sentiment analysis using an LSTM network on a dataset of movie reviews and classify them as positive or negative.
11	Perform parts-of-speech tagging using a Sequence-to-Sequence RNN architecture on a small text dataset and evaluate its accuracy.
12	Build an Encoder-Decoder model for machine translation to translate simple sentences from English to another language using a small parallel corpus.
13	Implement Principal Component Analysis (PCA) on a sample dataset and reduce its dimensionality. Visualize the data in 2D or 3D after reduction.



14	Implement a Generative Adversarial Network (GAN) to generate synthetic images similar to a given dataset (e.g., MNIST or CIFAR-10).
15	Develop a mini-project to apply deep learning models to a real-world problem, such as image generation, anomaly detection, or recommendation systems, and evaluate the results using appropriate performance metrics.
	Total Periods: 60

Learning Resources

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016.
2	Andrew Glassner, “Deep Learning: A Visual Approach”, No Starch Press, 2021.
3	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.
4	Yoav Goldberg, ``Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.
5	Francois Chollet, ``Deep Learning with Python", Manning Publications Co, 2018.
6	Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply different Gradient Descent optimization techniques (Batch, Stochastic, and Mini-Batch) to minimize functions and analyze their convergence behavior using appropriate visualizations.	Apply
CO2	Analyze the performance of neural network architectures—DNNs, CNNs, RNNs, and LSTMs—by experimenting with various activation functions, cost functions, and optimizers to understand their impact on learning.	Analyze
CO3	Evaluate machine learning models by splitting datasets into training, validation, and test sets, computing respective errors, and interpreting the bias–variance tradeoff and the effects of regularization techniques.	Evaluate
CO4	Apply deep learning methods to real-world tasks like image classification, sentiment analysis, POS tagging, and character-level language modelling.	Apply
CO5	Create advanced models such as PCA-based dimensionality reduction and Generative Adversarial Networks (GANs), and develop mini-projects addressing real-world problems, demonstrating the ability to design, implement, and evaluate complete deep learning pipelines.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	3	2	3	3	3
CO2	1	3	2	2	2	-	-	-	3	2	2	1	3
CO3	3	2	1	2	1	-	-	-	2	3	1	2	3
CO4	3	3	1	2	1	-	-	-	1	3	2	3	2
CO5	3	3	3	3	2	-	-	-	1	2	3	3	3
Avg.	2.6	2.6	1.6	2	1.4	-	-	-	2	2.4	2.2	2.4	2.8

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
THEORY COURSES										
1	U24MG711	Human Values and Ethics	HSMC	2	0	0	2	2	40	60
2	U24MG721	Total Quality Management	HSMC	3	0	0	3	3	40	60
3		Professional Elective-IV	PEC							
4		Professional Elective-V	PEC							
5		Professional Elective-VI	PEC							
6		Open Elective-II	OEC							
7		Mandatory Course-II**	MC	3	0	0	3	0	100	-
PRACTICAL COURSES										
8	U24AD712	Mini Project	EEC	0	0	4	4	2	60	40
9	U24AD722	Summer Internship*	EEC	0	0	4	4	2	100	-
			Total							

*During Summer Holidays
** Mandatory Course (Non-CGPA Course)

Assessment Scheme

Sl. No	Course Type	L	T	P	C	CIA Weightage (Theory)				CIA	ESE		CIA (W)	ESE (W)	Min. Marks to Pass for 100	
						T1	A1	T2	A2	Prac	Th	Prac			ESE	Total
1	U24MG711	2	0	0	2	60	40	60	40	-	100		40	60	45	50
2	U24MG721	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	PEC – IV														45	50
4	PEC – V														45	50
5	PEC – VI														45	50
6	OEC – II														45	50
7	MC	3	0	0	3	-	-	-	-	-	-	-	100	-	-	50
9	U24AD712	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
10	U24AD722	0	0	4	2	-	-	-	-	-	-	-	100	-	-	50

(W) – Weightage

U24MG711	HUMAN VALUES AND ETHICS	L	T	P	C
		2	0	0	2

Course Objective:

- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To install the scientific temper in the students' minds and develop their critical thinking.
- To promote sense of responsibility and understanding of the duties of citizen.

Detailed Syllabus

UNIT I DEMOCRATIC VALUES	**6**
Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement.	
UNIT II SECULAR VALUES	**6**
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.	
UNIT III SCIENTIFIC VALUES	**6**
Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, validating facts using evidence-based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.	
UNIT IV SOCIAL ETHICS	**6**
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.	
UNIT V SCIENTIFIC ETHICS	**6**
Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.	
	Total Periods: 30

Learning Resources

1	The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2	Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3	The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4	The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5	Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the importance of democratic, secular, and scientific values for the harmonious functioning of social life.	Understand
CO2	Describe the role of democratic and scientific values in shaping responsible personal and professional behaviour.	Understand

CO3	Interpret social problems using rational and logical thinking approaches.	Understand
CO4	Explain the principles of ethical behaviour in societal contexts.	Understand
CO5	Discuss the significance of critical thinking and the pursuit of truth in decision-making.	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24MG721	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objective:

- Understand the fundamentals of quality and TQM philosophy, including its evolution, principles, frameworks, and contributions of quality gurus.
- Explain and apply core TQM principles such as leadership, customer focus, employee involvement, continuous improvement, and supplier partnership.
- Analyze and use TQM tools and techniques including traditional quality tools, Six Sigma, benchmarking, FMEA, QFD, TPM, and quality circles.
- Evaluate quality costs and improvement methodologies to enhance organizational performance and process efficiency.
- Understand and implement Quality Management Systems (QMS and EMS) based on ISO 9001 and ISO 14001 standards in manufacturing and service organizations.

Detailed Syllabus

UNIT I INTRODUCTION TO TOTAL QUALITY MANAGEMENT 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent, Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.
UNIT V QUALITY MANAGEMENT SYSTEM 9 Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.
Total Periods: 45

Learning Resources

1	Dale H. Besterfiled, Carol B. Michna, Glen H. Bester field, Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.
2	James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.
3	Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.
4	Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
5	Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the concepts of quality, Total Quality Management, quality dimensions, TQM frameworks, benefits, and barriers.	Understand
CO2	Demonstrate TQM principles such as leadership, customer satisfaction models, employee involvement, continuous improvement, and supplier partnership in organizational contexts.	Understand
CO3	Describe TQM tools and techniques to analyze and solve quality-related problems.	Understand
CO4	Describe quality improvement strategies including cost of quality, BPR, Taguchi loss function, and performance measurement systems.	Understand
CO5	Explain Quality Management Systems and Environmental Management Systems	Understand

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD712	MINI PROJECT	L	T	P	C
		0	0	4	2

Course Objective:

- To provide practical exposure to real-world engineering problems and industry practices related to the student's discipline.
- To strengthen technical competencies by applying theoretical concepts to practical tasks in a professional environment.
- To develop professional skills such as teamwork, communication, time management, and ethical practices.
- To understand organizational structure and workplace processes within an industry setting.
- To enhance documentation and presentation skills through systematic reporting of internship activities.

Description:

- It is intended to provide early exposure to problem-solving, creativity, and hands- on learning.
- At the outset the department issues guidelines outlining objectives, scope, timelines and evaluation criteria.
- Students, typically working in small teams, identify a problem aligned with innovation, design, or societal needs, and submit a project proposal for approval.
- Faculty mentors are assigned to guide the teams throughout the project.
- During execution, students engage in activities such as ideation, design, prototyping, experimentation, and analysis, applying fundamental engineering concepts.
- Regular review meetings are conducted to monitor progress, provide feedback and ensure timely completion.
- For Socially relevant projects, emphasis is given to addressing real – world community challenges.
- Students maintain basic documentation, including progress records and design details.
- At the end, they submit a concise project report and demonstrate their work through a presentation or prototype evaluation.

Total Periods: 60

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Apply engineering knowledge to execute assigned tasks and solve practical problems	Apply
CO2	Analyze real-time industrial processes, systems, or workflows encountered during the internship	Apply
CO3	Demonstrate technical skills and professional practices relevant to their field	Apply
CO4	Evaluate their performance, learning outcomes, and industry practices through structured reports	Apply
CO5	Create comprehensive documentation and presentations summarizing internship experiences and outcomes	Apply



Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			2		2	2	2	2	2	3	3
CO2	2	3			2		2	2	2	2	2	3	3
CO3	2	-			2		2	2	2	2	2	3	3
CO4	2	2			2		2	2	2	2	2	3	3
CO5	2	-			2		2	2	2	2	2	3	3
Avg.	**2.2**	**2.3**			**2**		**2**	**2**	**2**	**2**	**2**	**3**	**3**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24AD722	SUMMER INTERNSHIP	L	T	P	C
		0	0	4	2

Course Objective:

- To provide practical exposure to real-world engineering practices and industrial environments.
- To apply theoretical knowledge gained in academics to solve practical problems in the workplace.
- To develop professional skills such as communication, teamwork, time management, and workplace ethics.
- To understand industrial processes, tools, and technologies relevant to the student's discipline.
- To enhance documentation and reporting abilities through systematic recording and presentation of internship activities.

Description:

- The 4-week summer internship for B.E./B.Tech. students are implemented through a well-defined process to ensure both academic relevance and meaningful industry exposure.
- Internships may be secured through the institution's placement cell, faculty references, or by students themselves, subject to departmental approval. Prior to the internship, the department issues detailed guidelines specifying eligibility, duration, expected outcomes, and documentation formats.
- Students submit their internship details, including offer letters, which are reviewed and approved, and faculty mentors are assigned to guide and monitor their progress.
- A structured orientation program is conducted to familiarize students with internship objectives, professional ethics, workplace conduct, and reporting requirements.
- During the internship, students actively engage in assigned technical tasks, apply theoretical knowledge to practical situations, and develop professional skills.
- They are required to maintain a daily or weekly logbook and submit periodic progress updates.
- Faculty mentors track student performance through regular interactions, while industry supervisors oversee daily activities, provide technical guidance, and evaluate the student's learning and overall contribution.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply engineering concepts and technical knowledge to perform assigned industrial tasks.	Apply
CO2	Analyze real-time problems, processes, and systems encountered during the internship.	Analyze
CO3	Demonstrate professional skills including teamwork, communication, and ethical practices.	Apply
CO4	Evaluate industrial practices, personal performance, and learning outcomes through structured reporting.	Evaluate
CO5	Create detailed internship reports, logbooks, and presentations summarizing their work and learning experience.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2		2		2	2	2		3	3	2
CO2	2	3	2		2		2	2	2		3	2	2
CO3	2	2	2		2		2	2	2		2	3	3
CO4	2	2	2		2		2	2	2		2	2	2
CO5	2	2	2		2		2	2	2		2	2	3
Avg.	2.2	2.4	2		2		2	2	2		2.4	2.4	2.4

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
PRACTICAL COURSES										
1	U24AD812	Capstone Project/ Industry Internship	EEC	0	0	16	16	8	60	40
				0	**0**	**16**	**16**	**8**		

U24AD812	CAPSTONE PROJECT / INDUSTRY INTERNSHIP	L	T	P	C
		0	0	16	8

Course Objective:

- To identify and define real-world problems in computing domains and develop appropriate solutions.
- To apply engineering and software development principles for designing and implementing systems or applications.
- To develop research, analytical, and problem-solving skills through project-based learning.
- To enhance professional competencies such as teamwork, communication, project management, and ethical practices.
- To strengthen documentation and presentation skills through systematic reporting and project demonstration.

Description:

- The Capstone Project/Industry Internship in the final semester is designed as a comprehensive learning experience that integrates theoretical knowledge with practical application.
- Students may undertake the capstone either internally within the institution under faculty supervision or externally in an industry, research organization, or startup.
- The external project/internship may be secured through the institution's placement cell, faculty references, or by students themselves, subject to departmental approval.
- At the beginning, the department issues detailed guidelines covering project scope, duration, expected outcomes, and evaluation criteria.
- Students are required to identify a problem statement, submit a project proposal, and obtain approval.
- Faculty guides are assigned for internal projects, while external projects involve both a faculty mentor and an industry supervisor.
- During execution, students carry out design, development, analysis, or implementation work, with periodic reviews to monitor progress.
- For industry-based projects, regular interaction with the organization ensures alignment with real-world requirements.
- Students must maintain proper documentation, including progress reports and logs.
- Upon completion, they submit a detailed project report and present their work through a final review and viva voce evaluation.



Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply computing and engineering knowledge to design and develop solutions for real-world problems.	Apply
CO2	Analyze problem requirements, system constraints, and data to propose effective solutions.	Analyze
CO3	Design and develop software systems, components, or processes to meet specified needs.	Create
CO4	Evaluate system performance, project outcomes, and alternative solutions considering technical and societal factors.	Evaluate
CO5	Create comprehensive project reports and deliver effective presentations demonstrating their work.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	2	2	3	3	2
CO2	2	3	2	2	2	2	2	2	2	2	3	3	2
CO3	2	2	3	3	3	3	3	2	2	3	2	3	3
CO4	2	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	2	2	3	2	2	2	2	2	2	2	3
Avg.	**2.2**	**2.4**	**2.2**	**2.2**	**2.4**	**2.2**	**2.2**	**2**	**2**	**2.2**	**2.4**	**2.6**	**2.4**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

PROFESSIONAL ELECTIVE - I
VERTICAL 1: FULL STACK DEVELOPMENT
(COMMON TO B.E. COMPUTER SCIENCE AND ENGINEERING)

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSFS01	Agile Software Development	PEC	3	0	0	3	3	40	60
2	U24CSFS02	UI and UX Design	PEC	1	0	4	5	3	50	50
3	U24CSFS03	App Development	PEC	1	0	4	5	3	50	50
4	U24CSFS04	Cloud Services Management	PEC	2	0	2	4	3	50	50
5	U24CSFS05	Devops	PEC	2	0	2	4	3	50	50
6	U24CSFS06	Web Application Security	PEC	2	0	2	4	3	50	50
7	U24CSFS07	Software Testing and Automation	PEC	2	0	2	4	3	50	50

U24CSFS01	AGILE SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the fundamentals of Agile methodologies, Lean concepts, stakeholder roles, and differences between Agile and traditional software development approaches.
- To learn Agile manifesto, XP practices, and Scrum framework for iterative and incremental software development.
- To develop knowledge of Agile planning, estimation, team coordination, and project monitoring techniques.
- To understand Agile requirements engineering, testing approaches, and tools for ensuring software quality.
- To learn Agile measurement, control mechanisms, scaling practices, and project management strategies.

Detailed Syllabus

UNIT I INTRODUCTION **9**

Agile Software Development: Basics and Fundamentals of Agile Process Methods - Values of Agile - Principles of Agile - stakeholders - Challenges Lean Approach: Waste Management - Kaizen and Kanban - add process and products add value - Roles related to the lifecycle - differences between Agile and traditional plans - differences between Agile plans at different lifecycle phases - Testing plan links between testing - roles and key techniques - principles – understand as a means of assessing the initial status of a project. How Agile helps to build quality.

UNIT II AGILE PRINCIPLES **9**

Agile and Scrum Principles: Agile Manifesto - Twelve Practices of XP - Scrum Practices – Applying Scrum-Need of scrum-working of scrum-advanced Scrum Applications-Scrum and the Organization - scrum values.

UNIT III PLANNING AND PRODUCT MANAGEMENT **9**

Agile Product Management: Communication - Planning - Estimation - Managing the Agile approach

- Monitoring progress - Targeting and motivating the team - Managing business involvement - Escalating issue - Quality - Risk - Metrics and Measurements.
UNIT IV REQUIREMENTS AND TESTING 9
Agile Requirements: User Stories - Backlog Management - Agile Architecture: Feature Driven Development - Agile Risk Management: Risk and Quality Assurance - Agile Tools - Agile Testing: Agile Testing Techniques - Test-Driven Development - User Acceptance Test - Agile Review: Agile Metrics and Measurements - The Agile approach to estimating and project variables.
UNIT V MEASUREMENTS 9
Agile Measurement - Agile Control-control parameters - Agile approach to Risk - The Agile approachtoConfigurationManagement-TheAternPrinciples-AternPhilosophy-Rationalefor using Atern - Refactoring - Continuous integration - Automated Build Tools - Scaling Agile for largeprojects:ScrumofScrums-Teamcollaborations-Scrum-EstimateaScrumProject-Track Scrum Projects - Communication in Scrum Projects - Best Practices to Manage Scrum.
Total Periods: 45

Learning Resources

1	Robert C. Martin, “Agile Software Development, Principles, Patterns, and Practices”, First Edition, Pearson Education India, 2002.
2	“Succeeding with Agile: SoftwareDevelopmentUsingScrum”,Pearson,2010.
3	Robert C Martin, Micah Martin, “Agile Principles, Patterns and Practices in C#”, Pearson Education, 2007
4	SteveMcConnell,”MoreEffectiveAgile:ARoadmapforSoftwareLeaders”,ConstruxPress,2019
5	Mark Merkow, “Secure, Resilient, and Agile Software Development”, CRC Press 2019
6	Peter Wlodarczak “Agile Software Development”, CRC Press 2019

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain Agile principles, Lean practices, stakeholder roles, and distinguish Agile from traditional software development approaches.	Understand
CO2	Apply Agile manifesto principles, XP practices, and Scrum framework to manage iterative and incremental software development.	Apply
CO3	Apply Agile planning, estimation, and product management techniques to manage project progress, risks, and quality.	Apply
CO4	Analyze user stories, implement Agile testing techniques such as TDD and UAT, and utilize Agile tools for quality assurance.	Analyse
CO5	Apply Agile measurement techniques, risk management strategies, and scaling practices for managing complex projects.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	3	2
CO2	3	3	2	1	2	-	-	-	-	-	2	3	3
CO3	3	3	3	2	2	-	-	-	-	-	2	3	3
CO4	2	3	2	3	3	-	-	-	-	-	2	3	3
CO5	2	2	3	2	3	-	-	-	-	-	3	3	3
Avg.	2.6	2.6	2.5	2	2.5	-	-	-	-	-	2.2	3	2.8

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSFS02	UI AND UX DESIGN	L	T	P	C
		1	0	4	3

Course Objective:

- To provide a sound understanding of UI & UX principles.
- To understand the design field and the role of UX in product development.
- To learn various research methods and ideation techniques used in UI/UX design.
- To explore the tools used in UI & UX development.
- To apply wireframes, prototypes, and user-centered design concepts.

Detailed Syllabus

UNIT I FOUNDATIONS OF DESIGN Introduction – UI vs UX – Stages of Design Thinking – Divergent & Convergent Thinking – Brainstorming – Game-storming – Observational Empathy.
UNIT II FOUNDATIONS OF UI DESIGN Visual & UI Principles – UI Elements & Patterns – Interaction Behaviours – Branding – Style Guides – Visual Consistency & Hierarchy.
UNIT III FOUNDATIONS OF UX DESIGN Introduction to User Experience – Importance of UX – Understanding UX – Introduction about UX Research Methods – UX Design Activities – Defining Product Goals – UX Workflow – Design Ideation & Prototyping – Task Flows – Card Sorting – Storyboards – UX Deliverables.
UNIT IV WIREFRAMING, PROTOTYPING & TESTING Low/Mid/High Fidelity Wireframes – Mockups – Efficient Designing – Interactive Prototypes – Usability Testing – UX Metrics – Synthesizing Test Findings – Prototype Iteration.
UNIT V RESEARCH, IDEATION & INFORMATION ARCHITECTURE Problem Identification – Research Methods – Persona Creation – Scenario Building – Flow Diagrams – Task Flow Mapping – Information Architecture – User Needs & Requirements.
Total Periods: 15

List of Experiments

Sl. No.	List of Experiments
1	Design a responsive website for a College Event Management System. Mini Project Idea: Students should design layouts for: • Desktop view • Tablet view • Mobile view
2	Create interaction patterns for a Food Delivery App. Design interactions such as: • Add to cart button animation • Swipe to delete item • Loading indicators • Checkout confirmation popup
3	Design a Library Management System Interface. Create a UI Style Guide including: • Typography

	• Button styles • Color palette • Icons • Layout grids
4	Build a Mobile App Prototype for Bus Ticket Booking. Design screens for: • Login • Search buses • Seat selection • Payment • Ticket confirmation
5	Design a Smart Study Planner App for Students. Follow the design thinking steps: • Empathize • Define • Ideate • Prototype • Test
6	Improve the College Website Navigation System.
7	Create ideas for a Campus Navigation App. Use brainstorming methods such as: • Mind mapping • Crazy 8 technique • Affinity diagrams
8	Design a UI pattern library for an E-commerce Website. Include: • Mood board • Color palette • Typography • Buttons • Form elements • Cards and navigation components
9	Solve a sample application problem through UX workflow.- Design an Assignment Reminder Application. • UX Workflow: • Problem definition • User research • Ideation • Wireframes • Prototype
10	Conduct end-to-end UX research (user research → persona → scenarios → mapping).-Develop a College Bus Tracking Application.
11	Sketch wireframes and build a prototype.- Design a Simple Online Grocery Shopping App. Create wireframes for: • Home page • Product listing • Product details • Cart • Checkout

12	Conduct usability testing and refine prototype.- Test the Online Grocery Shopping App Prototype. • Ask 5 users to perform tasks: • Search product • Add item to cart • Complete checkout • Collect feedback • Improve design
	Total Periods: 60
	Total: 15+60 = 75 Periods

Learning Resources

1	Joel Marsh, *"UX for Beginners"*, O'Reilly, 2022. (UNIT 1,3,4,5)
2	Jon Yablonski, *"Laws of UX: Using Psychology to Design Better Products & Services"*, O'Reilly, 2021. (UNIT 1,2,3,4,5)
3	Jennifer Tidwell, Charles Brewer, A. Valencia, *Designing Interfaces*, 3rd Edition, 2020. (UNIT 1, 2, 4)
4	Steve Krug, *Don't Make Me Think*, 2022. (UNIT 3,4,5)
5	https://www.interaction-design.org/
6	https://www.smashingmagazine.com/articles

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply UI/UX fundamentals and design principles.	Apply
CO2	Analyze UI/UX design of any product/application.	Analyze
CO3	Apply UX skills in product development.	Apply
CO4	Analyze sketching and prototyping principles to evaluate and improve user interface design solutions.	Analyze
CO5	Apply wireframes and working prototypes concepts	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	3	2	3	2	2	2	-	2	3	2	3
CO2	2	2	3	2	3	2	2	2	3	2	3	2	3
CO3	2	2	3	2	3	2	2	2	3	2	3	2	3
CO4	2	2	3	2	3	2	2	2	-	2	3	2	3
CO5	2	2	3	2	3	2	2	2	3	2	3	2	3
Avg	2	1.8	3	2	3	2	2	2	3	2	3	2	3

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSFS03	APP DEVELOPMENT	L	T	P	C
		1	0	4	3

Course Objective:

- To understand the basic concepts of native and cross-platform mobile app development.
- To learn how to build simple native mobile applications using Java/Kotlin
- To develop applications that use device features such as location and storage.
- To develop introductory cross-platform applications using React Native.
- To develop web applications with database access.

Detailed Syllabus

UNITI FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT Basics of mobile and web applications, Overview of Native, Hybrid and Cross-platform apps, Introduction to Progressive Web Apps (PWA), Concept of responsive Web Design
UNIT II NATIVE APP DEVELOPMENT USING JAVA Introduction to Native App development, Simple tools used for Native development, Basics of Java/Kotlin for Android, Basics of Swift/Objective-C for iOS, Fundamentals of components, state, props (introductory level)
UNIT III HYBRID APP DEVELOPMENT Concept of Hybrid Apps, When Hybrid Apps are preferred, Limitations of Hybrid Apps - Basic tools and frameworks: Ionic, Apache Cordova
UNIT IV CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE Overview of Cross-platform development, Benefits and limitations, Common frameworks: Flutter, Xamarin, React Native, Simple introduction to components, JSX, state and props
UNIT V NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS Comparison of app development frameworks, Build & runtime performance (basic level), Debugging ease, Time-to-development, UI/UX flexibility, Reusability & maintainability
Total Periods: 15

List of Experiments

Sl. No.	List of Experiments
1	Build a cross platform application for a BMI calculator, using react native.
2	Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income an dexpense.
3	Develop a cross platform application to convert units from imperial system to metric system (km to miles, kg to pounds etc.,)
4	Design and develop across platform application for day to day task (to-do)management.
5	Design an android application using Cordova for a user login screen with username, Password, reset button and a submit button. Also, include header image and a label. Use layout managers.
6	Design and develop an android application using Apache Cordova to find and display the current location of the user.

7	Write programs using Java to create Android application having Databases for a simple library application for displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.
8	Create an app that allows adding, editing, and deleting text notes stored locally.
9	Build an app that allows selecting an image from gallery and displaying it on the screen.
10	Develop a mobile application that fetches and displays temperature and weather conditions for a selected city using a simple free API.
11	**MINI PROJECT** Personal Habit Tracker App. (Add daily habits (water intake, reading, exercise etc.). Track progress with simple charts or counters, Store data locally using SQLite, Display weekly summary)
12	**MINI PROJECT** Student Attendance Manager App (Create subjects and student lists, Mark daily attendance View attendance percentage per subject)
	Total Periods:60
	Total: 15 + 60 = 75 Periods

Learning Resources

1	Head First Android Development, Dawn Griffiths, O'Reilly, 3rd Edition, O'Reilly, 2023(UNIT 1 &2)
2	Apache Cordova in Action, Raymond K. Camden, Manning. 2020 (UNIT 1,3,5)
3	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing (UNIT 1,4,5)
4	Android Programming for Beginners, John Horton, Packt Publishing, 3rd Edition, Packt Publishing, 2021(UNIT 1,2)
5	Apache Cordova 4 Programming, John M Wargo, 2020 (UNIT 1,3,5)
6	Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras. 2021(UNIT 1,2,3,4,5)
7	https://developer.android.com
8	https://reactnative.dev/docs/getting-started

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Develop Native applications with GUI Components.	Apply
CO2	Develop hybrid applications with basic event handling.	Apply
CO3	Implement cross-platform applications with location and data storage capabilities.	Apply
CO4	Implement cross platform applications with basic GUI and event Handling	Apply
CO5	Develop web applications with cloud database access.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	3	-	-	2	2	2	2	3	3
CO2	2	2	3	-	3	-	-	3	3	2	2	3	3
CO3	2	2	2	2	2	3	-	3	2	2	2	3	3
CO4	3	3	2	2	3	3	2	3	2	2	3	3	3
CO5	3	2	3	2	3	3	2	3	2	2	3	3	3
Avg	2.4	2.2	2.4	2	2.8	3	2	2.8	2.2	2	2.4	3	3

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSFS04	CLOUD SERVICE MANAGEMENT	L	T	P	C
		2	0	2	3

Course Objective:

- To introduce the basic concepts of cloud computing and cloud service management.
- To understand the AWS global infrastructure, security practices, and identity management.
- To learn the core AWS compute, storage, and networking services.
- To understand cloud architecture principles using the AWS Well-Architected Framework.
- To learn automatic scaling, load balancing, and monitoring concepts in AWS.

Detailed Syllabus

UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS **6**

Cloud Ecosystem - The Essential Characteristics - Basics of Information Technology Service Management and Cloud Service Management - Service Perspectives -Cloud Service Models - Cloud Service Deployment Models.

UNIT II AWS GLOBAL INFRASTRUCTURE OVERVIEW&SECURITY **6**

AWS Global Infrastructure – AWS Services and Service Categories – AWS Shared Responsibility Model – AWS Identity and Access Management (IAM) – Securing a New AWS Account – Securing Accounts – Securing Data – Networking Basics – Amazon VPC – VPC Networking – VPC Security – Content Delivery Network (CDN) Concepts – Amazon Route 53 – Amazon Cloud Front – Amazon Relational Database Service (RDS) – Introduction to Cloud Security Platforms (Crowd Strike).

UNIT III COMPUTE &STORAGE **6**

Compute Services Overview – Amazon EC2 Part 1 – Amazon EC2 Part 2 – Amazon EC2 Part 3 – Amazon EC2 Cost Optimization – Container Services – Introduction to AWS Lambda – Introduction to AWS Elastic Beanstalk – AWS Storage Services: Amazon S3 – Amazon S3 Storage Classes – Amazon S3 Glacier – AWS EBS – AWS EFS.

UNIT IV DATABASES & CLOUD ARCHITECTURE **6**

AWS Well-Architected Framework design principles-Operational excellence-Security-Reliability-Performance efficiency- Cost optimization-Reliability & high availability-AWS Trusted Advisor.

UNIT V AUTOMATIC SCALING AND MONITORING **6**

Elastic Load Balancing- Amazon Cloud Watch- Amazon EC2 auto scaling.

Total Periods:30

List of Experiments

Sl. No.	List of Experiments
1	Create a cloud account in Amazon Web Services / Google Cloud Platform and configure Identity and Access Management (IAM). Implement users, groups, roles, and Multi-Factor Authentication for secure access control.
2	Demonstrate cloud service models by launching a virtual machine using Amazon EC2 (IaaS), deploying an application using AWS Elastic Beanstalk (PaaS), and exploring SaaS solutions. Compare their features and use cases.
3	Create and configure a Virtual Private Cloud (VPC) in Amazon Web Services. Set up subnets, route tables, and internet gateways, and deploy instances within the VPC network.
4	Implement cloud security best practices by configuring Security Groups, Network ACLs, and IAM policies. Enable encryption and secure data storage in Amazon S3.
5	Launch and manage compute resources using Amazon EC2. Configure instance types, key pairs, Elastic IPs, and perform cost optimization techniques.
6	Implement storage solutions by creating and managing buckets in Amazon S3. Configure storage classes, lifecycle policies, and integrate with Amazon EBS volumes.
7	Deploy and manage a relational database using Amazon RDS. Configure connectivity, security, backup, and snapshot features.
8	Design a cloud architecture based on AWS Well-Architected Framework principles. Analyze system performance, reliability, security, and cost optimization using AWS Trusted Advisor.
9	Configure Elastic Load Balancing and Auto Scaling in Amazon Web Services. Simulate traffic and observe dynamic scaling of resources.
10	Monitor cloud resources using Amazon CloudWatch. Create alerts for resource usage and billing, and perform cost comparison across Amazon Web Services, Microsoft Azure, and Google Cloud Platform.
	Total Periods: 30
	Total: 30 + 30 = 60 Periods

Learning Resources

1	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications.
2	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013.
3	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour
4	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
5	AWS Certified Cloud Practitioner Study Guide – Ben Piper, David Clinton, Wiley. Explains AWS services such as EC2, S3, IAM, and RDS with practical examples.
6	"Cloud computing", By Prof. Soumya Kanti Ghosh, IIT Kharagpur, NPTEL. https://onlinecourses.nptel.ac.in/noc21_cs14/preview

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the fundamental concepts of cloud computing and various cloud service/deployment models.	Understand
CO2	Identify AWS global infrastructure components and apply basic security and IAM configurations.	Apply
CO3	Use AWS compute and storage services such as EC2, S3, EBS, and Lambda.	Apply

CO4	Apply AWS Well-Architected Framework principles in designing cloud-based solutions.	Apply
CO5	Configure load balancing, auto-scaling, and monitoring using AWS services.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	3	2
CO2	3	2	-	-	3	-	-	-	-	-	-	3	2
CO3	3	2	2	-	3	-	-	-	-	-	-	3	3
CO4	3	3	3	2	2	2	2	2	-	-	-	3	3
CO5	3	2	3	-	3	-	-	-	-	-	-	3	3
Avg.	3	2.2	2.7	2	2.6	2	2	2	-	-	-	3	2.6

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSFS05	DEVOPS	L	T	P	C
		2	0	2	3

Course Objective:

- To explain DevOps concepts, lifecycle models, and cloud service platforms.
- To build and manage software projects using Maven and Gradle tools.
- To develop Continuous Integration pipelines using Jenkins.
- To implement configuration management using Ansible automation tools.
- To deploy and monitor containerized applications using Docker, Kubernetes, and monitoring systems.

Detailed Syllabus

UNIT I INTRODUCTION TO DEVOPS **6**

Why Devops?–Comparison between Agile and Devops – Devops Architecture – Devops Lifecycle-Tools for Devops Lifecycle—Introduction To AWS-EC2,S3,RDS,GCP–Features, Services using GCP, Azure, Version control systems: Git and Github.

UNIT II COMPILE AND BUILD USING MAVEN & GRADLE **6**

Maven - Introduction, POM files, Maven Build lifecycle, Build phases, Profiles, repositories, plugins, Maven create and build Artifacts, Dependency management, Gradle - Introduction, Core Concepts, understand build using Gradle, Maven vs Gradle

UNIT III CONTINUOUS INTEGRATION USING JENKINS **6**

Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Jenkins Pipelines, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT IV CONFIGURATION MANAGEMENT USING ANSIBLE **6**

Ansible Introduction, Master/slave configuration, YAML basics, Ansible modules, Inventory files, playbooks, Roles & directory structures, adhoc commands in ansible.

UNIT V CONTAINERIZATION,ORCHESTRATION AND LOG MONITORING **6**

Containerization, Doctor Architecture – Docker images, Orchestration, Kubernets architecture, Objects, basic commands, Logging vs Monitoring, Pramatheus Architecture and Node Explorer.

Total: 30 Periods

List of Experiments

Sl. No	List of Experiments
1	Create and configure a Maven build pipeline for a sample project. Perform automated compilation, packaging, and dependency handling.
2	Execute regression test cases using the Maven build pipeline. Verify application stability after integrating code changes.
3	Build a simple application using the Gradle build tool. Manage project tasks and dependencies efficiently.
4	Create and configure a Continuous Integration pipeline in Jenkins. Automate build and testing processes for applications.
5	Set up a Continuous Deployment pipeline using Jenkins. Deploy the application automatically to a cloud platform.
6	Configure Ansible roles for modular automation. Organize reusable components for efficient configuration management. Write playbooks to define and execute automation tasks.
7	Create an Ansible playbook to provision web application infrastructure. Automate server setup and application environment configuration.
	Total Periods: 30
	Total: 30 + 30 = 60 Periods

Learning Resources

1	"DevOps" by Anuradha A. Puntambeka -Edition – 2023
2	"DevOps with Kubernetes" by Hideto Saito – 2025 Edition
3	Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2026
4	Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2025.
5	"Docker Deep Dive" by Nigel Poulton, Leanpub (2023 Edition)
6	"The Kubernetes Up & Running" by Kelsey Hightower, Brendan Burns(3rd Edition 2023)
7	Prometheus: Up & Running" by O'Reilly- Brain Brazil(2nd Edition,2023)

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Understand DevOps principles, lifecycle, architecture, version control systems, and cloud platforms including Amazon Web Services, Google Cloud Platform, and Microsoft Azure.	Understand
CO2	Build and manage software projects using build and dependency management tools such as Apache Maven and Gradle.	Apply
CO3	Develop and automate Continuous Integration pipelines using Jenkins with appropriate plugins and tool integrations.	Apply
CO4	Implement configuration management and infrastructure automation using Ansible playbooks, roles, and modules.	Apply

CO5	Deploy, orchestrate, and monitor containerized applications using Docker, Kubernetes, and monitoring tools like Prometheus.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	2	2	-	-	2	2	2	2
CO2	3	3	3	2	3	2	2	-	-	2	2	3	2
CO3	3	3	3	3	3	2	2	2	2	2	3	3	3
CO4	3	3	3	3	3	2	2	2	2	2	3	3	3
CO5	3	3	3	3	3	2	2	2	2	2	3	3	3
Avg.	3	2.8	2.8	2.6	2.8	2	2	2	2	2	2.6	2.8	2.6

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSFS04	WEB APPLICATION SECURITY	L	T	P	C
		2	0	2	3

Course Objective:

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applications
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To learn the insight about Hacking techniques and Tools

Detailed Syllabus

UNIT I FUNDAMENTALS OF WEB APPLICATION SECURITY **6**

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, HTTP vs HTTPS Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II SECURE DEVELOPMENT AND DEPLOYMENT **5**

Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III SECURE API DEVELOPMENT **6**

API Security- Session Cookies, Token Based Authentication, Basics of REST API &JSON security, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Micro service APIs: Locking Down Network Connections, Securing Incoming Requests

UNIT IV VULNERABILITY ASSESSMENT AND PENETRATION TESTING **6**

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing

UNIT V HACKING TECHNIQUES AND TOOLS **7**

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nikto, Burp Suite, etc.

	Total Periods: 30

List of Experiments

Sl. No.	List of Experiments
1	Wireshark is installed and used to capture and analyze different network protocols during user activities such as browsing and data transfer, highlighting that HTTP transmits data in plain text while HTTPS ensures secure communication through encryption and authentication mechanisms.
2	A secure login system is implemented for a web application by incorporating authentication and role-based authorization to ensure that only authorized users can access protected resources and sensitive data.
3	A web application is configured to transition from HTTP to HTTPS by enabling SSL/TLS certificates, ensuring encrypted communication between client and server to prevent data interception.
4	A web-based input form is developed and tested with various malicious inputs, where proper input validation and sanitization techniques are applied to prevent vulnerabilities such as Cross-Site Scripting (XSS) and injection attacks.
5	Secure session management is implemented in a web application by configuring session timeouts, secure cookies, and protection mechanisms to prevent session hijacking and fixation attacks.
6	Vulnerabilities in a web application are identified using OWASP ZAP by scanning a live application, where issues such as improper input validation and security misconfigurations are detected and analyzed.
7	A simple REST API is developed using Python with Flask for an application such as a student database, where GET, POST, PUT, and DELETE methods are implemented along with token-based authentication to ensure secure data access.
8	API security is enhanced by implementing rate limiting, API key-based authentication, and request validation to prevent abuse and ensure availability in real-time applications.
9	A vulnerability assessment is conducted on a system using OpenVAS, where identified vulnerabilities are classified based on severity and appropriate mitigation strategies are recommended.(Open-source tool-based)
10	Burp Suite is installed and used to test a web application for vulnerabilities, where attacks such as SQL Injection and Cross-Site Scripting (XSS) are performed, along with social engineering simulations like phishing and fake login pages to evaluate security weaknesses. Tool-based (Partially open-source)
	Total Periods:30
	Total:30 +30 = 60 Periods

Learning Resources:

1	Corey J. Ball, API Security for White Hat Hackers, 2023, No Starch Press.
2	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, 2nd Edition, 2024, O'Reilly
3	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
4	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
5	https://developer.mozilla.org/en-US/docs/Web/Security
6	https://developers.google.com/web/fundamentals/security

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome**	**Knowledge Level**
CO1	Explain the fundamental concepts of web application security and need for securing web systems.	Understand
CO2	Apply secure coding practices and security testing techniques	Apply
CO3	Develop secure web applications by applying secure coding practices and integrating secure APIs effectively	Apply
CO4	Analyze the significance of vulnerability assessment and penetration testing and evaluate their role in strengthening overall web security.	Analyze
CO5	Adopt an attacker's mindset to analyze system weaknesses and utilize ethical hacking toolsets to evaluate security vulnerabilities.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	2	2	-	-	-	2	-	2
CO2	3	2	2	-	-	2	2	2	2	-	2	2	2
CO3	3	2	3	-	-	2	2	-	-	-	3	2	3
CO4	3	2	-	2	3	2	2	2	2	-	2	3	2
CO5	3	2	-	2	3	2	2	2	2	-	2	3	3
AVG	3	2	2.5	2	3	2	2	2	2		2.2	2.5	2.4

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSFS07	**SOFTWARE TESTING AND AUTOMATION**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

Course Objective:

- To provide foundational knowledge on software testing principles, types, levels, and lifecycle models.
- To enable students to plan, design, and execute effective test cases using systematic approaches.
- To expose learners to advanced testing techniques, performance testing, and specialized testing for various environments.
- To introduce the concepts of test automation, various automation frameworks, and Selenium Web Driver.
- To develop skills in using TestNG and Cucumber tools for structured test automation and behavior-driven development.

Detailed Syllabus

UNIT I FOUNDATIONS OF TESTING **6**

Introduction to Software Testing – Need for Testing – Quality and Reliability – Failures, Errors and Faults–Software Testing Principles–Black-Box Testing and White-Box Testing –Functional versus Structural Testing–Software Testing Life Cycle (STLC)–V-model of Software Testing–Levels of Testing: Unit Testing–Integration Testing–System Testing

UNIT II TEST PLANNING, TEST DESIGN AND TEST EXECUTION **6**

Test Planning: Goal of Test Planning – Types of Test plan –Components of Test Plan –Test Strategy – Test Schedule – Test Cases – Bug Reporting – Metrics and Statistics. Test Design and Execution: Test Design Factors – Requirement Identification – Testable Requirements – Modeling Test Design Process – Modeling Test Results – Boundary Value Testing – Equivalence Class

Testing – Path Testing – Data Flow Testing - Test Case Design Effectiveness – Model-Driven Test Design – Test Procedures – Test Case Organization and Tracking
UNIT III ADVANCED TESTING CONCEPTS 6 Advanced Testing Concepts: Performance Testing – Load Testing – Stress Testing – Volume Testing – Fail-Over Testing – Recovery Testing – Configuration Testing – Compatibility Testing – Usability Testing – Documentation Testing – Security Testing – Testing in Agile Environment – Testing Web Applications – Testing Mobile Applications – Testing API
UNIT IV INTRODUCTION TO TEST AUTOMATION AND SELENIUM 6 Why Automation? – Manual vs Automated Testing – When to Automate – When Not to Automate – Types of Automation Tools – Automation Frameworks – Data-Driven – Keyword-Driven – Hybrid – BDD – Introduction to Selenium – Selenium Components – Selenium WebDriver–Locators: ID–Name–XPath–CSS Selector–Actions on Web Elements–Automating Simple Web Tests
UNIT V TESTNG AND CUCUMBER 6 TestNG: Need for Test Frameworks – TestNG Installation – TestNG Annotations – testng.xml–Grouping Tests–Parameterization–Generating Test Reports Cucumber (BDD): Behavior-Driven Development Concepts – Gherkin Syntax: Feature – Scenario–Steps–CreatingFeatureFiles–StepDefinitions–IntegratingSeleniumwith Cucumber – Running Cucumber Tests – Cucumber HTML and JUnit Reports
Total Periods: 30

List of Experiments

Sl. No	List of Experiments
1	Develop a comprehensive test plan for Amazon India covering scope, objectives, strategy, resources, schedule, and risks.
2	Design detailed test cases for core functionalities of Amazon India such as login, product search, cart, checkout, and payment processing.
3	Perform manual testing on any testing practice website or your own web page and identify defects. Document them and prepare a defect report.
4	Develop a test plan and design test cases for an Inventory Control System covering modules like stock management, supplier handling, and order processing.
5	Automate key functionalities of an e-commerce application using Selenium, including login, search, cart, and checkout processes.
6	Integrate TestNG with Selenium automation to enable structured execution, reporting, and parallel testing for any E-Commerce application.
7	Build a data-driven testing framework using Selenium and TestNG by fetching test data from external sources like Excel or CSV files.
8	Develop a Page Object Model framework using Selenium and TestNG to improve maintainability and reusability.
9	Build a BDD framework using Selenium, TestNG, and Cucumber with test scenarios written in Gherkin format.
Total Periods: 30	
Total: 30 + 30 = 60 Periods	

Learning Resources

1	Yogesh Singh, “SoftwareTesting”,CambridgeUniversityPress,2012
2	Srinivasan Desikan & Gopalaswamy Ramesh, “Software Testing: Principles and Practices”, Pearson Education, 2006.
3	Unmesh Gundecha, SatyaAvasarala,"SeleniumWebDriver3PracticalGuide" –Second Edition 2018

4	Cedric Beust & Hani Suleiman, "Next Generation Java Testing: Test NG and Advanced Concepts", Addison-Wesley, 2007.
5	GlenfordJ.Myers,CoreySandler,TomBadgett,TheArtofSoftwareTesting,3rdEdition, 2012, John Wiley & Sons, Inc.
6	"Software Testing", Prof. Meenakshi D'souza, IIIT Bangalore, NPTEL. ttps://onlinecourses.nptel.ac.in/noc22_cs61/
7	Selenium Tutorial - Online Tutorials Library - https://www.tutorialspoint.com/selenium/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Understand the fundamental principles of software testing, types of testing, and the software testing lifecycle for ensuring software quality and reliability.	Understand
CO2	Apply test planning techniques, create effective test cases, and execute test processes using test design strategies and metrics.	Apply
CO3	Analyze and differentiate performance, compatibility, usability, security, and other advanced testing methods in real-time scenarios.	Analyze
CO4	Apply Selenium WebDriver and appropriate automation frameworks to automate basic web-based test cases.	Apply
CO5	Develop automated test suites using TestNG and implement behavior-driven development using Cucumber with Selenium integration.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	2	-	2	3	2
CO2	3	3	2	2	3	-	-	-	2	-	2	3	2
CO3	2	3	2	3	2	-	-	-	2	-	2	2	2
CO4	2	2	3	2	3	-	-	-	2	2	3	2	3
CO5	2	2	3	2	3	-	-	-	2	2	3	2	3
Avg.	2.4	2.4	2.5	2.3	2.8	-	-	-	2	2	2.4	2.4	2.4

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

PROFESSIONAL ELECTIVE- II

VERTICAL 2: COMPUTATIONAL INTELLIGENCE

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSML03	Text and Speech Analysis	PEC	2	0	2	4	3	50	50
2	U24CSML04	Computer Vision	PEC	3	0	0	3	3	40	60
3	U24CSML05	Generative AI Fundamentals	PEC	3	0	0	3	3	40	60
4	U24CSML06	Game Theory	PEC	2	0	2	4	3	50	50
5	U24ADCI01	Recommender Systems	PEC	3	0	0	3	3	40	60
6	U24ADCI02	AI in Block Chain	PEC	3	0	0	3	3	40	60
7	U24ADCI03	Reinforcement Learning	PEC	2	0	2	4	3	50	50

U24CSML03	TEXT AND SPEECH ANALYSIS	L	T	P	C
		2	0	2	3

Course Objective:

- Introduce the foundational concepts of natural language processing and familiarize students with essential text preprocessing and representation techniques.
- Provide knowledge of text representation methods, word embeddings, and deep learning models used for effective text classification.
- Enable students to understand the principles of question answering and dialogue systems and explore methods for designing and evaluating them.
- Develop an understanding of text-to-speech synthesis techniques, including linguistic processing, prosody generation, and modern deep learning–based TTS models.
- Impart knowledge of automatic speech recognition processes, including acoustic modeling, feature extraction, language modeling, and performance evaluation metrics.

Detailed Syllabus

UNIT I NATURAL LANGUAGE BASICS	**6**
Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model	
UNIT II TEXT CLASSIFICATION	**6**
Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models	
UNIT III QUESTION ANSWERING AND DIALOGUE SYSTEMS	**6**
Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems - evaluating dialogue systems	
UNIT IV TEXT-TO-SPEECH SYNTHESIS	**6**
Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing -Concatenative and parametric approaches, Wave Net and other deep learning-based TTS systems.	
UNIT V AUTOMATIC SPEECH RECOGNITION	**6**
Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems. Language Models – LSTM- Decoding Strategies – Evaluation of ASR systems- Word Error rate, Recognition accuracy.	
Total Periods : 30	

List of Experiments

Sl. No	List of Experiments
1	Pattern Detection in User Inputs Using Python Regular Expressions
2	Morphological Analysis for Understanding Word Structure in Text Data
3	Exploring Text Search and Vocabulary Analytics Using Python and NLTK
4	Identifying Collocations and Bigram Patterns in Natural Language Corpora
5	Corpus Access and Linguistic Exploration Using NLTK in Python
6	Building a Word Frequency Analyzer for Extracting Top Non-Stopword Terms



7	Implementing Word2Vec for Learning Semantic Word Relationships
8	Named Entity Recognition for Extracting Key Information from Text
9	Text Classification Using Transformer-Based Deep Learning Models
10	Designing a Rule-Based Chatbot for Simple Dialogue Interaction
11	Text-to-Speech Synthesis and Accuracy Evaluation in Real-World Scenarios
12	Developing an Automatic Speech Recognition System and Computing Error Rates
	Total Periods:30
	Total:30 +30 = 60 Periods

Learning Resources

1	Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.
2	Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018.
3	Tanveer Siddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
4	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
5	Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Apply NLP fundamentals, text pre-processing, and feature-engineering techniques for textual data analysis.	Apply
CO2	Implement text representation and classification models using embeddings and deep learning architectures.	Apply
CO3	Solve question-answering a nd dialogue systems using IR, knowledge-based methods, and language models.	Apply
CO4	Construct text-to-speech systems using text normalization, letter-to-sound rules, prosody modeling, and deep learning approaches.	Apply
CO5	Compute automatic speech recognition systems using acoustic modeling, feature extraction, HMM/DNN methods, and language models.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	3	1	1	2	2	2	-	2	2
CO2	3	3	3	2	3	2	2	2	1	2	-	3	3
CO3	3	3	3	2	3	2	2	2	2	2	-	3	3
CO4	3	3	3	2	3	2	2	1	2	2	-	3	3
CO5	3	3	3	2	3	2	2	2	1	2	-	3	3
Avg.	3.0	3.0	3.0	2.0	3.0	1.8	1.8	1.8	1.6	2.0	-	2.8	2.8

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSML04	COMPUTER VISION	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature-based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image-based rendering and recognition

Detailed Syllabus

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9 Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighbourhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.
UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 9 nd mode finding - Normalized cuts - Graph cuts and energy-based methods.
UNIT III FEATURE-BASED ALIGNMENT & 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 - Spline-based motion - Optical flow - Layered motion.
UNIT IV 3D RECONSTRUCTION 9 Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.
UNIT VIMAGE-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 Periods: 45

Learning Resources

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.
3	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
5	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Summarize the basic principles of image processing and computer vision.	Understand

CO2	Apply basic and advanced image processing techniques using OpenCV.	Apply
CO3	Apply 2D a feature-based based image alignment, segmentation and motion estimations.	Apply
CO4	Apply 3D image reconstruction techniques.	Apply
CO5	Design and develop innovative image processing and computer vision applications.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2	2	2	2	-	-	2	2	3	1	1	2
CO2	2	2	2	2	2	-	-	2	2	2	2	1	2
CO3	2	3	3	2	2	-	-	2	2	1	1	2	2
CO4	2	3	3	2	2	-	-	2	2	3	1	2	2
CO5	2	2	2	2	2	-	-	2	2	3	2	2	2
Avg.	**1.8**	**2.4**	**2.4**	**2**	**2**	**-**	**-**	**2**	**2**	**2.4**	**1.4**	**1.6**	**2**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSML05	GENERATIVE AI FUNDAMENTALS	L	T	P	C
		3	0	0	3

Course Objective:

- Understand foundational concepts of generative models and deep learning architectures including CNNs, RNNs, and optimization techniques.
- Apply image generation techniques using variational methods, autoregressive flows, and practical implementations in TensorFlow 2.
- Outline Generative Adversarial Networks (GANs), their variants, and applications such as style transfer and deepfakes.
- Describe Large Language Models (LLMs), Transformers, GPT, and multi-modal generative models for text and image generation.
- Construct effective prompts for LLMs, including in-context learning and image prompting techniques.

Detailed Syllabus

UNIT I INTRODUCTION	**9**
Generative Models – Image transformation – Challenges - Deep Neural Networks – Perceptron – back propagation – CNN – RNN – Optimizer.	
UNIT II IMAGE GENERATION	**9**
Creating encodings of images – variational objective – Inverse Autoregressive flow – Importing CIFAR – Creating the network from TensorFlow 2.	
UNIT III GENERATIVE ADVERSARIAL NETWORKS	**9**
Generative Adversarial Networks – Vanilla GAN – Improved GANs – Progressive GAN – Challenges – Paired style transfer – Unpaired style transfer – Deepfakes – Modes of operation – key feature set – High level flow – Replacement – Re-enactment.	
UNIT IV LARGE LANGUAGE MODELS	**9**
Overview of LLMs - Transformers – GPT – Types of LLMs – Key concepts – other Transformers – T5 – Generative Pre-Training Models – Multi-modal Models – DALL.E 2	
UNIT V PROMPT ENGINEERING	**9**
Basics – In-Context Learning – In-Context Prompting – Techniques – Image Prompting – Prompt Hijacking – Challenges.	

	Total Periods: 45

Learning Resources

1	Ben Auffarth, Generative AI with Lang Chain, Packt Publishing,2023.
2	Amit Bahree, Generative Aiin Action, Manning Publication, First Edition,2023.
3	David Foster, Generative Deep Learning,2nd Edition, O'Reilly Media,2023.
4	Numa Dhamani and Maggie Engler, Introduction to Generative AI, Manning Publication, First Edition, 2024.
5	Valentina Alto, Modern Generative AI with ChatGPT and Open AI Models, Packt

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe the differences in generative models and neural network architectures.	Understand
CO2	Develop deep learning models for image generation and encoding using variational and autoregressive approaches in TensorFlow 2.	Apply
CO3	Apply different Generative Adversarial Network (GAN) techniques for applications such as style transfer and deepfake generation.	Apply
CO4	Apply the architecture and functioning principles of Large Language Models (LLMs) and multi-modal generative models.	Apply
CO5	Construct effective prompts for LLMs.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	3	1	3	-	-	2	3	-	3	3	3
CO2	3	3	3	2	3	-	-	2	2	-	3	3	3
CO3	3	2	2	1	3	-	-	2	2	-	3	3	3
CO4	3	2	2	2	3	-	-	2	2	-	3	3	3
CO5	3	2	2	2	3	-	-	3	2	-	3	3	3
Avg.	**2.8**	**2.2**	**2.2**	**1.6**	**3**	**-**	**-**	**2.2**	**2.2**	**-**	**3**	**3**	**3**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSML06	**GAME THEORY**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

Course Objective:

- Introduce fundamental concepts of games, solution concepts, and strategic reasoning.
- Formalize rational choice and strategic decision-making using game-theoretic tools.
- Explore applications of game theory in economics, computer science, and electronic trading markets.
- Highlight computational aspects of game theory, including algorithms for equilibrium computation.
- Apply game-theoretic models to practical scenarios such as auctions, market design, and search mechanisms.

Detailed Syllabus

UNIT I INTRODUCTION **6**

Introduction — Making rational choices: basics of Games — strategy — preferences — payoffs— Mathematical basics — Game theory — Rational Choice — Basic solution concepts-non-cooperative versus cooperative games — Basic computational issues — finding equilibria and learning in games-

Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets).
UNIT II GAMES WITH PERFECT INFORMATION 6 Games with Perfect Information — Strategic games — prisoner's dilemma, matching pennies -Nash equilibria —mixed strategy equilibrium — zero-sum games.
UNIT III GAMES WITH IMPERFECT INFORMATION 6 Games with Imperfect Information — Bayesian Games — Motivational Examples — General Definitions— Information aspects — Illustrations — Extensive Games with Imperfect — Information —Strategies — Nash Equilibrium —Repeated Games — The Prisoner's Dilemma — Bargaining.
UNIT IV NON-COOPERATIVE GAME THEORY 6 Non-cooperative Game Theory — Self-interested agents — Games in normal form — Analyzing games: from optimality to equilibrium — Computing Solution Concepts of Normal — Form Games— Computing Nash equilibria of two-player, zero-sum games —Computing Nash equilibria of two-player, general- sum games — Identifying dominated strategies.
UNIT V MECHANISM DESIGN 6 Aggregating Preferences — Social Choice — Formal Model — Voting — Existence of social functions — Ranking systems — Protocols for Strategic Agents: Mechanism Design Mechanism design with unrestricted preferences.
Total Periods: 30

List of Experiments

Sl. No.	List of Experiments
1	Analyzing Rational Choice Using the Prisoner’s Dilemma
2	Identifying Pure Strategy Nash Equilibrium in Duopoly Market Entry
3	Solving Sequential Decisions Using Backward Induction in Investment Games
4	Applying Dominated Strategy Elimination in Strategic Form Games
5	Computing Minimax Strategies in Zero-Sum Competitive Settings
6	Finding Mixed Strategy Nash Equilibrium in Imperfect-Information Zero-Sum Games
7	Observing Strategy Evolution and Cooperation in Repeated Prisoner’s Dilemma
8	Determining Bayesian Nash Equilibrium in Sealed-Bid First-Price Auctions
9	Evaluating Social Choice Functions Through Voting Mechanism Experiments
10	Designing Incentive-Compatible Mechanisms for Fair Resource Allocation
	Total Periods:30
	Total:30 +30 = 60 Periods

Learning Resources

1	M. J. Osborne, An Introduction to Game Theory. Oxford University Press.
2	M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press.
3	N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press.
4	A. Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.
5	Yoav Shoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press.
6	Zhu Han, Dusit Niyato, Walid Saad, Tamer Basar and Are Hjorungnes, “Game Theory in Wireless and Communication Networks”, Cambridge University Press.

7	Y. Narahari, “Game Theory and Mechanism Design”, IISC Press, World Scientific.
8	William Spaniel, “Game Theory 101: The Complete Textbook”, CreateSpace Independent Publishing.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Illustrate the fundamental notions of game theory, including games, strategies, payoffs, and solution concepts for strategic analysis.	Apply
CO2	Solve rational choice and strategic interaction problems using game-theoretic tools to determine optimal agent behaviour.	Apply
CO3	Analyse applications of game theory in economics, computer science, and electronic trading markets to identify market equilibria.	Apply
CO4	Compute equilibria in various game-theoretic scenarios while evaluating the computational challenges involved in algorithmic game theory.	Apply
CO5	Construct game-theoretic mechanisms for real-world problems such as auctions, market design, and online search mechanisms.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	2	-	2	2
CO2	3	3	3	2	3	2	2	2	1	2	-	3	2
CO3	3	3	3	2	3	2	2	2	2	2	-	3	3
CO4	3	3	3	2	3	1	1	1	2	2	-	3	3
CO5	3	3	3	2	3	2	2	2	1	2	-	3	3
Avg.	**3.0**	**2.8**	**2.8**	**2.0**	**2.8**	**1.6**	**1.6**	**1.6**	**1.4**	**2.0**	**-**	**2.8**	**2.6**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24ADCI01	RECOMMENDER SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the fundamentals and taxonomy of recommender systems
- To learn the architecture and techniques of content-based recommender systems.
- To analyze collaborative filtering methods such as user-based and item-based approaches.
- To examine attack types and develop robust recommender system strategies.
- To design and evaluate recommender systems using appropriate metrics and methodologies.

Detailed Syllabus

UNIT I INTRODUCTION **9**

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

UNIT II CONTENT-BASED RECOMMENDATION SYSTEMS **9**

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT III COLLABORATIVE FILTERING	**9**
A systematic approach, Nearest-neighbour collaborative filtering (CF), user-based and item-based CF, components of neighbourhood methods (rating normalization, similarity weight computation - and neighbourhood selection)	
UNIT IV ATTACK-RESISTANT RECOMMENDER SYSTEMS	**9**
Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.	
UNIT V EVALUATING RECOMMENDER SYSTEMS	**9**
Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures	
Total Periods: 45	

Learning Resources

1	Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2	Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3	Francesco Ricci , Lior Roach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer (2011)
4	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020
5	Recommender Systems Handbook (3rd Edition, 2022) – Edited by Francesco Ricci, Lior Rokach, and Bracha Shapira.
6	Recommender Systems: The Textbook (2016) – By Charu C. Aggarwal.
7	Recommender Systems: An Introduction (2010) – By Dietmar Jannach, Markus Zanker, Alexander Felfernig, and Gerhard Friedrich
8	Practical Recommender Systems *(*2019) – By Kim Falk
9	Statistical Methods for Recommender Systems *(*2016) – By Deepak K. Agarwal and Bee-Chung Chen.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain recommender systems using taxonomy, data mining, similarity measures, and SVD.	Understand
CO2	Analyze different profiles and recommendation outputs for accuracy	Understand
CO3	Apply matrix factorization techniques**.**	Apply
CO4	Elaborate on the evaluation paradigms for a recommendation system.	Apply
CO5	Apply appropriate accuracy metrics	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	1	-	-	2	2	-	-	1	1
CO2	2	2	2	2	1	-	-	2	2	-	-	2	2
CO3	2	3	3	2	2	-	-	1	2	-	-	2	2
CO4	2	2	2	2	2	-	-	2	2	-	-	2	2
CO5	2	3	3	2	3	-	-	1	2	-	-	2	2
Avg.	**2**	**2.4**	**2.4**	**2**	**1.8**	**-**	**-**	**1.6**	**2**	**-**	**-**	**1.8**	**1.8**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24ADCI02	AI IN BLOCK CHAIN	L	T	P	C
		3	0	0	3

Course Objective:

- Understand blockchain principles, platforms, and consensus mechanisms
- Explain AI integrates with blockchain for improved data management and decision systems
- Describe cryptocurrencies the role of AI in prediction and trading.
- Develop DI Apps using blockchain frameworks and tools.
- Analyze limitations, challenges, and future scope of AI–blockchain integration.

Detailed Syllabus

UNIT I INTRODUCTION TO BLOCKCHAIN	**9**
Overview – Blockchain vs Distributed Ledger Technology vs Distributed Databases – Public vs private vs permissioned blockchains – Privacy in blockchains – Blockchain platforms - Hyperledger – Hash graph, Corda – IOTA - Consensus Algorithms – Building DApps with blockchain tools	
UNIT II BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE	**9**
Introduction to the AI landscape - AI and Blockchain driven Databases – Centralized vs Distributed data – Blockchain data – Big data for AI analysis – Global databases – Data Management in a DAO - Benefits of combining blockchain and AI – Aicumen Technologies - Combining blockchain and AI to humanize digital interactions.	
UNIT III CRYPTOCURRENCY AND AI	**9**
Bitcoins – Ethereum - Role Of Ai In Cryptocurrency – Cryptocurrency Trading – Making Price Predictions With Ai – Market Making – Future Of Cryptocurrencies.	
UNIT IV DEVELOPING BLOCKCHAIN PRODUCTS	**9**
Development Life Cycle of a DIApp – Designing a DIApp – Developing a DIApp – Testing – Deploying – Monitoring – Implementing DIApps.	
UNIT V LIMITATIONS AND FUTURE OF AI WITH BLOCKCHAIN	**9**
Technical Challenges – Business Model Challenges – Scandals and Public perception – Government Regulation – Privacy Challenges for Personal Records – Convergence of AI with Blockchain – Future – Enterprise.	
	Total Periods: 45

Learning Resources

1	Ganesh Prasad Kumble, Anantha Krishnan, “Practical Artificial Intelligence and Blockchain: A guide to converging blockchain and AI to build smart applications for new economies”, Packt Publications, 2020.
2	Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015.
3	Andreas M. Antonopoulos — Mastering Bitcoin: Programming the Open Blockchain, 2014
4	Imran Bashir — Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, *2017*
5	Daniel Drescher, “Block Chain Basics”, Apress; 1st edition, 2017.
6	Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O’Dowd, Venkatraman Ramakrishna, “Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer”, Import, 2018.
7	**“**Bitcoin and CryptocurrencyTechnologies”by Narayanan, Bonneau, Felten, Miller & Goldfeder, 2016**.**

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply blockchain principles and consensus mechanisms to design decentralized architectures for public and private networks.	Apply
CO2	Apply AI-driven database techniques and DAOs to automate data management and digital interactions.	Apply
CO3	Implement AI models for cryptocurrency price prediction and algorithmic trading strategies within blockchain ecosystems.	Apply
CO4	Construct Decentralized Applications (DApps) by executing the complete development life cycle from design to deployment.	Create
CO5	Solve technical, regulatory, and privacy challenges in AI-Blockchain integration using standardized enterprise frameworks.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	3	-	-	2	2	-	-	2	2
CO2	3	3	3	2	3	-	-	2	2	-	-	3	2
CO3	3	3	3	2	3	-	-	1	2	1	-	3	3
CO4	3	3	3	2	3	-	-	2	2	-	-	3	3
CO5	3	3	3	2	3	-	-	2	1	-	-	2	3
Avg.	**3.0**	**3.0**	**3.0**	**2.0**	**3.0**	**-**	**-**	**1.8**	**1.8**	**1.0**	**-**	**2.6**	**2.6**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24ADCI03	**REINFORCEMENT LEARNING**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

Course Objective:

- Describe core reinforcement learning (RL) concepts, including agents, environments, and policies.
- Explore Markov Decision Processes (MDPs) and Dynamic Programming for solving RL problems.
- Implement Monte Carlo methods, Temporal Difference (TD) learning, and Q-learning.
- Explore value function approximation and deep reinforcement learning methods like DQN.
- Demonstrate advanced RL techniques, including Policy Gradient, Actor-Critic, and Proximal Policy Optimization.

Detailed Syllabus

UNIT I BASICS OF REINFORCEMENTLEARNING **6**

Introduction to Reinforcement Learning–Elements of Reinforcement Learning– Scope – History of Reinforcement Learning– The Agent-Environment Interface – Examples of Reinforcement Learning – Why Study Reinforcement Learning – Challenges in Reinforcement Learning – Multi-arm Bandit Problem.

UNIT II MARKOV DECISION PROCESSES AND DYNAMIC PROGRAMMING **6**

Overview of Markov Chain - Overview of Markov Decision Process – Model Reinforcement Learning Problem using MDP – Markov Process – Markov Chain – Markov Decision Process – Alternative

Bellman Equations for value functions – Optimal policy and optimal value functions – Using Dynamic programming to solve RL problems – Policy Evaluation – Policy Improvement – Policy Iteration – Value Iteration.
UNIT III MONTE CARLO AND TEMPORAL DIFFERENCING 6 Monte Carlo Introduction – Policy Evaluation – Incremental Update – Exploration Vs Exploitation – Policy Improvement – Temporal Differencing Learning – TD Policy Evaluation – Epilon-Greedy policy – On-policy Vs Off-policy – Q-Learning – SARSA Learning – Double Q-Learning – Applications of Q-Learning – Grid Problems - N-Step Bootstrapping.
UNIT IV VALUE FUNCTION APPROXIMATION 6 Linear value function approximation – Challenge of Large-scale MDP – Value Function approximations – Stochastic Gradient Descent – Linear value and non-linear value approximation – Deep neural nets – Naïve Deep-Q Learning – Experience Replay – DQN for Games – DQN with Double-Q learning – Prioritized experience Replay – Advantage Function and Duelling Network Architecture.
UNIT V ADVANCED DEEP REINFORCEMENT LEARNING 6 Policy Gradient Methods – Policy-Based methods – Policy Gradient – REINFORCE – Baseline – Actor-Critic Methods -Problems with Continuous Action space – Problems with Standard Methods – Policy Performance Bounds – Proximal Policy Optimization -Latest Trends – Distributed Reinforcement Learning – Curiosity Driven Exploration – Random network Distillation – Planning with AlphaZero.
Total Periods: 30

List of Experiments

Sl. No.	List of Experiments
1	Implement a simple Tic-Tac-Toe game using reinforcement learning.
2	Implement a 10-armed Gradient bandit algorithm.
3	Implement a game using dynamic programming in reinforcement learning.
4	Implement any real-world problem using Monte Carlo Algorithm.
5	Implement SARSA.
6	Implement Q-Learning (Off Policy TD Learning),
7	Solve a real world problem using Q-Learning with Linear Function Approximation.
8	Implement SARSA with Linear Function Approximation.
9	Implement a game using Deep Reinforcement Learning.
10	Implement Deep Q-Learning in Python using Keras& OpenAI Gym for an agent that can play a game.
	TotalPeriods:30
	Total:30 +30 = 60 Periods

Learning Resources

1	Richard S.Sutton and Andrew G.Barto, Reinforcement learning: An introduction, Second Edition, MIT Press, 2019.
2	Michael Hu, The Art of Reinforcement Learning – Fundamentals, Mathematics and Implementations with Python, Apress, 2024.
3	Sudharsan Ravichandiran, Deep Reinforcement Learning with Python, Second Edition, Packet Publishing, Birmingham, 2020.
4	Csaba Szepesvari, Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence & Machine Learning), Morgan & Claypool Publishers, 2010.



5	Laura Graesser and Wah Loon Keng, Foundations of Deep Reinforcement learning: theory and Practice in Python, Pearson India, New Delhi, 2022.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain key RL concepts and agent-environment interactions.	Apply
CO2	Model and solve RL problems using MDPs and Dynamic Programming.	Apply
CO3	Apply Temporal Difference methods, including SARSA and Q-learning.	Apply
CO4	Implement value function approximation and deep RL techniques	Apply
CO5	Solve real-world problems using Reinforcement Learning	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	1	-	-	2	2	-	-	1	1
CO2	2	2	2	2	1	-	-	2	2	-	-	2	2
CO3	2	3	3	2	2	-	-	1	2	-	-	2	2
CO4	2	2	2	2	2	-	-	2	2	-	-	2	2
CO5	2	3	3	2	3	-	-	1	2	-	-	2	2
Avg.	**2**	**2.4**	**2.4**	**2**	**1.8**	**-**	**-**	**1.6**	**2**	**-**	**-**	**1.8**	**1.8**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

PROFESSIONAL ELECTIVE – III

VERTICAL 3: DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24ADDA01	Data Warehousing	PEC	2	0	2	4	3	50	50
2	U24ADDA02	Social Network Analytics	PEC	3	0	0	3	3	40	60
3	U24ADDA03	Business Analytics	PEC	3	0	0	3	3	40	60
4	U24ADDA04	Cognitive Science and Analytics	PEC	3	0	0	3	3	40	60
5	U24ADDA05	Knowledge Engineering	PEC	2	0	2	4	3	50	50
6	U24ADDA06	Health Care Analytics	PEC	3	0	0	3	3	40	60
7	U24ADDA07	Stream Processing and Analytics	PEC	2	0	2	4	3	50	50

U24ADDA01	DATA WAREHOUSING	L	T	P	C
		2	0	2	3

Course Objective:

- To learn the basics of data warehouse Architecture
- To understand the OLAP Technology
- To understand the partitioning strategy
- To differentiate various schema
- To understand the roles of process manager & system manager.

Detailed Syllabus

UNIT I INTRODUCTION TO DATA WAREHOUSE 6 Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture – Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse
UNIT II ETL AND OLAP TECHNOLOGY 6 What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP – Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.
UNIT III METADATA, DATA MART AND PARTITION STRATEGY 6 Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting– Horizontal Partition
UNIT IV DIMENSIONAL MODELING AND SCHEMA 6 Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition – Process Architecture- Types of Database Parallelism – Data Warehouse Tools.
UNIT V SYSTEM & PROCESS MANAGERS 6 Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing
Total Periods: 30

List of Experiments

Sl. No	List of Experiments
1.	Data exploration and integration with WEKA.
2.	Apply weka tool for data validation
3.	Plan the architecture for real time application
4.	Write the query for schema definition
5.	Design data ware house for real time applications
6.	Analyse the dimensional Modeling
7.	Case study using OLAP
8.	Case study using OTLP
9.	Implementation of warehouse testing.

	Total Periods:30
	Total:30 +30 = 60 Periods

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Design data warehouse architecture for various Problem.	Apply
CO2	Apply the OLAP Technology.	Apply
CO3	Analyze the partitioning strategy.	Analyze
CO4	Critically analyze the differentiation of various schema for given problem.	Analyze
CO5	Analyze the roles of the Process Manager and System Manager to understand how they support efficient operating system functioning.	Apply

Learning Resources

1	Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2	Ralph Kimball, “The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling”, Third edition, 2013.
3	David Poole, Alan Mackworth, RandyGoebel,“Computational Intelligence: a logical approach”, Oxford University Press, 2006.
4	G.Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Sixth Edition, Pearson Education, Reprint 2021.
5	https://business.baylor.edu//gina_green/teaching/dw/spr16/Ponniah_data-warehousing-fundamentals-for-it-professionalsSecondEdition.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	-	3	-	-	2	2	2	3	2	3
CO2	3	3	3	-	3	-	-	2	2	2	3	2	3
CO3	3	2	3	-	3	-	-	2	2	2	3	2	3
CO4	3	3	3	-	3	-	-	2	2	2	3	2	3
CO5	3	-	-	-	-	-	-	3	3	3	3	2	3
Avg.	**3**	**2.2**	**2.4**	**-**	**2.4**	**-**	**-**	**2.5**	**2.5**	**2.5**	**3**	**2**	**3**

For CO-PO/PSO Mapping:3 – Substantial (High), 2– Moderate(Medium), 1– Slight (Low)

U24ADDA02	**SOCIAL NETWORK ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- Describe the basics of social networks and issues of security and privacy.
- Explore the methods and metrics for predicting links in social networks, community detection and
- characteristics of ego networks.
- Describe the models of information diffusion, cascades, and clusters in networks.
- Explore the model and aggregate social network data, create social-semantic applications, and apply recommendation techniques



- Explore visualization techniques, including structural and semantic visualization, and perform mining tasks.

Detailed Syllabus

UNIT I INTRODUCTION TO SOCIAL NETWORKS	**9**
Complex Networks, Overview of Social Network Analysis, Social Media Content, Levels of Network Analysis, Network Statistics, Representation of the Networks, Network Models, Network Centrality, Security and Privacy in Social Networks.	
UNIT II LINK PREDICTION	**9**
Link Analysis, Link Prediction, Link Prediction Methods, Metrics for Link prediction, prediction of Performance Metrics, Community Detection, Taxonomy of community criteria, Community evaluation, Ego Networks - Characteristics of Ego Networks, Ego Network Measures, Network Cohesion.	
UNIT III INFORMATION DIFFUSION	**9**
Game Theoretic models, User behavior in social networks, Strategic Interaction in networks, Information Networks, Information Cascades, Cascading behavior in Networks, Diffusion in Network, Modeling, Cascades and Clusters, Diffusion, Thresholds, Six degrees of separation Decentralized search, Epidemics, Influence maximization, Outbreak detection, Markets and Information, Voting, Property Rights, Social Network Analysis Tools.	
UNIT IV SOCIAL SEMANTIC AND RECOMMENDER SYSTEM	**9**
Modeling and aggregating Social Network Data – Network Data Representation, Ontological Representation of Social Individuals and Relationships – Aggregating and Reasoning with Social Network Data – Developing social-semantic applications - Recommendation in Communities -Social Collaboration Platforms-Recommendation Types- Partner Recommendation -Social Network-Based Collaboration .-Reputation Model - Structural Importance Model - Framework and Ranking Algorithm - Social Broker Recommendation - Virtual Organizations -Expert Communities - Broker Ranking.	
UNIT V VISUALIZING, MINING SOCIAL NETWORKS	**9**
Taxonomy of Visualizations - Structural Visualization, Semantic and Temporal Visualization, Statistical Visualization, The Convergence of Visualization, Interaction and Analytics - Structural and Semantic Filtering with Ontologies, Centrality-based Visual Discovery and exploration, Mining Social Network Graphs - Clustering, Discovery of Communities, Partitioning, overlapping Communities, Simrank, Triangles in social networks, Neighbourhoods, Transitive closure	
	Total Periods:45

Learning Resources

1	Social Network Modelling and Analysis, Niyati Aggrawal, Adarsh Anand, Taylor and Francis, CRC Press, 2022
2	Social Networks and the Semantic Web, Peter Mika, Springer 2007
3	Social Network data Analytics, Charu C Aggarwal, Springer, 2011
4	Networks, Crowds, and Markets reasoning about a highly connected world, David Easley and Jon Kleinberg, Cambridge University Press, 2010
5	Social Network Analysis and Education, Theory Methods & Applications by Brain V, Carolan, Sage Publications, 2014
6	Understanding Social Networks Theories, Concepts and Findings, Charles and Kadushin, Oxford University Press, 2012
7	Analyzing Social Networks, Stephan P Borgatti, Martin G Everett, Jeffrey C Johnson, Sage Publications, 2017
8	Social Recommender Systems, Daniel Schall, Springer, 2015

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the fundamental concepts , structure and components of socials.	Apply
CO2	Apply link prediction and community detection methods.	Apply
CO3	Analyze the models of diffusion and the cascade information in networks.	Analyze
CO4	Apply techniques for modeling and aggregating social network data.	Apply
CO5	Use Structural and semantic visualization tools to represent network data.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	1	1	-	-	-	1	-	2	1	1
CO2	3	3	2	2	1	-	-	-	1	-	2	2	1
CO3	3	3	2	3	2	-	-	-	1	-	2	2	2
CO4	3	2	3	2	2	-	-	-	1	-	2	3	2
CO5	3	3	2	3	3	-	-	-	2	-	2	2	3
Avg.	**3.0**	**2.6**	**2.25**	**2.2**	**1.8**	**-**	**-**	**-**	**1.2**	**-**	**2.0**	**2.0**	**1.8**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24ADDA03	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To understand the Analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence.
- To understand various types of analytics for Business Forecasting.
- To model the supply chain management for Analytics
- To apply analytics for different functions of a business.

Detailed Syllabus

UNIT I INTRODUCTION TO BUSINESS ANALYTICS **9**

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition– Data Preparation – Hypothesis Generation – Modelling – Validation and Evaluation – Interpretation – Deployment and Iteration.

UNIT II BUSINESS INTELLIGENCE **9**

Data Warehouses and Data Mart – Knowledge Management –Types of Decisions – Decision Making Process – Decision Support Systems – Business Intelligence –OLAP – Analytic functions

UNIT III BUSINESS FORECASTING **9**

Introduction to Business Forecasting and Predictive analytics – Logic and Data-Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV HR & SUPPLY CHAIN ANALYTICS **9**

Human Resources – Planning and Recruitment – Training and Development – Supply Chain Analytics- Supply chain network – Planning Demand, Inventory and Supply – Logistics –

Analytics applications in HR & Supply Chain. Apply HR Analytics to make a prediction of the demand for hourly employees for a year
UNIT V MARKETING & SALES ANALYTICS **9** Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning - Analytics applications in Marketing and Sales. Do predictive analytics for customers' behaviour in marketing and sales.
Total Periods : 45

Learning Resources

1	"Fundamentals of Business Analytics", Prasad P N and Seema Acharya, Wiley India, First Edition, 2011.
2	"Business Intelligence", David Loshin, Morgan Kaufmann Publishers, Second Edition, 2012
3	R. Evans James, Business Analytics, 2017.
4	R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016.
5	Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016.
6	VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
7	Mahadevan B, "Operations Management -Theory and Practice", 3rd Edition, Pearson Education, 2018.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the real-world business problems and model with analytical solutions.	Understand
CO2	Apply business intelligence tools and decision-making techniques for organizational problem-solving.	Apply
CO3	Analyze and build forecasting and predictive models using data-driven and machine learning approaches.	Analyze
CO4	Apply analytics techniques in HR and supply chain domains for effective decision-making.	Apply
CO5	Develop predictive analytics solutions for marketing and sales to understand customer behavior.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	-	-	2	-	-	-	2	1
CO2	3	2	2	1	2	-	-	2	1	-	1	2	2
CO3	2	3	2	3	3	-	-	2	1	-	2	3	2
CO4	2	2	2	2	2	-	-	2	2	-	3	2	3
CO5	2	3	3	2	2	-	-	2	2	-	2	3	3
Avg.	2.4	2.4	2	1.8	2	-	-	2	1.2	-	1.6	2.4	2.2

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24ADDA04	COGNITIVE SCIENCE AND ANALYTICS	L	T	P	C
		3	0	0	3

Course Objective:

- To explain cognitive computing and design principles.
- To distinguish between NLP and cognitive computing.
- To apply advanced analytics to cognitive computing.
- To discuss application of cognitive computing in business.
- To illustrate various applications of cognitive computing.

Detailed Syllabus

UNIT I FOUNDATION & DESIGN PRINCIPLES **9**

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition. Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation and visualization services.

UNIT II NLP IN COGNITIVE SYSTEM **9**

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems. Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.

UNIT III BIG DATA Vs COGNITIVE COMPUTING **9**

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data. Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, Impact of open-source tools on advanced analytics.

UNIT IV COGNITIVE COMPUTING IN BUSINESS **9**

The Business Implications of Cognitive Computing: Preparing for change, advantages of new disruptive models, knowledge meaning to business, difference with a cognitive systems approach, meshing data together differently, using business knowledge to plan for the future, answering business questions in new ways, building business specific solutions, making cognitive computing a reality, cognitive application changing the market- IBM Watson as a cognitive system.

UNIT V APPLICATIONS **9**

The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing- Building a cognitive health care application- Smarter Cities-Cognitive Computing in Government.

Total Periods: 45

Learning Resources

1	Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, “Cognitive computing and Big Data Analytics”, Wiley, 2015.
2	Vijay Raghvan, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications", by Elsevier publications, North Holland Publication, 1st Edition, 2016.
3	Bernadette Sharp (Author), Florence Sedes (Author), Wieslaw Lubaszewski (Author), Cognitive Approach to Natural Language Processing Hardcover, First Edition May 2017.

4	Arun Kumar Sangaiah, Arunkumar Thangavelu, et al., Cognitive Computing for Big Data Systems Over IoT: Frameworks, Tools and Applications: Lecture Notes on Data Engineering and Communications Technologies 1st edition 2018.
5	Min Chen and Kai Hwang, Big-Data Analytics for Cloud, IoT and Cognitive Computing Wiley Publication, 1st Edition, 2017.
6	Mallick, Pradeep Kumar, Borah, Samarjeet," Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain cognitive computing and design principles.	Understand
CO2	Distinguish between NLP and cognitive computing.	Apply
CO3	Apply advanced analytics to cognitive computing.	Apply
CO4	Discuss application of cognitive computing in business.	Apply
CO5	Illustrate various applications of cognitive computing.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	2	2	-	1	2	-	3
CO2	3	-	-	-	-	-	-	2	2	-	1	2	1	3
CO3	3	-	-	-	2	-	-	2	2	-	2	2	2	3
CO4	3	-	-	-	-	-	-	2	2	-	2	2	-	3
CO5	3	-	-	-	2	-	-	2	2	-	2	2	2	3
Avg.	**3.0**	**-**	**-**	**-**	**2.0**	**-**	**-**	**2**	**2**	**-**	**1.6**	**2**	**1.7**	**3.0**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24ADDA05	KNOWLEDGE ENGINEERING	L	T	P	C
		2	0	2	3

Course Objective:

- Understand the fundamental concepts of knowledge representation and reasoning in AI.
- Apply various reasoning techniques to solve knowledge-based problems.
- Design and develop knowledge-based systems using rule-based and ontology-based approaches.
- Analyze and evaluate the performance, consistency, and correctness of knowledge bases.
- Develop a mini knowledge engineering project and demonstrate effective communication.

Detailed Syllabus

UNIT I REASONING UNDERUNCERTAINTY **6**

Introduction–Abductivereasoning–Probabilisticreasoning:EnumerativeProbabilities– Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning–Knowledge Engineering.

UNIT II METHODOLOGY AND MODELING	**6**
Conventional Design and Development –Development tools and Reusable Ontologies– Agent Design and Development using Learning Technology–Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios	
UNIT III ONTOLOGIES–DESIGN AND DEVELOPMENT	**6**
Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features– Representation–Transitivity–Inheritance–ConceptsasFeatureValues– Ontology Matching. Design and Development Methodologies – Steps in Ontology. Development –Domain Understanding and Concept Elicitation–Modelling-based Ontology Specification.	
UNIT IV REASONIING WITH ONTOLOGIES AND RULES	**6**
Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine –Evidence-based hypothesis analysis–Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.	
UNIT V LEARNING AND RULE LEARNING	**6**
Machine Learning – Concepts – Generalization and Specialization Rules – Types – FormaldefinitionofGeneralization.Modelling,LearningandProblemSolving –Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.	
	Total Periods:30

List of Experiments

Sl. No.	List of Experiments
1	Perform operations with Evidence Based Reasoning.
2	Perform Evidence based Analysis.
3	Perform operations on Probability Based Reasoning.
4	Perform Believability Analysis.
5	Implement Rule Learning and refinement.
6	Perform analysis based on learned patterns.
7	Construction of Ontology for a given domain.
	Total Periods:30
	Total:30 +30 = 60 Periods

Learning Resources

1	Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (
2	Ronald J. Brachman ,Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
3	Ela Kumar ,Knowledge Engineering, IK International Publisher House,2018
4	John F. Sowa :Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning,2000.
5	King, Knowledge Management and Organizational Learning, Springer, 2009.
6	JayLiebowitz,KnowledgeManagementLearningfromKnowledgeEngineering,1st Edition,2001

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Understand the fundamental concepts of knowledge representation and Reasoning in AI	Understand
CO2	Apply various reasoning techniques to solve knowledge-based problems.	Apply
CO3	Design and develop knowledge-based systems using rule-based and ontology-based approaches.	Create
CO4	Analyze and evaluate the performance, consistency, and correctness of knowledge bases.	Analyze
CO5	Develop a mini knowledge engineering project and demonstrate Effective communication.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	2	2	-	1	2	-	3
CO2	3	-	-	-	-	-	-	2	2	-	1	2	1	3
CO3	3	-	-	-	2	-	-	2	2	-	2	2	2	3
CO4	3	-	-	-	-	-	-	2	2	-	2	2	-	3
CO5	3	-	-	-	2	-	-	2	2	-	2	2	2	3
Avg.	3.0	-	-	-	2	-	-	2	2	-	1.6	2	1.7	3.0

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24ADDA06	**HEALTHCARE ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To know the sources of healthcare data and basic analytics.
- To introduce various bio-medical imaging modalities and applications.
- To learn the application of sensors in healthcare data collection and analytics.
- To understand mining from clinical text data.
- To learn the usage of advanced analytics in healthcare applications.

Detailed Syllabus

UNIT I HEALTH CARE DATA SOURCES AND BASIC ANALYTICS 9

Overview of Healthcare Data Sources: Electronic Health Records (EHR), Biomedical Images, Sensor Data, Biomedical signals, Genomic data, Clinical Data, Social Media data- Phenotyping Algorithms - Overview of Coding Systems: International Classification of Diseases (ICD - 9, 10, 11), International Classification of Functioning, Disability, and Health (ICF), Unified Medical Language System (UMLS), Digital Imaging and Communications in Medicine (DICOM) - Introduction to Data Analytics for Healthcare: Clinical prediction, Temporal and visual analytics, Privacy Preservation Data Publishing.

UNIT II BIOMEDICAL–IMAGE AND SIGNAL ANALYSIS 9

OverviewofBiomedicalImagingModalities:ComputedTomography,PositronEmission Tomography, Magnetic Resonance Imaging, Ultrasound, Object Detection: Template Matching, Model- Based Detection, Data Driven Detection Methods - Image Segmentation - Image Registration - Feature Extraction - Introduction to biomedical signals - Types of Biomedical Signals - ECG Signal Analysis - Denoising of Signals using Principal Component Analysis -

Multivariate Biomedical Signal Analysis -Recent Trends in Biomedical image and Signal Analysis.
UNIT III MINING OF SENSOR DATA IN HEALTHCARE 9 Sensor Data in Medical Informatics: Scope and challenges - Challenges in Healthcare Data Analysis - Sensor Data Mining Applications: Intensive Care Data Mining, Sensor Data Mining in Operating Rooms, General Mining of Clinical Sensor Data - Nonclinical Healthcare Applications: Chronic Disease and Wellness Management, Activity Monitoring and Reality Mining - Data Analytics for Pervasive Health: Body area Networks, Sensor Technology – Applications: Continuous Monitoring, Assisted Living and Smart Hospitals.
UNIT IV NLP AND SOCIAL MEDIA ANALYTICS FOR HEALTHCARE 9 Introduction to Natural Language Processing - Core NLP Components - Mining Information from Clinical Text: Information Extraction and Methodologies Rule-Based, pattern-based Approaches - Clinical Text Corpora and Evaluation Metrics - Challenges of Processing Clinical Reports - Clinical Applications -Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks
UNIT V ADVANCED DATA ANALYTICS FOR HEALTHCARE 9 Introduction to Clinical Prediction Models: Basic Statistical Prediction Models, Alternative Clinical Prediction Models, Survival Models, Evaluation and Validation - Visual Analytics for Healthcare: Introduction, Visual Analytics in Public Health and Population Research, Visual Analytics for Clinical Workflow - Legal and Ethical Issues in Clinical Decision Support Systems - Fraud Detection in Healthcare: Definition and Types of Healthcare Fraud, Identifying Healthcare Fraud from Data, Knowledge Discovery- Based approaches for Identifying Fraud.
Total Periods: 45

Learning Resources

1	Chandan K. Reddy and Charu C. Aggarwal, Healthcare Data Analytics, CRC Press, 2020.
2	A. Jaya ,K. Kalaiselvi , Dinesh Goyal, Handbook on Intelligent Healthcare Analytics: KnowledgeEngineeringwithBigData,Wiley,2022.
3	Pantea Keikhosrokiani, Big Data Analytics for Healthcare: Datasets, Techniques, Life Cycles, Management, and Applications, Academic Press, Elsevier, 2022

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Understand the various sources of healthcare data and perform basic analytics on those data.	Understand
CO2	Explore various biomedical modalities and describe the basic properties of each kind.	Understand
CO3	Recognize and articulate the foundational assumptions, definitions, and usage of sensors in healthcare analytics.	Understand
CO4	Demonstrate application of natural language processing on healthcare data collected from social media.	Apply
CO5	Apply the various advanced data analytics techniques for different real-time healthcare applications.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	1	1	-	-	2	2
CO2	3	-	-	-	-	-	-	1	1	-	-	2	2
CO3	3	-	-	-	2	-	-	2	2	-	2	2	2
CO4	3	-	-	-	2	-	-	2	2	-	2	2	2
CO5	3	-	-	-	2	-	-	2	2	-	2	2	2
Avg.	**3.0**	**-**	**-**	**-**	**2**	**-**	**-**	**1.6**	**1.6**	**-**	**2**	**2**	**2**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24ADDA07	STREAM PROCESSING AND ANALYTICS	L	T	P	C
		2	0	2	3

Course Objective:

- To understand the framework and models for real-time stream processing.
- To learn algorithms for processing and analyzing continuous data streams.
- To identify and mine frequent patterns and item sets from streaming data.
- To evaluate the performance of stream learning algorithms in dynamic environments.
- To design and implement distributed stream processing systems using modern tools.

Detailed Syllabus

UNIT I INTRODUCTION TO DATA STREAMS **6**

Data Stream Models – Bounds of Random Variables – Poisson Process – Maintaining Simple Statistics from Data Streams – Sliding Window Model and Computation – Data Synopsis Techniques – Sampling Methods – Histograms – Wavelets – Discrete Fourier Transform (DFT) – Change Detection and Concept Drift – Monitoring Learning Processes.

UNIT II STREAMING ALGORITHMS **6**

Clustering Examples: Basic Concepts - Partitioning Clustering – Hierarchical Clustering – Micro Clustering – Grid Clustering - Clustering Variables - The Very Fast Decision Tree Algorithm (VFDT) -The Base Algorithm, Analysis of the VFDT Algorithm, Extensions to the Basic Algorithm: Processing Continuous Attributes, Functional Tree Leaves, Concept Drift.

UNIT III FREQUENT PATTERN MINING **6**

Introduction – Heavy Hitters - Mining Frequent Item sets from Data Streams - Landmark Windows -Mining Recent Frequent Item sets - Frequent Item sets at Multiple Time Granularities - Sequence Pattern Mining - Reservoir Sampling for Sequential Pattern Mining over data stream.

UNIT IV EVALUATING STREAMING ALGORITHMS **6**

Learning from Data Streams - Evaluation Issues - Design of Evaluation Experiments – Evaluation Metrics - Comparative Assessment - Evaluation Methodology in Non-Stationary Environments.

UNIT V DATA FLOW MANAGEMENT **6**

Distributed Data Flows – Apache Kafka – Apace Flume - Processing Streaming Data – Storing Streaming Data – Delivering Streaming Metrics.

Total Periods:30

List of Experiments

Sl. No.	List of Experiments
1.	Simulate a real-time sensor data stream and compute incremental mean and variance
2.	Implement sliding window processing to track statistics (e.g., maximum stock price)
3.	Apply reservoir sampling on a streaming dataset

4.	Detect concept drift in streaming data using ADWIN
5.	Implement micro-clustering on streaming data
6.	Train a Very Fast Decision Tree (VFDT) for stream classification
7.	Track heavy hitters using Lossy Counting algorithm
8.	Mine frequent item sets from streaming data
9.	Evaluate streaming algorithms using prequential accuracy and performance metrics
10.	Design an end-to-end stream processing pipeline (Kafka → Processing → Storage → Visualization)
	Total Periods:30
	Total:30 +30 = 60 Periods

Learning Resources

1	Joao Gama, “Knowledge Discovery from Data Streams”, 2nd Edition, CRC Press, 2023.
2	Byron Ellis, “Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data”, 2nd Edition, Wiley, 2021.
3	Andrew Psaltis, “Streaming Data: Understanding the Real-Time Pipeline”, Updated Edition, Manning Publications, 2022.
4	Bugra Gedik, Deepak S. Turaga, Henrique C. M. Andrade, “Fundamentals of Stream Processing: Application Design, Systems, and Analytics”, Cambridge University Press, 2014.
5	Charu C. Aggarwal, “Data Streams: Models and Algorithms”, Springer (Updated Reprint), 2018.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Understand the fundamental concepts, models, and techniques used in real-time data stream processing.	Understand
CO2	Apply streaming algorithms such as clustering and classification on continuous data streams.	Apply
CO3	Analyze and extract frequent patterns and item sets from streaming data.	Analyze
CO4	Evaluate the performance of stream learning algorithms using appropriate metrics in dynamic environments.	Evaluate
CO5	Design and implement distributed stream processing systems and end-to-end data flow pipelines using modern tools.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	–	–	–	–	–	–	2	2	2
CO2	2	3	2	2	3	–	–	–	–	–	2	3	3
CO3	2	3	2	2	2	–	–	–	–	–	2	3	2
CO4	2	3	2	3	2	–	–	–	–	–	2	2	3
CO5	2	2	3	2	3	1	–	1	2	2	3	3	3
Avg.	**2.2**	**2.6**	**2.25**	**2.25**	**2.5**	**1**	**–**	**1**	**2**	**2**	**2.2**	**2.6**	**2.6**

For CO-PO/PSO Mapping: 3–Substantial(High), 2–Moderate(Medium), 1–Slight(Low)

PROFESSIONAL ELECTIVE – IV
VERTICAL 4: EMERGING TECHNOLOGIES
Common to B.E. Computer Science and Engineering

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSET01	Game Development	PEC	2	0	2	4	3	50	50
2	U24CSET02	Augmented Reality/Virtual Reality	PEC	2	0	2	4	3	50	50
3	U24CSET03	Robotic Process Automation	PEC	2	0	2	4	3	50	50
4	U24CSET04	Quantum Computing	PEC	3	0	0	3	3	40	60
5	U24CSET05	Soft Computing	PEC	3	0	0	3	3	40	60
6	U24CSET06	Industrial IOT	PEC	3	0	0	3	3	40	60
7	U24CSET07	Digital marketing	PEC	1	0	4	5	3	50	50

U24CSET01	GAME DEVELOPMENT	L	T	P	C
		2	0	2	3

Course Objective:

- Provide foundational knowledge of 2D and 3D graphics concepts essential for game development.
- Introduce the major stages involved in the game development lifecycle.
- Develop an understanding of the core components and functioning of game engines.
- Offer exposure to contemporary game development environments, tools, and software toolkits.
- Enable students to design and implement simple games using the PyGame development environment.

Detailed Syllabus

UNIT I 3D GRAPHICS FOR GAME DESIGN **6**

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations–Projections–Color Models–Illumination and Shader Models–Animation–Controller Based Animation.

UNIT II GAME DESIGN PRINCIPLES **6**

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design –Proposals–Writing for Preproduction, Production and Post – Production.

UNIT III GAME ENGINE DESIGN **6**

Rendering Concept–Software Rendering–Hardware Rendering–Spatial Sorting Algorithms– Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Path finding

UNIT IV OVERVIEW OF GAMING PLATFORM AND FRAMEWORKS **6**

Pygame Game development–Unity–Unity Scripts–Mobile Gaming, Game Studio, Unity Single player and Multi-Player games

UNITV GAME DEVELOPMENT USING PYGAME **6**

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development–Device Handling in Pygame–Overview of Isometric and Tile Based arcade Games– Puzzle Games.

TotalPeriods:30

List of Experiments

Sl. No	List of Experiments
1	Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game.
2	Character design, sprites, movement and character control
3	Level design: design of the world in the form of tiles along with interactive and collectible objects
4	Design of interaction between the player and the world, optionally using the physics engine.
5	Developing a 2D interactive using Pygame
6	Developing a Puzzle game
7	Design of menus and user interaction in mobile platforms.
8	Developing a 3D Game using Unreal
9	Developing a Multiplayer game using unity
	Total Periods:30
	Total:30 +30 = 60 Periods

Learning Resources

1	Jung Hyun Han, “3DGraphics for Game Programming ”,Chapman and Hall/CRC,2011.
2	Jesse Schell, The Art of Game Design: A Book of Lenses, 3rdEdition, CRCPress,2019.
3	SanjayMadhav,“GameProgrammingAlgorithmsandTechniques:APlatformAgnostic Approach”,AddisonWesley,2013.
4	WillMcGugan,“BeginningGameDevelopmentwithPythonandPygame:FromNoviceto Professional”,Apress,2007.
5	Paul Craven, “PythonArcadegames”,ApressPublishers,2016
6	DavidH.Eberly,“3DGameEngineDesign:APracticalApproachtoReal-TimeComputer Graphics”,SecondEdition,CRCPress,2006.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the concepts of 2D and 3D Graphics.	Understand
CO2	Design game design documents.	Apply
CO3	Implementation of gaming engines.	Apply
CO4	Survey gaming environments and frameworks.	Understand
CO5	Implement a simple game in PyGame.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	3	-	-	-	2	2	-	2	3
CO2	2	2	2	2	2	-	-	-	2	3	-	2	2
CO3	3	3	3	2	2	-	-	-	2	2	-	3	3
CO4	2	2	2	2	3	-	-	-	2	2	-	2	3
CO5	3	2	3	2	3	-	-	-	2	2	-	3	3
Avg.	2.6	2.2	2.4	2	2.6	-	-	-	2	2.2	-	2.4	2.8

For CO-PO/PSO Mapping:3–Substantial (High), 2–Moderate (Medium), 1–Slight (Low)

U24CSETO2	AUGMENTED REALITY /VIRTUAL REALITY	L	T	P	C
		3	0	0	3

Course Objective:

- To know the fundamentals of augmented and virtual reality.
- To acquire the knowledge about computing hardware related to VR.
- To understand the tools and techniques used in VR implementation.
- To understand the tools and techniques used in AR implementation.
- To explore various application domains of AR/VR.

Detailed Syllabus

UNIT I INTRODUCTION **9**

Introduction to Virtual Reality – Definition – Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality– Components of VR System– Augmented Reality –Definition–Modeling the Real Environment–Sensing & Reconstruction–Displays–User Interfaces–Applications.

UNIT II VR COMPUTING ARCHITECTURE **9**

Computing Architectures of VR – Rendering Principle – Graphics and Haptics Rendering – PC Graphics Architecture – Graphics Accelerators – Graphics Benchmarks – Workstation Based Architectures – SGI Infinite Reality Architecture – Distributed VR Architectures - Multi-pipeline Synchronization–Collocated Rendering Pipelines–Distributed Virtual Environments–AR Architecture.

UNIT III VR MODELING & PROGRAMMING **9**

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling–Transformation Matrices–Object Position–Transformation Invariants–Object Hierarchies–Viewing The 3D World–Physical Modeling–Collision Detection–Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management– VR Programming–Toolkits and Scene Graphs–World Toolkit–Java 3D– Comparison of World Toolkit and Java3D–GHOST–People Shop

UNIT IV AUGMENTED REALITY TECHNOLOGIES **9**

Vision-Based 3D Tracking and Pose Estimation–AR in spatial uncertainty–HMD for AR– Projector- based AR–Mobile phone-based AR–Screen Spaces of AR –Mixed Reality for Robots– User- centered HRI–Mental Transformation in HRI–Computational Cognitive Modeling– Evaluating the usability of the virtual environment – Security Robot-Spatial Computing.

UNIT V APPLICATIONS OF VR/AR **9**

Traditional VR Applications – Medical Applications- Education, Art & Entertainment – Military – Virtual Prototyping–Manufacturing–Robotics– Visualization–AR in Industry–Augmented Virtual Environments – Memories in AR – Social & Interactive Paradigms – Future of AR Gaming-Role of Generative AI in Mixed Reality.

Total Periods : 45

Learning Resources

1	Claudia Tom Dieck, Timothy H. Jung, Sandra M.C. Lourei, "Augmented Reality and Virtual Reality: New Trends in Immersive Technology", Packt Publisher.2021
2	Virtual Reality by Samuel Greengard,MITPress,2019
3	Ralf Doerner, Wolfgang Broll, Paul Grimm and Bernnard Jung, "Virtual and Augmented Reality (VR/AR)",Springer Publication,2023
4	Burdea GC, Coiffet P, "Virtual reality technology", Second Edition, Wiley-IEEE Press, 2006



5	Mihelj, Matjaž, Domen Novak, and Samo Beguš."Virtual reality technology and applications" Springer Publication, 2014
6	Haller M, Billinghurst M, Thomas B, Emerging technologies of augmented reality: Interfaces and design", IGI Global; 2006
7	Hale K S, Stanney K M, "Handbook of virtual environments: Design, implementation, and applications". CRC Press; 2014

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Describe the principles, components, and system architecture of Virtual Reality (VR) and Augmented Reality (AR).	Understand
CO2	Explain VR computing architectures, rendering techniques, and distributed virtual environments.	Understand
CO3	Apply geometric, kinematic, and physical modeling techniques for developing virtual environments.	Apply
CO4	Analyze vision-based tracking, pose estimation, and interaction techniques in AR systems.	Analyze
CO5	Evaluate the applications, impact, and emerging trends of VR/AR across various domains.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	1	-	-	1	1	-	-	1	1
CO2	2	2	2	2	2	-	-	1	1	-	-	2	2
CO3	3	3	3	2	3	-	-	1	1	-	-	3	2
CO4	2	3	2	2	2	-	-	1	1	-	-	2	2
CO5	2	2	2	2	2	-	-	2	2	1	1	2	2
Avg.	2.2	2.4	2	1.8	2	-	-	1.2	1.2	1	1	2	1.8

For CO-PO/PSO Mapping:3–Substantial(High),2–Moderate(Medium), 1–Slight(Low)

U24CSET03	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		2	0	2	3

Course Objective:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

Detailed Syllabus

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 6

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT II AUTOMATION PROCESS ACTIVITIES	**6**
Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events	
UNIT III APP INTEGRATION, RECORDING AND SCRAPING	**6**
App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.	
UNIT IV EXCEPTION HANDLING AND CODE MANAGEMENT	**6**
Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine	
UNIT V DEPLOYMENT AND MAINTENANCE	**6**
Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA	
	Total Periods:30

List of Experiments

Sl. No.	List of Experiments
1.	Create a Sequence to obtain user inputs display them using a message box.
2.	Create a Flowchart to navigate to a desired page based on a condition.
3.	Create a State Machine workflow to compare user input with a random number.
4.	Build a process in the RPA platform using UI Automation Activities.
5.	Create an automation process using key System Activities, Variables and Arguments.
6.	Also implement Automation using System Trigger
7.	Automate login to (web)Email account
8.	Recording mouse and keyboard actions.
9.	Scraping data from website and writing to CSV
10.	Implement Error Handling in RPA platform
11.	Web Scraping
12.	Email Query Processing
	Total Periods:30
	Total:30 +30 = 60 Periods

Learning Resources

1	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packet Publishing, 2018
2	Tom Taulli, “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, A press publications, 2020.
3	Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018.
4	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings



	Private Limited, 2018
5	A Gerardus Blokdyk, “Robotic Process Automation Rpa A Complete Guide “, 2020

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe the concepts, evolution, components, tools, and applications of Robotic Process Automation (RPA).	Understand
CO2	Apply workflow design techniques including sequence, flowchart, control flow, and data manipulation in RPA.	Apply
CO3	Develop automation solutions using application integration, recording, scraping, and process mining techniques.	Apply
CO4	Analyze and implement exception handling, debugging, and code management practices in RPA projects.	Analyze
CO5	Evaluate deployment strategies, orchestration, maintenance, and future trends of RPA systems.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	2	-	-	2	2	-	-	1	1
CO2	2	3	3	2	3	-	-	2	2	-	-	2	2
CO3	3	3	3	2	3	-	-	2	2	-	-	3	2
CO4	2	3	2	2	2	-	-	2	2	-	-	2	2
CO5	2	2	2	2	2	-	-	2	2	1	1	2	2
Avg.	**2.2**	**2.6**	**2.2**	**1.8**	**2.4**	**-**	**-**	**2**	**2**	**1**	**1**	**2**	**1.8**

For CO-PO/PSO Mapping: 3–Substantial(High),2–Moderate(Medium),1–Slight (Low)

U24CSET04	**QUANTUM COMPUTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- Apply basic principles of quantum computation to simple experimental quantum information processing scenarios.
- Apply quantum mechanics principles to understand and work with classical computational models such as Turing machines and circuit-based computation.
- Analyse quantum circuits, algorithms, universal quantum gates, and the Quantum Fourier transform to understand their structure and functional relationships.
- Apply concepts of quantum noise, quantum operations, error correction, entropy, and distance measures to understand and evaluate quantum information processes.
- Apply quantum algorithms for machine learning and use quantum versions of linear and probabilistic models to solve relevant computational tasks.

Detailed Syllabus

UNIT I FUNDAMENTAL CONCEPTS **9**

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

UNIT II QUANTUM MECHANICS AND OVERVIEW OF COMPUTATIONAL MODELS	**9**
Quantum Mechanics: Linear Algebra – Postulates of Quantum Mechanics – Application: Superdense Coding – Density Operator – The Shmidt Decomposition and Purifications - EPR and the Bell Inequality – Computational Models: Turing Machines – Circuits – Analysis of Computational Problems.	
UNIT III QUANTUM COMPUTATION	**9**
Quantum Circuits: Quantum Algorithms – Universal Quantum Gates – Quantum Circuit - Model of Computation – Simulation – Quantum Fourier Transform and Applications – Quantum Search Algorithms – Quantum Computers.	
UNIT IV QUANTUM INFORMATION	**9**
Quantum Noise and Quantum Operations: Classical Noise and Markov processes – Quantum Operations – Examples – Applications – Distance Measures for Quantum Information – Quantum Error Correction – Entropy	
UNIT V QUANTUM MACHINE LEARNING	**9**
Quantum Clustering - Quantum K-Means and K-Medians- Quantum Classifiers - Nearest neighbours - Support Vector Machine (SVM) in quantum space - Quantum Principal Component Analysis - Feature Maps - Linear Models - Probabilistic Models - Quantum Neural Networks	
	Total Periods:45

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Describe the fundamental concepts of quantum computing, including qubits, quantum information, and global perspectives.	Understand
CO2	Explain the principles of quantum mechanics and computational models relevant to quantum computing.	Understand
CO3	Apply quantum algorithms and circuit models for solving computational problems.	Apply
CO4	Analyze quantum information concepts including noise, error correction, and entropy.	Analyze
CO5	Evaluate quantum machine learning techniques and their applications in real-world problems.	Evaluate

Learning Resources

1	Santanu Ganguly, “Quantum Machine Learning: An Applied Approach : The Theory and Application of Quantum Machine Learning in Science and Industry”, Publisher Apress L. P., 2021
2	Jack D. Hidary, “Quantum Computing: An Applied Approach” 1st edition, Springer, 2019.
3	Chris Bernhardt, “Quantum Computing for Everyone”, The MIT Press; Reprint edition, 2020.
4	Scott Aaronson, “Quantum Computing Since Democritus”, Cambridge University Press, 2013.
5	N. David Mermin, “Quantum Computer Science: An Introduction”, Cambridge University Press, 2007

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	1	-	-	1	1	-	-	1	1
CO2	2	3	3	2	2	-	-	1	1	-	-	2	2
CO3	2	2	2	2	1	-	-	1	1	-	-	2	1
CO4	3	3	3	2	3	-	-	1	1	-	-	3	2
CO5	2	3	2	2	2	-	-	2	2	1	1	2	2
Avg.	2.2	2.6	2.2	1.8	1.8	-	-	1.2	1.2	1	1	2	1.8

For CO-PO/PSOMapping:3–Substantial(High), 2–Moderate (Medium), 1–Slight(Low)

U24CSET05	SOFT COMPUTING	L	T	P	C
		3	0	0	3

Course Objective:

- To give students knowledge of soft computing theories and fundamentals.
- To understand fuzzy sets and fuzzy logic for problem solving.
- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems.
- To familiarize with genetic and other optimization algorithms while seeking global optimum in self-learning situations.
- To implement hybrid systems using fuzzy, neural networks and optimization algorithms.

Detailed Syllabus

UNIT I FUNDAMENTALS OF NEURAL NETWORKS **9**

Hard and Soft Computing - Biological neuron and its working-Nerve structure and Synapse – Artificial Neuron and its Model – Activation Functions – Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Learning Techniques: supervised, unsupervised, reinforcement - Back Propagation Networks Architecture - Back Propagation Learning Methods – Effect of Learning Rule Co- Efficient: Single Layer and Multilayer Perceptron - Auto-Associative and Hetero-Associative Memory.

UNIT II COMPETETIVE NEURAL NETWORKS **9**

Kohenen's Self Organizing Map –SOM Architecture, learning procedure–Application; Learning Vector Quantization, Learning by LVQ – Adaptive Resonance Theory – Learning procedure – Weight updation – Sample problems – Applications

UNIT III FUZZY COMPUTING **9**

Basic Concepts of Fuzzy Logic – Fuzzy Sets and Crisp Sets – Fuzzy Set Theory and Operations – Properties of Fuzzy Sets – Fuzzy and Crisp Relations – Membership Functions – Fuzzy If-Then Rules, Fuzzy propositions, implications and inferences - Aggregation of fuzzy outputs - Defuzzification methods – Fuzzy Controller design– Industrial Applications

UNIT IV EVOLUTIONARY ALGORITHM **9**

Introduction to optimization problems – Genetic Algorithm - Working Principle – Procedures of GA– FlowChartofGA–GeneticRepresentation:(Encoding)InitializationandSelection–Genetic Operators: Reproduction, Crossover, Mutation- Particle Swarm Optimization – Ant colony Optimization– Algorithmicstepsandimplementation-ConvergenceofEvolutionaryAlgorithm– Multi objective optimization problems

UNIT V HYBRID CONTROL SCHEMES	**9**
Fuzzification and rule base using ANN – Neuro fuzzy systems - ANFIS – Fuzzy Neuron - Optimization of membership function and rule base using Genetic Algorithm –- Tuning Neural networkparametersusingEvolutionaryalgorithms-IntroductiontoSupportVectorMachine-Case study of hybrid techniques – Familiarization of Neural Network, Fuzzy logic and ANFIS controller's toolbox	
	Total Periods:45

Learning Resources

1	S. Rajasekaran, G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India, 2010.
2	J.S.R. Jang, C.T. Sun, E. Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education, 2004.
3	Satish Kumar, "Neural Networks: A Classroom Approach", Second Edition McGrawHill, 2017
4	James .A. Freeman, David. M Skapura, **"**Neural Networks: Algorithms, Applications and Programming Techniques" (Computation and Neural Systems Series), Addison Wesley, 1991
5	S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Second Edition, Wiley-India, 2007.
6	Siman Haykin, "Neural Networks", Prentice Hall of India, 1999.
7	Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley Publications, 2016.
8	David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, 2008.
9	Melanie Mitchell, "An Introduction to Genetic Algorithms", MIT Press, 2000
10	Corinna Cortes and V. Vapnik, "Support - Vector Networks, Machine Learning" 1995.
11	Snehashish Chakravarty, Deepti Moyi Sahoo, Nisha Rani Mahato, "Concepts of Soft Computing: Fuzzy and ANN with Programming", Springer, 2019.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Apply neural network architectures and learning techniques for solving basic computational problems.	Apply
CO2	Implement competitive neural network models such as Self-Organizing Maps and Learning Vector Quantization for clustering tasks.	Apply
CO3	Apply fuzzy logic principles and inference systems to design simple control applications.	Apply
CO4	Solve optimization problems using evolutionary algorithms such as Genetic Algorithms, Particle Swarm Optimization, and Ant Colony Optimization	Apply
CO5	Apply hybrid intelligent techniques including neuro-fuzzy models and evolutionary optimization for real-world problem solving.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	1	-	-	1	1	-	-	1	1
CO 2	2	3	2	2	1	-	-	1	1	-	-	2	1
CO3	3	3	3	2	3	-	-	1	1	-	-	3	2
CO4	2	3	2	2	2	-	-	1	1	-	-	2	2
CO5	2	2	2	2	2	-	-	2	2	1	1	2	2
Avg	2.2	2.6	2	1.8	1.8	-	-	1.2	1.2	1	1	2	1.6

For CO-PO/PSO Mapping:3–Substantial(High), 2– Moderate(Medium),1–Slight(Low)



U24CSET06	INDUSTRIAL IOT	L	T	P	C
		3	0	0	3

Course Objective:

- Understand the basic technologies and protocols used in Industrial IoT.
- Illustrate the models and architectures of IIoT.
- Identify and apply different sensors for various IIoT applications.
- Explain the various protocols used in IIoT.
- Solve real-world problems using IIoT analytics.

Detailed Syllabus

UNIT I INTERNET OF THINGS (IoT)	**9**
Introduction – Networking – Cyber Physical Systems – Evolution of IoT – IoT Networking Components - Addressing Strategies – IoT Sensing and Actuation.	
UNIT II INDUSTRIAL IoT	**9**
Industry 4.0 – IIoT – Industrial Internet Systems – Industrial Sensing – Industrial Processes – Business Models and Reference Architecture.	
UNIT III SENSORS AND ACTUATORS	**9**
Sensors – Sensor Characteristics – Sensorial Deviations – Sensing Types - Considerations – Actuators – Actuator Types – Actuator Characteristics.	
UNIT IV PROTOCOLS	**9**
Processing topologies and types – Connectivity Technologies – IEEE 802.15.4 – Zigbee – RFID – LoRa – Wi-Fi – Communication Technologies – Constrained nodes – Networks – Infrastructure Protocols - IPV6 – Discovery Protocols – MQTT – MQTT-SN – SOAP - REST.	
UNIT V IIOT ANALYTICS AND APPLICATIONS	**9**
IIoT Analytics – Categorization – Use – Challenges – Mapping of analytics with IIRA Architecture – Deployment of Analytics – Health care applications in industries - Inventory Management and Quality Control – Plant Safety and Security.	
	Total Periods: 45

Learning Resources

1	S. Misra, A. Mukherjee, and A. Roy, Introduction to IoT. Cambridge University Press, 2020.
2	S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press, 2020.
3	Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications,1st Edition, Wiley Publications, 2013.
4	Dieter Uckelmann , Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Industry 4.0: The Industrial Internet of Things, Springer-Verlag Berlin Heidelberg, 2011.
5	Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
6	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, CISCO Press, 2017.
7	Introduction to Industry 4.0 and Industrial Internet of Things”, Prof. Sudip Misra, IIT Kharagpur, NPTEL. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Elaborate the basic technologies and protocols used in Industrial IoT.	Understand
CO2	Illustrate the models and architectures of IIoT.	Apply
CO3	Interpret and apply different sensors for various IIoT applications.	Apply
CO4	Explain the various protocols used in IIoT.	Apply
CO5	Solve real-world problems using IIoT analytics.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24CSET07	DIGITAL MARKETING	L	T	P	C
		1	0	4	3

Course Objective:

- Apply digital marketing principles to analyze online market space, develop basic website plans, and create content strategies for branding.
- Apply SEO and SEM techniques—including keyword selection, on-page/off-page optimization, and PPC—to improve search engine visibility and traffic.
- Create targeted email and mobile marketing campaigns using automation, segmentation, SMS strategies, and performance measurement frameworks.
- Create social media marketing strategies by designing engagement plans, influencer collaborations, and campaign ideas that enhance brand presence.
- Create data-driven digital transformation strategies using attribution models, web & social analytics, and current digital marketing trends

Detailed Syllabus

UNIT I INTRODUCTION TO ONLINE MARKET

Online Market space -Digital Marketing Strategy-Website Planning and Content Marketing.

UNITII SEARCHENG IN EOPTIMISATION

Search Engine optimization -Keyword Strategy-SEO Strategy-On- Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components

UNIT III E-MAILMARKETING

E-Mail Marketing-Types of E-Mail Marketing-Email Automation- Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing-SMS Campaigns-Profiling and targeting

UNIT IV SOCIAL MEDIA MARKETING

Social Media Marketing-Social Media Channels-Leveraging Social media for brand conversations and buzz. Engagement Marketing (overview)-Influencer Marketing.

UNIT V DIGITAL TRANSFORMATION
Digital Transformation & Channel Attribution – Web & social analytics- Strategy improvement- recent trends Analytics-Ad-words, Email ,Mobile, Social Media
Total Periods:15

List of Experiments

Sl. No.	List of Experiments
1	Subscribe to a weekly / quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aid sits potential customer segments.
2	Create a Basic Brand Website(Using Wix/WordPress)
3	Perform keyword search for ask in care hospital website based on search volume and Competition using Google keyword planner tool.
4	Create a Content Calendar for a Brand
5	Create a SEO On-Page Optimization Task for an assigned webpage such as Optimize title tag, meta description • Add header tags • Improve internal links • Add image alt texts
6	Create a SEO Off – Page Optimization Task for • Identify back link opportunities • Create guest post outline • Prepare link-building plan
7	Demonstrate how to use the Google Webmasters Indexing API
8	Design Google Ads–Mock PPC Campaign Setup(only simulation) • Choose keyword groups • Write text ads • Estimate bid value • Prepare budget allocation
9	Design a Social Media Ad(Facebook & Instagram) • Using Facebook Ad smock tool: • Create image/video ad • Select audience • Choose placements • Determine objective
10	Discuss an interesting case study regarding how an insurance company manages leads
11	Discuss how Predictive analytics is impacting marketing automation
12	Design a Mobile SMS Campaign, Prepare an SMS campaign for: • Flash sale • Appointment reminder • Location-based offer
13	Discuss negative and positive impacts and ethical implications of using social media for political advertising.
14	Create a Conversion Funnel Analysis for an e-commerce website
15	Mini Project: 1.Social Media Campaign Plan for a Real/Mock Brand 2. Full Digital Marketing Funnel for a Product/Service End-to-End SEO Optimization for a Small Business Website
Total Periods:60	
Total:15 +60 = 75 Periods	

Learning Resources

1	Fundamentals of Digital Marketing by Puneet Singh Bhatia; Publisher: Pearson Education; First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373
2	Digital Marketing by Vandana Ahuja; Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
3	Marketing 4.0: Moving from Traditional to Digital by Philip Kotler; Publisher: Wiley; 1st Edition (April 2017)
4	Ryan, D.(2014).Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.
5	Barker, Barker, Bormann and Neher(2017),Social Media Marketing: A Strategic Approach,2E South Western, C engage Learning.
6	Pulizzi.J, Beginner's Guide to Digital Marketing, McGraw Hill Education
7	Google Digital Garage – Fundamentals of Digital Marketing https://learndigital.withgoogle.com/digitalgarage
8	Google Ads Learning Center (Official SEM Guide) https://support.google.com/google-ads/answer/6086446
9	Word Stream – SEM & PPC Guides https://www.wordstream.com/ppc

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Apply digital marketing principles to analyze online market space, develop basic website plans, and create content strategies for branding.	Apply
CO2	Apply SEO and SEM techniques—including keyword selection, on-page/off-page optimization, and PPC—to improve search engine visibility and traffic.	Apply
CO3	Create targeted email and mobile marketing campaigns using automation, segmentation, SMS strategies, and performance measurement frameworks.	Create
CO4	Create social media marketing strategies by designing engagement plans, influencer collaborations, and campaign ideas that enhance brand presence.	Create
CO5	Create data-driven digital transformation strategies using attribution models, web & social analytics, and current digital marketing trends.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	3	-	-	2	2	2	2	2	2
CO2	3	3	3	2	3	-	-	2	2	2	2	2	2
CO3	3	2	3	2	3	-	-	2	2	3	3	2	2
CO4	3	2	3	2	3	-	-	2	2	3	3	2	2
CO5	3	3	3	2	3	-	-	2	2	3	3	2	2
Avg.	**3**	**2.4**	**2.8**	**2**	**3**	**-**	**-**	**2**	**2**	**2.6**	**2.6**	**2**	**2**

For CO-PO/PSO Mapping: 3–Substantia l(High),2–Moderate (Medium),1–Slight (Low)

OPEN ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	CATE – GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24OECS01	Data Science Fundamentals	OEC	2	0	2	4	3	50	50
2	U24OECS02	Artificial Intelligence and Machine Learning Foundation	OEC	2	0	2	4	3	50	50
3	U24OECS03	AR/VR Fundamentals	OEC	3	0	0	3	3	40	60
4	U24OECS04	UI / UX Design Foundation	OEC	1	0	4	5	3	50	50
5	U24OECS05	App Development Fundamentals	OEC	1	0	4	5	3	50	50

U24OECS01	DATA SCIENCE FUNDAMENTALS	L	T	P	C
		2	0	2	3

Course Objective:

- To explain the basic concepts of data science, data types, and the data science process.
- To use Python libraries such as NumPy and Pandas for basic data manipulation.
- To describe basic machine learning concepts and types.
- To explain basic data visualization techniques and tools.
- To outline basic techniques for handling large datasets.

Detailed Syllabus

UNIT I INTRODUCTION **6**

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 II DATA MANIPULATION **9**

Python Shell - Jupyter Notebook - Python Magic Commands - NumPy Arrays-Universal Functions– Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical Indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance

UNIT III MACHINE LEARNING **5**

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis

UNIT IV DATA VISUALIZATION **5**

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colours – subplots – text and annotation – customization – three-dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn

UNIT V HANDLING LARGE DATA **5**

Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, building a recommender system -

Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.
Total Periods: 30

List of Experiments

S. No.	List of Experiments
1	Download, install and explore the features of Python for data analytics.
2	Working with Numpy arrays
3	Working with Pandas data frames
4	Basic plots using Matplotlib
5	Statistical and Probability measures a) Frequency distributions b) Mean, Mode, Standard Deviation c) Variability d) Normal curves e) Correlation and scatter plots f) Correlation coefficient g) Regression
6	Use the standard benchmark 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 modelling.
7	Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8	Apply and explore various plotting functions on any data set. Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.
Total Periods: 30	
Total: 30+30= 60 Periods	

Learning Resources

1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
3	Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
4	Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.

Course Outcomes

At the end of the course the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply basic statistical measures and identify steps in the data science process	Apply

CO2	Implement data manipulation techniques to pre-process and organize datasets	Apply
CO3	Apply simple classification, regression, and clustering techniques	Apply
CO4	Develop simple visualizations to represent data using standard tools	Apply
CO5	Demonstrate simple methods to manage and analyze large datasets.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24OECS02	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FOUNDATION	L	T	P	C
		2	0	2	3

Course Objective:

- To understand the importance, principles, and search methods of AI
- To provide knowledge on predicate logic and Prolog.
- To introduce machine learning fundamentals
- To study of supervised learning algorithms.
- To study about unsupervised learning algorithms.

Detailed Syllabus

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniform-cost search - Depth First Search - Depth Limited Search.

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory- Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning – Constraint Satisfaction Problems (CSP) - Examples - Map Colouring - Job Scheduling - Backtracking Search for CSP.

UNIT III MACHINE LEARNING 6

Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression.

UNIT IV SUPERVISED LEARNING	**6**
Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm - Rule based Classification - Naïve Bayesian classification - Support Vector Machines (SVM).	
UNIT V UNSUPERVISED LEARNING	**6**
Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm.	
	Total Periods : 30

List of Experiments

S. No	List of Experiments
1	**Programs for Problem solving with Search** • Implement breadth first search • Implement depth first search • Analysis of breadth first and depth first search in terms of time and space • Implement and compare Greedy and A* algorithms.
2	**Supervised learning** • Implement the non-parametric locally weighted regression algorithm in order to fit data points. • Select appropriate data set for your experiment and draw graphs. • Write a program to demonstrate the working of the decision tree based algorithm. • Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets. • Write a program to implement the naïve Bayesian classifier.
3.	**Unsupervised learning** • Implementing neural network using self-organizing maps • Implementing K-Means algorithm to cluster a set of data. • Implementing Hierarchical clustering algorithm.
4	**Installation of gnu-prolog, Study of Prolog (gnu-prolog).** The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.
	Total Periods: 30
	Total: 30+30 = 60 Periods

Learning Resources

1	S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Fourth Edition, 2021
2	S.N. Sivanandam and S.N. Deepa, Principles of soft computing-Wiley India, 3rd Edition.
3	Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
4	I. Bratko, “Prolog: Programming for Artificial Intelligencell, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
5	C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.



Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain AI concepts, agent structures, and uninformed search algorithms.	Understand
CO2	Apply informed and adversarial search methods to solve AI problems.	Apply
CO3	Demonstrate machine learning fundamentals and regression techniques.	Apply
CO4	Develop supervised learning models using major classification algorithms.	Apply
CO5	Implement unsupervised learning methods such as PCA and clustering.	Apply

Course Articulation Matrix

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

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

U24OECS03	AR/VR FUNDAMENTALS	L	T	P	C
		3	0	0	3

Course Objective:

- To know the fundamentals of Augmented Reality (AR) and Virtual Reality (VR).
- To acquire knowledge about computing hardware related to VR.
- To understand the tools and techniques used in VR implementation.
- To understand the tools and techniques used in AR implementation.
- To explore various application domains of AR/VR.

Detailed Syllabus

UNIT I INTRODUCTION **9**

Introduction to Virtual Reality – Definition – Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality– Components of VR System– Augmented Reality –Definition–Modeling the Real Environment–Sensing & Reconstruction–Displays–User Interfaces–Applications.

UNIT II VR COMPUTING ARCHITECTURE	**9**
Computing Architectures of VR – Rendering Principle – Graphics and Haptics Rendering – PC Graphics Architecture – Graphics Accelerators – Graphics Benchmarks – Workstation Based Architectures – SGI Infinite Reality Architecture – Distributed VR Architectures - Multi-pipeline Synchronization–CollocatedRenderingPipelines–DistributedVirtualEnvironments–AR Architecture.	
UNIT III VR MODELING & PROGRAMMING	**9**
Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling–Transformation Matrices–Object Position–Transformation Invariants – Object Hierarchies–Viewing The3DWorld–Physical Modeling–Collision Detection–Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management–VR Programming–Tool kits and Scene Graphs–World Toolkit– Java3D– Comparison of World Toolkit andJava3D–GHOST–People Shop	
UNIT IV AUGMENTED REALITY TECHNOLOGIES	**9**
Vision-Based3D Tracking and Pose Estimation–AR in spatial uncertainty–HMD for AR– Projector- based AR–Mobile phone-based AR–Screen Spaces of AR-Mixed Reality for Robots– User-centered HRI–Mental Transformation in HRI–Computational Cognitive Modeling– Evaluating the usability of the virtual environment – Security Robot-Spatial Computing.	
UNIT V APPLICATIONS OF VR/AR	**9**
Traditional VR Applications – Medical Applications- Education, Art & Entertainment – Military – Virtual Prototyping–Manufacturing–Robotics– Visualization–AR in Industry–Augmented Virtual Environments – Memories in AR – Social & Interactive Paradigms – Future of AR Gaming – Role of Generative AI in Mixed Reality.	
	Total Periods:45

Learning Resources

1	Claudia Tom Dieck, Timothy H. Jung, Sandra M. C. Loureiro, “Augmented Reality and Virtual Reality: New Trends in Immersive Technology”, Packet Publisher, 2021
2	Virtual Reality by Samuel Greengard, MIT Press, 2019
3	Ralf Doerner, Wolfgang Broll, Paul Grimm and Bernhard Jung, “Virtual and Augmented Reality (VR/AR)”, Springer Publication, 2023
4	Burdea G C, Coiffet P, “Virtual Reality Technology”, Second Edition, Wiley-IEEE Press, 2006
5	Mihelj, Matjaž, Domen Novak, and Samo Beguš, “Virtual Reality Technology and Applications”, Springer Publication, 2014
6	Haller M, Billinghurst M, Thomas B, editors, “Emerging Technologies of Augmented Reality: Interfaces and Design”, IGI Global, 2006
7	Hale K S, Stanney K M, “Handbook of Virtual Environments: Design, Implementation, and Applications”, CRC Press, 2014

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe the principles, components, and system architecture of Virtual Reality (VR) and Augmented Reality (AR).	Understand
CO2	Explain VR computing architectures, rendering techniques, and distributed virtual environments.	Understand

CO3	Apply geometric, kinematic, and physical modeling techniques for developing virtual environments.	Apply
CO4	Analyze vision-based tracking, pose estimation, and interaction techniques in AR systems.	Analyze
CO5	Evaluate the applications, impact, and emerging trends of VR/AR across various domains.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	1	1	-	-	1	1	-	-	1	1
CO2	2	2	2	2	2	-	-	1	1	-	-	2	2
CO3	3	3	3	2	3	-	-	1	1	-	-	3	2
CO4	2	3	2	2	2	-	-	1	1	-	-	2	2
CO5	2	2	2	2	2	-	-	2	2	1	1	2	2
Avg.	2.2	2.4	2	1.8	2	-	-	1.2	1.2	1	1	2	1.8

For CO-PO/PSO Mapping:3–Substantial(High),2–Moderate(Medium), 1–Slight(Low)

U24OECS04	UI / UX DESIGN FOUNDATION	L	T	P	C
		1	0	4	3

Course Objective:

- To provide a sound understanding of UI & UX principles.
- To understand the design field and the role of UX in product development.
- To learn various research methods and ideation techniques used in UI/UX design.
- To explore the tools used in UI & UX development.
- To apply wireframes, prototypes, and user-centered design concepts.

Detailed Syllabus

UNIT I FOUNDATIONS OF DESIGN

Introduction – UI vs UX – Stages of Design Thinking – Divergent & Convergent Thinking – Brainstorming – Game-storming – Observational Empathy.

UNIT II FOUNDATIONS OF UI DESIGN FOUNDATIONS OF DESIGN

Visual & UI Principles – UI Elements & Patterns – Interaction Behaviours – Branding – Style Guides – Visual Consistency & Hierarchy.

UNIT III FOUNDATIONS OF UX DESIGN

Introduction to User Experience – Importance of UX – Understanding UX – Introduction about UX Research Methods – UX Design Activities – Defining Product Goals – UX Workflow – Design Ideation & Prototyping – Task Flows – Card Sorting – Storyboards – UX Deliverables.

UNIT IV WIREFRAMING, PROTOTYPING & TESTING

Low/Mid/High Fidelity Wireframes – Mockups – Efficient Designing – Interactive Prototypes – Usability Testing – UX Metrics – Synthesizing Test Findings – Prototype Iteration.

UNIT V RESEARCH, IDEATION & INFORMATION ARCHITECTURE

Problem Identification – Research Methods – Persona Creation – Scenario Building – Flow Diagrams – Task Flow Mapping – Information Architecture – User Needs & Requirements.

Total Periods: 15

List of Experiments

Sl. No.	List of Experiments
1	Design a responsive website for a College Event Management System. Mini Project Idea: Students should design layouts for: • Desktop view • Tablet view • Mobile view
2	Create interaction patterns for a Food Delivery App. Design interactions such as: • Add to cart button animation • Swipe to delete item • Loading indicators • Checkout confirmation popup
3	Design a Library Management System Interface. Create a UI Style Guide including: • Typography • Button styles • Color palette • Icons • Layout grids
4	Build a Mobile App Prototype for Bus Ticket Booking. Design screens for: • Login • Search buses • Seat selection • Payment • Ticket confirmation
5	Design a Smart Study Planner App for Students. Follow the design thinking steps: • Empathize • Define • Ideate • Prototype • Test
6	Improve the College Website Navigation System.
7	Create ideas for a Campus Navigation App. Use brainstorming methods such as: • Mind mapping • Crazy 8 technique • Affinity diagrams
8	Design a UI pattern library for an E-commerce Website. Include: • Mood board • Color palette • Typography • Buttons • Form elements • Cards and navigation components
9	Solve a sample application problem through UX workflow.- Design an Assignment Reminder Application. UX Workflow: 1. Problem definition

	2. User research 3. Ideation 4. Wireframes 5. Prototype
10	Conduct end-to-end UX research (user research → persona → scenarios → mapping).- Develop a College Bus Tracking Application.
11	Sketch wireframes and build a prototype.- Design a Simple Online Grocery Shopping App. Create wireframes for: • Home page • Product listing • Product details • Cart • Checkout
12	Conduct usability testing and refine prototype.- Test the Online Grocery Shopping App Prototype. Ask 5 users to perform tasks: • Search product • Add item to cart • Complete checkout Collect feedback, Improve design
	Total Periods: 60
	Total: 15+60 = 75 Periods

Learning Resources

1	Joel Marsh, “UX for Beginners”, O’Reilly, 2022.
2	Jon Yablonski, “Laws of UX: Using Psychology to Design Better Products & Services”, O’Reilly, 2021.
3	Jennifer Tidwell, Charles Brewer, A. Valencia, Designing Interfaces, 3rd Edition, 2020.
4	Steve Krug, Don’t Make Me Think, 2022.
5	https://www.interaction-design.org/
6	https://www.smashingmagazine.com/articles

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Apply UI/UX fundamentals and design principles.	Apply
CO2	Analyze UI/UX design of any product/application.	Analyze
CO3	Apply UX skills in product development.	Apply
CO4	Analyze sketching and prototyping principles to evaluate and improve user interface design solutions.	Analyze
CO5	Apply wireframes and working prototypes concepts	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1	2	1	3	2	3	2	2	2	-	2	3	2	3
CO2	2	2	3	2	3	2	2	2	3	2	3	2	3
CO3	2	2	3	2	3	2	2	2	3	2	3	2	3
CO4	2	2	3	2	3	2	2	2	-	2	3	2	3
CO5	2	2	3	2	3	2	2	2	3	2	3	2	3
Avg	2	1.8	3	2	3	2	2	2	3	2	3	2	3

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

24OECS05	APP DEVELOPMENT FUNDAMENTALS	L	T	P	C
		1	0	4	3

Course Objective:

- To understand the basic concepts of native and cross-platform mobile app development.
- To learn how to build simple native mobile applications using Java/Kotlin
- To develop applications that use device features such as location and storage.
- To develop introductory cross-platform applications using React Native.
- To develop web applications with database access.

Detailed Syllabus

UNITI FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT
Basics of mobile and web applications, Overview of Native, Hybrid and Cross-platform apps, Introduction to Progressive Web Apps (PWA), Concept of responsive Web Design

UNIT II NATIVE APP DEVELOPMENT USING JAVA
Introduction to Native App development, Simple tools used for Native development, Basics of Java/Kotlin for Android, Basics of Swift/Objective-C for iOS, Fundamentals of components, state, props (introductory level)

UNIT III HYBRID APP DEVELOPMENT
Concept of Hybrid Apps, When Hybrid Apps are preferred, Limitations of Hybrid Apps - Basic tools and frameworks: Ionic, Apache Cordova

UNIT IV CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE
Overview of Cross-platform development, Benefits and limitations, Common frameworks: Flutter, Xamarin, React Native, Simple introduction to components, JSX, state and props

UNIT V NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS
Comparison of app development frameworks, Build & runtime performance (basic level), Debugging ease, Time-to-development, UI/UX flexibility, Reusability & maintainability

Total Periods: 15

List of Experiments

Sl. No.	List of Experiments
1	Build a cross platform application for a BMI calculator, using react native.
2	Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense.

3	Develop a cross platform application to convert units from imperial system to metric system(km to miles, kg to pounds etc.,)
4	Design and develop across platform application for day to day task (to-do)management.
5	Design an android application using Cordova for a user login screen with username, Password, reset button and a submit button. Also, include header image and a label. Use layout managers.
6	Design and develop an android application using Apache Cordova to find and display the current location of the user.
7	Write programs using Java to create Android application having Databases for a simple library application for displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.
8	Create an app that allows adding, editing, and deleting text notes stored locally.
9	Build an app that allows selecting an image from gallery and displaying it on the screen.
10	Develop a mobile application that fetches and displays temperature and weather conditions for a selected city using a simple free API.
11	**MINI PROJECT** Personal Habit Tracker App. (Add daily habits (water intake, reading, exercise etc.). Track progress with simple charts or counters, Store data locally using SQLite, Display weekly summary)
12	**MINI PROJECT** Student Attendance Manager App (Create subjects and student lists, Mark daily attendance View attendance percentage per subject)
	Total Periods:60
	Total: 15 + 60 = 75 Periods

Learning Resources

1	Head First Android Development, Dawn Griffiths, O'Reilly, 3rd Edition, O'Reilly, 2023(UNIT 1 &2)
2	Apache Cordova in Action, Raymond K. Camden, Manning. 2020 (UNIT 1,3,5)
3	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing (UNIT 1,4,5)
4	Android Programming for Beginners, John Horton, Packt Publishing, 3rd Edition, Packt Publishing, 2021(UNIT 1,2)
5	Apache Cordova 4 Programming, John M Wargo, 2020 (UNIT 1,3,5)
6	Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras. 2021(UNIT 1,2,3,4,5)
7	https://developer.android.com
8	https://reactnative.dev/docs/getting-started

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Develop Native applications with GUI Components.	Apply
CO2	Develop hybrid applications with basic event handling.	Apply
CO3	Implement cross-platform applications with location and data storage capabilities.	Apply
CO4	Implement cross platform applications with basic GUI and event Handling	Apply
CO5	Develop web applications with cloud database access.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PSO1	PSO2
CO1	2	2	2	-	3	-	-	2	2	2	2	3	3
CO2	2	2	3	-	3	-	-	3	3	2	2	3	3
CO3	2	2	2	2	2	3	-	3	2	2	2	3	3
CO4	3	3	2	2	3	3	2	3	2	2	3	3	3
CO5	3	2	3	2	3	3	2	3	2	2	3	3	3
Avg	**2.4**	**2.2**	**2.4**	**2**	**2.8**	**3**	**2**	**2.8**	**2.2**	**2**	**2.4**	**3**	**3**

For CO-PO/PSO Mapping: 3 – Substantial (High), 2 – Moderate (Medium), 1 – Slight (Low)

MANDATORY COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24MC11	Disaster Risk Reduction and Management	MC	3	0	0	3	0	100	-
2	U24MC21	Environmental Science	MC	3	0	0	3	0	100	-
3	U24MC31	History of Science and Technology in India	MC	3	0	0	3	0	100	-
4	U24MC41	Personal Finance	MC	3	0	0	3	0	100	-
5	U24MC51	Well-Being with Traditional Practices-Yoga, Ayurveda and Siddha	MC	3	0	0	3	0	100	-

U24MC11	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0

Course Objective:

- To introduce the basic concepts of disasters, hazards, vulnerability, and disaster risks.
- To understand different types of disasters and their impacts on society and the environment.
- To study the principles and strategies of disaster risk reduction (DRR).
- To learn the disaster management framework, policies, and institutional mechanisms in India.
- To understand the use of modern tools, technology, and case studies in disaster management.

Detailed Syllabus

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals.

UNIT II DISASTER RISK REDUCTION (DRR) **9**

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies. - Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT **9**

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT **9**

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management.

UNIT V DISASTER MANAGEMENT: CASE STUDIES **9**

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field work related to disaster management. - Field Work-Mock drill.

Total Periods: 45

Learning Recourses

1	Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2	Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3	Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN13:978-9380386423
4	Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the concepts of disasters, hazards, vulnerability, and disaster risks.	Understand
CO2	Describe different types of disasters and their impacts on society and the environment.	Understand
CO3	Explain the principles and strategies of disaster risk reduction.	Understand
CO4	Discuss disaster management policies, institutions, and frameworks in India.	Understand
CO5	Describe the disaster management tools, technologies, and case study knowledge to disaster situations.	Understand

U24MC21	ENVIRONMENTAL SCIENCE	L	T	P	C
		3	0	0	0

Course Objective:

- To introduce the basic concepts and importance of Environmental Science and natural resources.
- To understand ecosystem structure, energy flow, and the importance of biodiversity.
- To study different types of environmental pollution and their control measures.
- To understand major environmental issues and the concept of sustainable development.
- To understand environmental laws, policies, and the role of public participation in environmental protection.

Detailed Syllabus

UNIT I INTRODUCTION TO ENVIRONMENT AND NATURAL RESOURCES 8

Definition, scope, and importance of Environmental Science. Components of the environment: lithosphere, hydrosphere, atmosphere, and biosphere. Structure and functions of the environment. Natural resources: renewable and non-renewable resources. Resource distribution and utilization. Resource depletion and conservation strategies. Sustainable use of natural resources and the concept of equitable resource sharing. Importance of environmental awareness and responsibility.

UNIT II ECOSYSTEMS AND BIODIVERSITY 10

Concept, structure, and functions of ecosystems. Types of ecosystems: terrestrial and aquatic ecosystems. Food chains, food webs, and ecological pyramids. Energy flow in ecosystems. Biogeochemical cycles: water cycle, carbon cycle, and nitrogen cycle. Biodiversity: definition, types (genetic, species, and ecosystem diversity), values of biodiversity. Threats to biodiversity such as habitat destruction, overexploitation, pollution, and climate change. Biodiversity conservation methods: in-situ and ex-situ conservation strategies.

UNIT III ENVIRONMENTAL POLLUTION **10** Definition and types of environmental pollution: air pollution, water pollution, soil pollution, noise pollution, thermal pollution, and radioactive pollution. Sources, causes, effects, and control measures for different types of pollution. Solid waste management: types of waste, waste segregation, recycling, and disposal methods. Management of e-waste and plastic waste. Importance of pollution prevention and environmental protection practices.	
UNIT IV ENVIRONMENTAL ISSUES AND SUSTAINABLE DEVELOPMENT **9** Major environmental issues: climate change, global warming, ozone layer depletion, acid rain, deforestation, land degradation, urbanization, and population growth. Impact of environmental issues on ecosystems and human health. Concept of sustainable development and sustainable lifestyles. Sustainable Development Goals (SDGs). Sustainable agriculture, renewable energy sources, and green buildings. Carbon footprint, life cycle assessment (LCA), environmental ethics, and green campus initiatives.	
UNIT V ENVIRONMENTAL POLICIES, LEGISLATION AND FIELDWORK **8** Environmental policies and legislation in India: Environmental (Protection) Act, 1986; Air (Prevention and Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Forest Conservation Act; Biological Diversity Act. Role of National Green Tribunal (NGT). Environmental Impact Assessment (EIA). Role of government agencies, NGOs, and public participation in environmental protection. Fieldwork/Project component: campus environmental audit, biodiversity survey, waste segregation activity, case study analysis, or visit to a pollution control facility.	
Total Periods: 45	

Learning Recourses

1	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,2016.
3	R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
4	Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
5	Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
6	https://moef.gov.in — Ministry of Environment, Forest and Climate Change, India
7	https://sdgs.un.org/goals — UN Sustainable Development Goals
8	https://niti.gov.in — NITI Aayog's SDG India Index

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the basic concepts of environment and natural resources.	Understand
CO2	Describe ecosystem structure, functions, and biodiversity conservation.	Understand
CO3	Describe different types of environmental pollution and their control methods.	Understand
CO4	Discuss major environmental issues and principles of sustainable development.	Understand
CO5	Explain environmental policies, legislation, and apply environmental practices through field activities.	Understand

U24MC31	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
		3	0	0	0

Course Objective:

- To introduce the basic concepts and perspectives of the history of science and technology.
- To understand the contributions of important scholars in the study of science and technology in India.
- To study the development of science and technology in ancient and medieval India.
- To understand the influence of colonial rule on science and technology in India.
- To understand the growth and impact of science and technology in post-independent India.

Detailed Syllabus

UNIT I CONCEPTS AND PERSPECTIVES

Meaning and Nature of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction between science, technology & society, Sources for the history of science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA

Introduction to the Major Historians and their works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others; Approaches to the study of science and technology in Indian Historiography

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT AND MEDIEVAL INDIA

Technology in pre-historic period- Origin of agriculture and its technological impact – Science and Technology during Vedic and Later Vedic periods – Development from 1st century AD to 1200 CE – Technological legacy of Medieval India – Interaction with Arab world and knowledge exchange – Medical traditions: Ayurvedic and Unani – Alchemy and early chemistry – Developments in Astronomy and Mathematics – Science and Technology on the eve of British conquest.

UNIT IV SCIENCE AND TECHNOLOGY IN COLONIAL INDIA

Science under colonial rule: Science and the Empire – Introduction to Western science in India – Indian responses to modern science – Growth of techno-scientific and educational development – Role of colonial policies in shaping scientific development.

UNIT V SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA

Science, Technology and Development discourse- Evolution of science and Technology policies in India – Growth of scientific institutions and research – Advances in modern fields: Space, information technology, biotechnology – Science and technology in a globalized India – Social implications of emerging technologies.

Total Periods: 45

Learning Recourses

1	Deepak Kumar, Science and the Raj: A Study of British India, Oxford University Press, New Delhi, 1995.
2	S. Irfan Habib and Dhruv Raina, Social History of Science in Colonial India, Oxford University Press, New Delhi, 2007.
3	D. D. Kosambi, The Culture and Civilization of Ancient India in Historical Outline, Vikas Publishing House, New Delhi, 1997.
4	Dhruv Raina, Images and Contexts: The Historiography of Science and Modernity in India, Oxford University Press, 2003.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the basic concepts and sources of the history of science and technology.	Understand
CO2	Discuss the contributions of major scholars in the historiography of science and technology in India.	Understand
CO3	Describe the development of science and technology in ancient and medieval India.	Understand
CO4	Discuss the impact of colonial rule on scientific development in India.	Understand
CO5	Explain the role of science and technology in post-independent India.	Understand

U24MC541	**PERSONAL FINANCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**0**

Course Objective:

- To introduce students to the principles and importance of financial planning, goal setting, risk–return relationship, and informed financial decision-making.
- To develop the ability to apply time value of money concepts, compounding principles, and asset allocation strategies in evaluating savings and investment alternatives.
- To familiarize students with various financial assets and investment avenues such as bank deposits, mutual funds, equity, bonds, gold, real estate, and small savings instruments.
- To create awareness about responsible borrowing, credit management, loan evaluation, and debt control strategies.
- To enable students to design a comprehensive personal financial plan incorporating insurance, retirement planning, tax planning, and periodic review mechanisms for long-term financial security.

Detailed Syllabus

UNIT I FINANCIAL PLANNING	**9**
Importance of Financial Planning – Steps involved in Financial Planning – SMART Goals – Achieving Goals – Risk & Returns – Savings & Investment – Loans & Investment.	
UNIT II ANALYZING SAVING & INVESTMENT	**9**
Time value of money – Power of Compounding – Rule of 72 and other rules like 69, 70, 144 – Personal Balance sheet and net worth – Inflation effect on Investment – Asset Allocation – Systematic Investment Planning.	
UNIT III FINANCIAL ASSETS	**9**
Investment avenues , Small Savings – Post Office Savings Schemes – Company Fixed Deposits – Bank Deposits –Gold – Gold ETF – Mutual Funds – ELSS – Investing in Equity - Investment in Commodities – Government and Corporate Bonds – Collecting Antiques and artifacts – Real Estate – Chit Funds.	
UNIT IV MANAGING LOANS	**9**
Personal Loan – Housing Loan – Reverse Mortgage – Education Loan – Gold Pledging – Basics & dangers of Credit Card Debts –CIBIL Score – Steps to avoid excess debt.	
UNIT V PROTECTION RELATED PRODUCTS	**9**
Insurance – Life Insurance – Importance of Term Life Insurance – Pension Schemes – Health Insurance - start early and peaceful retirement – Tracking and reviewing financial plan – Danger of Dipping your retirement savings, Basic of tax planning income tax.	
	Total Periods: 45

Learning Resources

1	Tyco Press (2014), "Personal Finance Simplified", Callisto Publishing, 20th Edition
2	Robert Kiyosaki, Rich Dad Poor Dad (2017), Plata Publishing , New Delhi
3	Madura, Jeff. (2013), 'Personal Finance', Pearson Education, 5th Edition
4	Jack Kapoor, Les Dlabay, Rober J. Huges, (2010), 'Personal Finance ', McGraw Hill

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the importance of financial planning, goal setting, risk-return relationship, and the role of savings and investment in personal finance.	Understand
CO2	Apply time value of money concepts, compounding principles, and asset allocation strategies to evaluate personal financial decisions.	Apply
CO3	Analyze various financial assets and investment avenues (bank deposits, mutual funds, equity, bonds, gold, real estate, etc.) to select suitable options based on risk profile and financial goals.	Analyze
CO4	Evaluate loan options, credit management practices, and debt risks to make responsible borrowing decisions and maintain financial stability.	Evaluate
CO5	Develop a comprehensive personal financial plan incorporating insurance, retirement planning, tax planning, and periodic review mechanisms.	Create

U24MC51	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA	L	T	P	C
		3	0	0	0

Course Objective:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

Detailed Syllabus

UNIT I HEALTH AND ITS IMPORTANCE **6**

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath. **Present health status -** The life expectancy-present status - mortality rate - dreadful diseases - non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities. **Types of diseases and disorders -** Lifestyle disorders – Obesity – Diabetes - cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. **Causes of the above diseases / disorders -** Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time. **Simple lifestyle modifications to maintain health -** Healthy Eating habits (Balanced diet according to age) Physical Activities

(Stretching exercise, aerobics, resisting exercise) – Maintaining BMI-Importance and actions to be taken.

UNIT II DIET 10

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong. **Balanced Diet and its 7 Components -** Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water. **Food additives and their merits & demerits -** Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions. **Definition of BMI and maintaining it with diet** - Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM. **Common cooking mistakes -** Different cooking methods, merits and demerits of each method.

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 8

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. **Secrets of traditional healthy living -** Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (TriDosha Theory) -Udal Thathukkal **Prevention of illness with our traditional system of medicine -** Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 7

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -short term and long-term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement. **Sleep -** Sleep and its importance for mental wellness - Sleep and digestion. **Immunity -** Types and importance - Ways to develop immunity

UNIT V YOGA 2+12

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

Total Periods: 45

Learning Recourses

1	Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2	Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California



3	WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work,Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D.Roberts, A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England
4	The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001
5	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
6	Simple lifestyle modifications to maintain health. https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook
7	Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
8	https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
9	Benefits of healthy eating https://www.cdc.gov/nutrition/resources-publications/benefitsof-healthy-eating.html
10	Food additives: https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/foodadditives
11	BMI:https://www.hsph.harvard.edu/nutritionsource/healthy-weight/ https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---recommendations
12	Yoga https://www.healthifyme.com/blog/types-of-yoga/ https://yogamedicine.com/guide-types-yoga-styles/ Ayurveda: https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-inayurveda
13	Siddha : http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp
14	CAM : https://www.hindawi.com/journals/ecam/2013/376327/
15	Preventive herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the meaning of health, its types, and common lifestyle diseases.	Understand
CO2	Describe the importance of diet, balanced nutrition, and BMI for maintaining good health.	Understand
CO3	Explain the basic principles of Ayurveda and Siddha systems for disease prevention.	Understand
CO4	Discuss the importance of mental wellness, stress management, sleep, and immunity.	Understand
CO5	Describe the importance of yoga and practice simple yogasanas for a healthy life.	Understand

MINORS COURSES
VERTICAL – I BUSINESS DATA ANALYTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24MNBA01	Statistics for Management	PEC	3	0	0	3	3	40	60
2	U24MNBA02	Datamining for Business Intelligence	PEC	3	0	0	3	3	40	60
3	U24MNBA03	Human Resource Analytics	PEC	3	0	0	3	3	40	60
4	U24MNBA04	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3	40	60
5	U24MNBA05	Operation and Supply Chain Analytics	PEC	3	0	0	3	3	40	60
6	U24MNBA06	Financial Analytics	PEC	3	0	0	3	3	40	60

U24MNBA01	STATISTICS FOR MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objective:

- To explain the role of statistics in managerial decision-making.
- To summarize the methods of data collection and presentation.
- To classify measures of central tendency and dispersion.
- To illustrate probability concepts and distributions.
- To interpret statistical inference techniques for business applications.

Detailed Syllabus

UNIT I INTRODUCTION TO STATISTICS **9**

Meaning, Nature and Scope of Statistics – Importance in Business Decision Making – Types of Data – Data Collection Methods – Classification and Tabulation of Data – Diagrammatic and Graphical Presentation.

UNIT II MEASURES OF CENTRAL TENDENCY **9**

Mean, Median and Mode – Properties and Uses – Weighted Mean – Measures of Central Tendency for Grouped and Ungrouped Data – Practical Applications in Business.

UNIT III MEASURES OF DISPERSION AND SKEWNESS **9**

Range, Quartile Deviation, Mean Deviation and Standard Deviation – Coefficient of Variation – Skewness and Kurtosis – Interpretation and Applications.

UNIT IV PROBABILITY AND DISTRIBUTIONS **9**

Concept of Probability – Laws of Probability – Conditional Probability – Theorem of Total Probability – Bayes' Theorem – Probability Distributions: Binomial, Poisson and Normal Distribution.

UNIT V STATISTICAL INFERENCE **9**

Sampling Techniques – Sampling and Non-Sampling Errors – Estimation – Hypothesis Testing – t-test, Chi-square test and ANOVA – Applications in Business Decision Making.

Total Periods: 45

Learning Resources

1	Statistics for Management – Richard I. Levin & David S. Rubin, Pearson, Latest Edition, 2021.
2	Business Statistics – S. P. Gupta, Sultan Chand & Sons, Latest Edition, 2020.
3	Statistics for Business and Economics – Paul Newbold, Pearson, Latest Edition, 2022.
4	Business Statistics Using Excel– David M. Levine, Pearson, Latest Edition, 2021.
5	Fundamentals of Statistics – S. C. Gupta &V. K. Kapoor, Sultan Chand & Sons, Latest Edition, 2020.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Explain the role and importance of statistics in management.	Understand
CO2	Summarize methods of data collection and presentation.	Understand
CO3	Classify measures of central tendency and dispersion.	Understand
CO4	Illustrate probability concepts and statistical distributions.	Understand
CO5	Interpret basic statistical inference techniques for business decisions.	Understand

U24MNBA02	DATAMINING FOR BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Objective:

- To describe the concepts and significance of data mining in business intelligence.
- To outline the data preprocessing and data warehousing techniques.
- To explain classification and clustering methods used in data mining.
- To examine association rules and pattern discovery techniques.
- To discuss applications of data mining in business decision-making.

Detailed Syllabus

UNIT I INTRODUCTION TO DATA MINING **9**

Data Mining – Meaning and Importance – Data Mining vs Data Analytics – Knowledge Discovery in Databases (KDD) Process – Business Intelligence Concepts – Applications of Data Mining in Business.

UNIT II DATA PREPROCESSING AND WAREHOUSING **9**

Data Cleaning – Data Integration – Data Transformation – Data Reduction – Data Warehousing – Architecture of Data Warehouse – OLAP Operations – Data Marts.

UNIT III CLASSIFICATION TECHNIQUES **9**

Classification – Decision Trees – Naïve Bayes Classification – K-Nearest Neighbor (KNN) – Model Evaluation Methods – Accuracy, Precision and Recall.

UNIT IV CLUSTERING AND ASSOCIATION RULES **9**

Clustering – K-Means Clustering – Hierarchical Clustering – Association Rule Mining – Apriori Algorithm – Market Basket Analysis.

UNIT V DATA MINING APPLICATIONS IN BUSINESS **9**

Customer Relationship Management (CRM) – Fraud Detection – Sales and Marketing Analysis – Risk Management – Web Mining – Ethical Issues in Data Mining.

Total Periods: 45

Learning Resources

1	Data Mining: Concepts and Techniques – Jiawei Han, Morgan Kaufmann, Latest Edition, 2022.
2	Introduction to Data Mining – Pang-Ning Tan, Pearson, Latest Edition, 2021.
3	Data Mining for Business Analytics – Galen Shmueli, Wiley, Latest Edition, 2020.
4	Business Intelligence Guidebook – Rick Sherman, Morgan Kaufmann, Latest Edition, 2015
5	Fundamentals of Data Mining in Genomics and Proteomics – Werner Dubitzky, Springer, Latest Edition, 2021.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Describe the concepts and importance of data mining in business intelligence.	Understand
CO2	Outline data preprocessing and data warehousing techniques.	Understand
CO3	Explain classification methods used in data mining.	Understand
CO4	Examine clustering and association rule techniques.	Understand
CO5	Discuss applications of data mining in business contexts	Understand

U24MNBA03	HUMAN RESOURCE ANALYTICS	L	T	P	C
		3	0	0	3

Course Objective:

- To recognize the role of analytics in human resource management.
- To explain HR metrics and data-driven decision-making in organizations.
- To illustrate techniques used in workforce analytics.
- To examine employee performance and retention analytics.
- To appraise the application of HR analytics in strategic management.

Detailed Syllabus

UNIT I INTRODUCTION TO HR ANALYTICS	**9**
Meaning and Scope of HR Analytics – Evolution of HR Analytics – Role of Analytics in HRM – HR Analytics vs HR Metrics – Importance in Organizational Decision Making.	
UNIT II HR DATA AND METRICS	**9**
Sources of HR Data – Types of HR Data – HR Metrics: Turnover Rate, Absenteeism, Cost per Hire – Data Collection and Management – HR Dashboards and Reporting.	
UNIT III WORKFORCE ANALYTICS	**9**
Workforce Planning – Talent Analytics – Recruitment Analytics – Training and Development Analytics – Competency Mapping – Workforce Optimization.	
UNIT IV PERFORMANCE AND RETENTION ANALYTICS	**9**
Employee Performance Analysis – Performance Appraisal Data – Predicting Employee Attrition – Retention Strategies – Employee Engagement Analytics.	

UNIT V STRATEGIC HR ANALYTICS AND APPLICATIONS **9**
HR Analytics in Strategic Decision Making – Predictive HR Analytics – HR Scorecards – Ethical Issues in HR Analytics – Future Trends in HR Analytics.
Total Periods: 45

Learning Resources

1	HR Analytics: The What, Why and How– Tracey Smith, Kogan Page, Latest Edition, 2021.
2	Predictive HR Analytics – Kirsten Edwards, Kogan Page, Latest Edition, 2019.
3	Human Resource Analytics – Dipak Kumar Bhattacharyya, Sage Publications India, Latest Edition, 2017 (Reprint).
4	HR Analytics Handbook– Sharma and Sharma, McGraw Hill Education India, Latest Edition, 2020.
5	People Analytics for Dummies– Mike West, Wiley, Latest Edition, 2018 (Reprint).

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Recognize the importance of analytics in human resource management.	Understand
CO2	Explain HR data sources and key metrics used in organizations.	Understand
CO3	Illustrate workforce analytics techniques in HR functions.	Understand
CO4	Examine employee performance and retention analytics	Understand
CO5	Appraise the role of HR analytics in strategic decision-making.	Understand

U24MNBA04	**MARKETING AND SOCIAL MEDIA WEB ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To identify the role of analytics in digital marketing and social media.
- To explain web analytics tools and techniques used in marketing.
- To differentiate key performance indicators and metrics in online marketing.
- To examine social media analytics and consumer engagement.
- To assess the application of web analytics in marketing strategies.

Detailed Syllabus

UNIT I INTRODUCTION TO DIGITAL MARKETING ANALYTICS **9**
Digital Marketing – Concepts and Importance – Role of Analytics in Marketing – Web Analytics: Meaning and Scope – Types of Digital Data – Overview of Marketing Analytics.
UNIT II WEB ANALYTICS TOOLS AND TECHNIQUES **9**
Web Analytics Tools – Google Analytics – Data Collection Techniques – Traffic Analysis – User Behaviour Analysis – Conversion Tracking – A/B Testing.
UNIT III MARKETING METRICS AND KPIs **9**
Key Performance Indicators (KPIs) – Click Through Rate (CTR) – Cost per Click (CPC) – Conversion Rate – Customer Acquisition Cost – Return on Investment (ROI) – Campaign Performance Analysis.
UNIT IV SOCIAL MEDIA ANALYTICS **9**
Social Media Platforms and Data – Engagement Metrics – Sentiment Analysis – Influencer Analytics – Social Media Monitoring Tools – Content Performance Evaluation.

UNIT V APPLICATIONS AND STRATEGIES IN WEB ANALYTICS **9**
Marketing Strategy Development using Analytics – Customer Segmentation – Personalization Techniques – Predictive Marketing Analytics – Ethical Issues in Digital Analytics.
Total Periods: 45

Learning Resources

1	Web Analytics 2.0 – Avinash Kaushik, Wiley, Latest Edition, 2020 (Reprint).
2	Digital Marketing Analytics – Chuck Hemann&Ken Burbary, Que Publishing, Latest Edition, 2018 (Reprint).
3	Marketing Analytics– Wayne L. Winston, Wiley, Latest Edition, 2020.
4	Social Media Analytics – Marshall Sponder, McGraw Hill Education, Latest Edition, 2019.
5	Digital Marketing – Dave Chaffey, Pearson, Latest Edition, 2022.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Identify the role of analytics in digital marketing and social media.	Understand
CO2	Explain web analytics tools and techniques used in marketing.	Understand
CO3	Differentiate key performance metrics and KPIs in online marketing.	Understand
CO4	Examine social media analytics and user engagement patterns.	Understand
CO5	Assess the application of web analytics in marketing strategies.	Understand

U24MNBA05	OPERATION AND SUPPLY CHAIN ANALYTICS	L	T	P	C
		3	0	0	3

Course Objective:

- To outline the role of analytics in operations and supply chain management.
- To explain demand forecasting and inventory analysis techniques.
- To describe analytical models used in logistics and distribution.
- To examine performance measurement in supply chains.
- To summarize the application of analytics in optimizing operations.

Detailed Syllabus

UNIT I INTRODUCTION TO OPERATIONS AND SUPPLY CHAIN ANALYTICS **9**
Operations Management – Supply Chain Management: Concepts and Importance – Role of Analytics in Operations – Components of Supply Chain – Data-Driven Decision Making in Operations.
UNIT II DEMAND FORECASTING AND INVENTORY ANALYTICS **9**
Demand Forecasting – Qualitative and Quantitative Methods – Time Series Basics – Inventory Management – EOQ Model – Safety Stock – Reorder Point – Inventory Control Techniques.
UNIT III LOGISTICS AND DISTRIBUTION ANALYTICS **9**
Logistics Management – Transportation Models – Distribution Network Design – Warehouse Analytics – Routing and Scheduling – Cost Optimization in Logistics.
UNIT IV SUPPLY CHAIN PERFORMANCE MEASUREMENT **9**
Supply Chain Performance Metrics – Key Performance Indicators – Benchmarking – Service Level Measurement – Balanced Scorecard in Supply Chain – Risk Assessment in Supply Chain.

UNIT V: OPTIMIZATION AND APPLICATIONS IN OPERATIONS **9**
Optimization Techniques in Operations – Linear Programming Basics – Capacity Planning – Lean Operations – Supply Chain Analytics Applications in Manufacturing and Services – Emerging Trends.
Total Periods: 45

Learning Resources

1	Supply Chain Management: Strategy, Planning, and Operation – Sunil Chopra&Peter Meindl, Pearson, Latest Edition, 2022.
2	Operations Management – William J. Stevenson, McGraw Hill Education, Latest Edition, 2021.
3	Designing and Managing the Supply Chain – David Simchi-Levi, McGraw Hill Education, Latest Edition, 2020.
4	Supply Chain Analytics – Nada R. Sanders, Pearson, Latest Edition, 2020.
5	Operations Research– Hamdy A. Taha, Pearson, Latest Edition, 2019.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Outline the role of analytics in operations and supply chain management.	Understand
CO2	Explain demand forecasting and inventory analysis techniques.	Understand
CO3	Describe logistics and distribution analytics models.	Understand
CO4	Examine supply chain performance measurement methods.	Understand
CO5	Summarize optimization approaches in operations and supply chain analytics.	Understand

U24MNBA06	**FINANCIAL ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To explain the significance of analytics in financial decision-making.
- To interpret financial data using analytical tools and techniques.
- To describe models used in investment and risk analysis.
- To examine financial market behaviour using analytical approaches.
- To summarize applications of analytics in corporate finance and investments.

Detailed Syllabus

UNIT I INTRODUCTION TO FINANCIAL ANALYTICS **9**
Financial Analytics – Meaning and Scope – Role of Analytics in Finance – Types of Financial Data – Financial Statements Analysis – Ratio Analysis – Introduction to Financial Modelling.
UNIT II CORPORATE FINANCE ANALYTICS **9**
Cash Flow Analysis – Cost of Capital – Capital Budgeting Techniques – Payback Period – Net Present Value (NPV) – Internal Rate of Return (IRR) – Break-even Analysis.
UNIT III FINANCIAL MARKET ANALYTICS **9**
Risk and Return – Measurement of Risk – Time Series Basics in Finance – Stock and Bond Analysis – Market Indicators – Introduction to Volatility Concepts.

UNIT IV PORTFOLIO AND INVESTMENT ANALYTICS **9** Portfolio Analysis – Diversification – Capital Asset Pricing Model (CAPM) – Sharpe Ratio – Basics of Derivatives – Option Pricing Concepts – Investment Decision Analysis.	
UNIT V RISK ANALYSIS AND APPLICATIONS **9** Financial Risk – Types of Risk – Credit Risk Concepts – Value at Risk (VaR) – Risk Management Techniques – Applications of Financial Analytics in Business.	
Total Periods: 45	

Learning Resources

1	Financial Analytics with R – Mark J. Bennett &Dirk L. Hugen, Cambridge University Press, Latest Edition, 2020.
2	Python for Finance – Yuxing Yan, Packt Publishing, Latest Edition, 2017
3	Quantitative Financial Analytics – Edward E. Williams & John A. Dobelman, World Scientific, Latest Edition, 2017
4	Investment Analysis and Portfolio Management – Prasanna Chandra, McGraw Hill Education India, Latest Edition, 2021.
5	Financial Management – I. M. Pandey, Vikas Publishing, Latest Edition, 2022.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the role and importance of financial analytics.	Understand
CO2	Interpret financial data using analytical techniques	Understand
CO3	Describe models used in corporate finance and investment analysis.	Understand
CO4	Examine financial market behaviour and portfolio concepts.	Understand
CO5	Summarize risk analysis methods and financial applications.	Understand

VERTICAL – II PUBLIC ADMINISTRATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24MNPA01	Principles of Public Administration	PEC	3	0	0	3	3	40	60
2	U24MNPA02	Constitution of India	PEC	3	0	0	3	3	40	60
3	U24MNPA03	Public Personnel Administration	PEC	3	0	0	3	3	40	60
4	U24MNPA04	Administrative Theories	PEC	3	0	0	3	3	40	60
5	U24MNPA05	Indian Administrative System	PEC	3	0	0	3	3	40	60
6	U24MNPA06	Public Policy Administration	PEC	3	0	0	3	3	40	60

U24MNPA01	PRINCIPLES OF PUBLIC ADMINISTRATION	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the meaning, nature, scope, and evolution of public administration.
- To learn the classical and modern administrative theories.
- To familiarize about the structure and principles of administrative organization.
- To understand the basic functions of personnel and financial administration.
- To describe about the development of administration and emerging trends in public administration.

Detailed Syllabus

UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION	**9**
Meaning, Nature and Scope of Public Administration – Evolution of Public Administration – Public and Private Administration – New Public Administration (NPA) – New Public Management (NPM) – Governance: Concept and Dimensions.	
UNIT II ADMINISTRATIVE THOUGHT	**9**
Classical Theories – Woodrow Wilson, Henri Fayol, Max Weber – Neo-Classical Theory: Human Relations Approach – Modern Theories: Systems Theory, Decision-Making Theory – Criticism of Classical Theories.	
UNIT III ADMINISTRATIVE STRUCTURE AND ORGANIZATION	**9**
Principles of Organization – Hierarchy, Unity of Command, Span of Control – Line and Staff Agencies – Forms of Organization: Department, Corporation, Board and Commission – Public Enterprises – Accountability and Control.	
UNIT IV PERSONNEL AND FINANCIAL ADMINISTRATION	**9**
Personnel Administration – Recruitment, Training, Promotion – Civil Service: Meaning and Types – Financial Administration – Budgeting, Accounting and Auditing – Performance Budgeting and Zero-Based Budgeting – Role of Finance Ministry.	
UNIT V DEVELOPMENT AND CONTEMPORARY PUBLIC ADMINISTRATION	**9**
Development Administration – Concept and Features – Good Governance and E-Governance – Public Policy: Formulation and Implementation – Administrative Reforms in India – Role of NGOs and Civil Society.	
	Total Periods: 45

Learning Resources

1	Public Administration – M. Laxmikanth, McGraw Hill Education India, Latest Edition, 2023.
2	New Horizons of Public Administration– Mohit Bhattacharya, Jawahar Publishers and Distributors, Latest Edition, 2022.
3	Public Administration: Concepts and Theories – Rumki Basu, Sterling Publishers, Latest Edition, 2021.
4	Administrative Thinkers – D. Ravindra Prasad, Sterling Publishers, Latest Edition, 2020.
5	Public Administration in Theory and Practice – M. P. Sharma&B. L. Sadana, Kitab Mahal, Latest Edition, 2022.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the concept, scope, and significance of public administration.	Understand
CO2	Describe major administrative theories and contributions of thinkers	Understand
CO3	Explain organizational principles and administrative structures.	Understand
CO4	Describe personnel systems and financial management in public administration.	Understand
CO5	Explain development administration and recent administrative reforms.	Understand

U24MNPA02	**CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To understand the historical background and evolution of the Indian Constitution.
- To familiarize learners with the features and principles of the Constitution.
- To develop knowledge about fundamental rights, duties and directive principles.
- To understand the structure and functioning of Union and State governments.
- To analyse constitutional bodies and recent developments in Indian governance.

Detailed Syllabus

UNIT I HISTORICAL BACKGROUND AND MAKING OF THE CONSTITUTION 9 Historical background of the Indian Constitution – Regulating Act 1773, Charter Acts, Government of India Acts – Constituent Assembly: Composition and Functions – Drafting Committee – B. R. Ambedkar – Salient features of the Constitution.
UNIT II FUNDAMENTAL RIGHTS AND DUTIES 9 Fundamental Rights – Right to Equality, Freedom, Against Exploitation, Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies – Fundamental Duties – Directive Principles of State Policy – Relationship between Fundamental Rights and DPSP.
UNIT III UNION GOVERNMENT 9 President – Powers and Functions – Vice President – Prime Minister and Council of Ministers – Parliament: Lok Sabha and Rajya Sabha – Legislative Procedures – Judicial Review.
UNIT IV STATE GOVERNMENT AND JUDICIARY 9 Governor – Chief Minister and Council of Ministers – State Legislature – High Courts – Supreme Court of India – Judicial Activism and Independence of Judiciary.
UNIT V CONSTITUTIONAL BODIES AND AMENDMENTS 9 Election Commission – Finance Commission – Union Public Service Commission – Comptroller and Auditor General (CAG) – Constitutional Amendments – Basic Structure Doctrine – Recent Constitutional Developments.
Total Periods: 45

Learning Resources

1	Indian Polity – M. Laxmikanth, McGraw Hill Education India, Latest Edition, 2023.
2	Introduction to the Constitution of India– D. D. Basu, LexisNexis, Latest Edition, 2022.

3	Our Constitution – Subhash C. Kashyap, National Book Trust, Latest Edition, 2021.
4	Indian Government and Politics – B. L. Fadia, Sahitya Bhawan Publications, Latest Edition, 2022.
5	Constitutional Law of India– J. N. Pandey, Central Law Agency, Latest Edition, 2021.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Understand the historical background and features of the Indian Constitution.	Understand
CO2	Explain fundamental rights, duties and directive principles.	Understand
CO3	Describe the structure and functions of the Union Government.	Understand
CO4	Explain the organization of State Government and Judiciary.	Understand
CO5	Understand constitutional bodies and amendment procedures.	Understand

U24MNPA03	**PUBLIC PERSONNEL ADMINISTRATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To interpret the role and significance of personnel administration in public organizations.
- To distinguish various systems and principles of public personnel management.
- To summarize recruitment, training and career development processes in civil services.
- To explain performance appraisal and promotion systems in government.
- To discuss discipline, ethics and accountability in public service.

Detailed Syllabus

UNIT I INTRODUCTION TO PUBLIC PERSONNEL ADMINISTRATION 9

Meaning, Nature and Scope of Public Personnel Administration – Evolution of Personnel Systems – Role of Human Resources in Public Administration – Distinction between Public and Private Personnel Administration – Emerging Trends in HRM in Public Sector.

UNIT II CIVIL SERVICE SYSTEMS 9

Civil Service: Meaning and Features – Types of Civil Services – Generalist vs Specialist – Neutrality and Anonymity – Recruitment Agencies – Union Public Service Commission – State Public Service Commission.

UNIT III RECRUITMENT, TRAINING AND DEVELOPMENT 9

Principles of Recruitment – Methods of Recruitment – Training: Types and Importance – Training Institutions in India – Career Development – Capacity Building in Public Service.

UNIT IV PERFORMANCE APPRAISAL AND PROMOTION 9

Performance Appraisal: Meaning and Methods – Confidential Reports – Promotion Policies – Seniority vs Merit – Pay Structure and Incentives – Employee Motivation in Public Sector.

UNIT V DISCIPLINE, ETHICS AND ACCOUNTABILITY 9

Disciplinary Procedures – Conduct Rules – Administrative Ethics – Code of Conduct – Integrity in Public Service – Grievance Redressal Mechanisms – Role of Vigilance Institutions

Total Periods: 45

Learning Resources

1	Personnel Administration in India– Avasthi and Maheshwari, Lakshmi Narain Agarwal, Latest Edition, 2021.
2	Public Personnel Administration – M. P. Sharma, Kitab Mahal, Latest Edition, 2022.
3	Human Resource Management in Public Sector – B. P. Singh, Excel Books, Latest Edition, 2020.
4	Public Administration in Theory and Practice– M. P. Sharma & B. L. Sadana, Kitab Mahal, Latest Edition, 2022.
5	Indian Administration– S. R. Maheshwari, Orient Blackswan, Latest Edition, 2021.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Interpret the role and importance of personnel administration in public organizations	Understand
CO2	Distinguish various civil service systems and their features.	Understand
CO3	Summarize recruitment, training and development processes in public services.	Understand
CO4	Explain performance appraisal and promotion systems in administration.	Understand
CO5	Discuss discipline, ethics and accountability mechanisms in public service	Understand

U24MNPA04	ADMINISTRATIVE THEORIES	L	T	P	C
		3	0	0	3

Course Objective:

- To outline the evolution of administrative thought.
- To clarify the principles of classical administrative theories.
- To examine human relations and behavioural approaches.
- To illustrate modern administrative theories and systems approach.
- To compare traditional and contemporary administrative perspectives.

Detailed Syllabus

UNIT I EVOLUTION OF ADMINISTRATIVE THOUGHT **9**

Nature and Significance of Administrative Theory – Evolution of Administrative Thought – Politics-Administration Dichotomy – Contribution of Woodrow Wilson – Early Administrative Ideas.

UNIT II CLASSICAL ADMINISTRATIVE THEORIES **9**

Scientific Management Theory – Contribution of F. W. Taylor – Administrative Theory of Henri Fayol – Bureaucratic Theory of Max Weber – Principles and Criticism.

UNIT III NEO-CLASSICAL AND HUMAN RELATIONS APPROACH **9**

Human Relations Theory – Hawthorne Experiments – Contribution of Elton Mayo – Behavioural Approach – Motivation Theories – Limitations of Human Relations Approach.

UNIT IV MODERN ADMINISTRATIVE THEORIES **9**

Systems Theory – Decision-Making Theory – Contribution of Herbert Simon – Ecological Approach – Comparative Public Administration – Critique of Modern Theories.

UNIT V CONTEMPORARY ADMINISTRATIVE PERSPECTIVES **9**
New Public Administration – New Public Management – Governance Approach – Public Choice Theory – Emerging Trends in Administrative Thought.
Total Periods: 45

Learning Resources

1	Administrative Thinkers– D. Ravindra Prasad, Sterling Publishers, Latest Edition, 2020.
2	New Horizons of Public Administration – Mohit Bhattacharya, Jawahar Publishers and Distributors, Latest Edition, 2022.
3	Public Administration: Concepts and Theories – Rumki Basu, Sterling Publishers, Latest Edition, 2021.
4	Administrative Behavior– Herbert A. Simon, Free Press, Latest Edition, 2013
5	The Theory of Public Administration – Nigro and Nigro, Harper & Row, Latest Edition 2017.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Outline the evolution of administrative thought and early theories.	Understand
CO2	Clarify the principles of classical administrative theories.	Understand
CO3	Examine human relations and behavioural approaches in administration.	Understand
CO4	Illustrate modern administrative theories and their applications.	Understand
CO5	Compare traditional and contemporary administrative perspectives.	Understand

U24MNPA05	**INDIAN ADMINISTRATIVE SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To describe the structure and characteristics of the Indian administrative system.
- To explain the organization of central and state administration.
- To identify the role of district and local administration in governance.
- To examine the functions of public institutions and regulatory bodies.
- To highlight administrative reforms and challenges in India.

Detailed Syllabus

UNIT I EVOLUTION AND FEATURES OF INDIAN ADMINISTRATION **9**
Historical evolution of Indian Administration – Colonial legacy – Post-independence developments – Salient features of Indian Administrative System – Continuity and change in administration.
UNIT II CENTRAL ADMINISTRATION **9**
President and Council of Ministers – Prime Minister and Cabinet Secretariat – Central Secretariat – Ministries and Departments – Role of Civil Services – Cabinet Secretariat.

UNIT III STATE AND DISTRICT ADMINISTRATION **9** State Administration – Governor and Chief Minister – State Secretariat – District Administration – Role of District Collector – Changing role in development administration.	
UNIT IV LOCAL ADMINISTRATION AND PUBLIC INSTITUTIONS **9** Panchayati Raj Institutions – Urban Local Bodies – Functions and Responsibilities – Role of Public Sector Institutions – Regulatory Authorities and Statutory Bodies.	
UNIT V ADMINISTRATIVE REFORMS AND CHALLENGES **9** Administrative Reforms in India – Administrative Reforms Commission – Good Governance Initiatives – E-Governance – Issues of Corruption, Transparency and Accountability – Contemporary Challenges in Indian Administration.	
	Total Periods: 45

Learning Resources

1	Indian Administration – S. R. Maheshwari, Orient Blackswan, Latest Edition, 2021.
2	Indian Administration – Arora and Goyal, New Age International, Latest Edition, 2020.
3	Public Administration in India – Padma Ramachandran, National Book Trust, Latest Edition, 2021.
4	Indian Polity– M. Laxmikanth, McGraw Hill Education India, Latest Edition, 2023.
5	Governance in India – M. Laxmikanth, McGraw Hill Education India, Latest Edition, 2022.

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Describe the evolution and features of the Indian administrative system.	Understand
CO2	Explain the structure and functioning of central administration.	Understand
CO3	Identify the organization of state and district administration.	Understand
CO4	Examine the role of local administration and public institutions.	Understand
CO5	Highlight administrative reforms and contemporary challenges in India	Understand

U24MNPA06	PUBLIC POLICY ADMINISTRATION	L	T	P	C
		3	0	0	3

Course Objective:

- To define the concept and significance of public policy in governance.
- To classify different types and approaches of public policy.
- To explain the stages involved in public policy formulation and implementation.
- To interpret the role of institutions and stakeholders in policy processes.
- To review policy evaluation and contemporary policy challenges.

Detailed Syllabus

UNIT I INTRODUCTION TO PUBLIC POLICY **9** Meaning and Nature of Public Policy – Scope and Importance – Types of Public Policy – Public Policy vs Decision Making – Role of Government in Policy Making.

UNIT II APPROACHES AND MODELS OF PUBLIC POLICY	**9**
Institutional Approach – Group Theory – Elite Theory – Rational Model – Incremental Model – Systems Approach – Policy Analysis Frameworks.	
UNIT III POLICY FORMULATION AND IMPLEMENTATION	**9**
Policy Formulation – Agenda Setting – Policy Design – Policy Implementation – Role of Bureaucracy and Political Executive – Factors influencing implementation.	
UNIT IV POLICY ACTORS AND INSTITUTIONS	**9**
Role of Legislature, Executive and Judiciary – Role of Civil Society and NGOs – Role of International Organizations – NITI Aayog – Policy Networks and Stakeholders.	
UNIT V POLICY EVALUATION AND CONTEMPORARY ISSUES	**9**
Policy Monitoring and Evaluation – Techniques of Policy Evaluation – Public Policy and Development – Issues in Policy Implementation – Emerging Policy Challenges in India.	
Total Periods: 45	

Learning Resources

1	Public Policy: Concepts, Theory and Practice – B. Guy Peters, Routledge, Latest Edition, 2021.
2	Public Policy – Thomas R. Dye, Pearson, Latest Edition, 2020.
3	Understanding Public Policy – Thomas R. Dye, Pearson, Latest Edition, 2021.
4	Public Policy and Administration in India – Rajesh K. Shukla, Sage Publications India, Latest Edition, 2022.
5	Public Policy in India– Kuldeep Mathur, Oxford University Press India, Latest Edition, 2020.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Define the concept and significance of public policy.	Understand
CO2	Classify various approaches and models of public policy.	Understand
CO3	Explain the stages of policy formulation and implementation.	Understand
CO4	Interpret the role of institutions and stakeholders in policy processes.	Understand
CO5	Review policy evaluation methods and contemporary policy issues.	Understand