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.E. Computer Science and Engineering
Full Time Programmes
Curriculum and Syllabus

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B.E. Computer Science and Engineering
Full Time Programme
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Chairperson
Board of Studies

Dr. J. SURESH, M.E., Ph.D.
Head of the Department
Department of CSE
CARE College of Engineering (Autonomous)
No. 27, Thayanur, Trichy-620 009.

Principal

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



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Department of Computer Science and Engineering

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

Emerge as a renewed department for globally competent Computer Science Engineers.

Department Mission

M1	To impart quality education, problem solving and Entrepreneurship skills in Computer Science and Engineering.
M2	To facilitate research based innovative projects in Computer Science and Engineering.
M3	To develop Moral, Ethical Values and Social Responsibility among the students.

CARE COLLEGE OF ENGINEERING, TIRUCHIRAPPALLI
(AN AUTONOMOUS INSTITUTION)
REGULATION 2024 CURRICULUM AND SYLLABUS
B.E. COMPUTER SCIENCE AND ENGINEERING

Program Educational Objectives (PEOs)

PEO1: Graduates will pursue higher education and research, or have a successful career in Industries or as Entrepreneurs.
PEO2: Graduates will have the ability and attitude to adapt to emerging technological changes.
PEO3: Graduates will exhibit leadership abilities, professional ethics, communication skills, Interpersonal skills and life-long learning.

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: Apply software engineering principles and practices for developing quality software for scientific and business applications to meet societal needs.
PSO2: Adapt to emerging information and communication tools and technologies (ICT) to innovate ideas and solutions to existing/novel problems.

CARE COLLEGE OF ENGINEERING, TIRUCHIRAPPALLI 620 009
(AN AUTONOMOUS INSTITUTION)
REGULATIONS 2024
CHOICE BASED CREDIT SYSTEM
B. E. COMPUTER SCIENCE AND ENGINEERING
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 Laboratory 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	U24M212	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	U24MA321	Probability and Queuing Theory	BSC	3	1	0	4	4	40	60
2	U24CS311	Operating System	PCC	3	0	0	3	3	40	60
3	U24CS321	Data Structures	PCC	3	0	0	3	3	40	60
4	U24CS331	Object Oriented Programming Using Java	PCC	3	0	0	3	3	40	60
5	U24CS341	Software Engineering	PCC	3	0	0	3	3	40	60
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	U24CS372	Operating System Laboratory	PCC	**0**	**0**	**4**	**4**	**2**	**60**	**40**
9	U24EM312	Design Thinking and Innovation	EEC	**0**	**0**	**2**	**2**	**1**	**100**	**NIL**
				15	**1**	**14**	**30**	**23**		

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	U24CS411	Computer Network Architecture and Protocols	PCC	3	0	0	3	3	40	60
2	U24CS421	Database Management Systems	PCC	3	0	0	3	3	40	60
3	U24CS431	Theory of Computation	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	NIL
THEORY CUM PRACTICAL COURSES										
6	U24CS453	Web Technologies	PCC	1	0	4	5	3	50	50
PRACTICAL COURSES										
7	U24CS462	Database Management Systems laboratory	PCC	0	0	4	4	2	60	40
8	U24CS472	Networks 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	**0**	**18**	**32**	**23**		

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	U24CS511	Mobile Computing	PCC	3	0	0	3	3	40	60
2	U24CS521	Compiler Design	PCC	3	0	0	3	3	40	60
3	U24EM511	Aptitude and Reasoning – II	EEC	2	0	0	2	2	100	NIL
4	U24MG511	Leadership and Team Management	HSMC	2	0	0	2	2	40	60
5		Professional Elective –I	PEC	-	-	-	-	3	-	-
6		Mandatory Course – I	MC	3	0	0	3	0	100	NIL
THEORY CUM PRACTICAL COURSES										
7	U24CS533	Embedded Systems and IoT System Design	PCC	1	0	4	5	3	50	50
8	U24CS543	Artificial Intelligence and Machine Learning	PCC	3	0	2	5	4	50	50
PRACTICAL COURSES										
9	U24CS552	Mobile Application Development Laboratory	PCC	0	0	4	4	2	60	40
10	U24EM522	Soft Skills and Personality Development – II	EEC	0	0	2	2	1	100	NIL
								23		

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	PCC	3	0	0	3	3	40	60
2	U24CS621	Cryptography and Network Security	PCC	3	0	0	3	3	40	60
3	U24MG611	Project Management	HSMC	2	0	0	2	2	40	60
4	U24MG621	Entrepreneurship	HSMC	2	0	0	2	2	40	60
5		Professional Elective - II	PEC	-	-	-	-	3		
6		Professional Elective - III	PEC	-	-	-	-	3		
7		Open Elective – I	OEC	-	-	-	-	3		
8		Mandatory Course – II	MC	3	0	0	3	0	100	NIL
PRACTICAL COURSES										
9	U24CS632	Cloud Computing Laboratory	PCC	0	0	4	4	2	60	40
10	U24CS642	Network Security Laboratory	PCC	0	0	4	4	2	60	40
								23		

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 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	-	-
4		Professional Elective _ V	PEC	-	-	-	-	3	-	-
5		Professional Elective – VI	PEC	-	-	-	-	3	-	-
6		Open Elective – II	OEC	-	-	-	-	3	-	-
PRACTICAL COURSES										
7	U24CS712	Mini Project	EEC	0	0	4	2	2	60	40
8	U24CS722	Summer Internship *	EEC	-	-	-	-	2	100	NIL
								21		

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

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
PRACTICAL COURSE										
1	U24CS812	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.Tech. - Artificial Intelligence and Data Science)

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: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSML01	Data Analytics	PEC	2	0	2	4	3	50	50
2	U24CSML02	Deep Learning Techniques	PEC	2	0	2	4	3	50	50
3	U24CSML03	Text and Speech Analysis	PEC	2	0	2	4	3	50	50
4	U24CSML04	Computer Vision	PEC	3	0	0	3	3	40	60
5	U24CSML05	Generative AI Fundamentals	PEC	3	0	0	3	3	40	60
6	U24CSML06	Game Theory	PEC	2	0	2	4	3	50	50
7	U24CSML07	Ethics and AI	PEC	3	0	0	3	3	50	50

VERTICAL 3: CYBER SECURITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSCS01	Information Security	PEC	3	0	0	3	3	40	60
2	U24CSCS02	Modern Cryptography	PEC	3	0	0	3	3	40	60
3	U24CSCS03	Ethical Hacking	PEC	3	0	0	3	3	40	60
4	U24CSCS04	Secure Software Systems	PEC	3	0	0	3	3	40	60
5	U24CSCS05	Security and Privacy in Cloud	PEC	3	0	0	3	3	40	60
6	U24CSCS06	Cyber Forensics	PEC	3	0	0	3	3	40	60
7	U24CSCS07	Cryptocurrency and Blockchain Technologies	PEC	3	0	0	3	3	40	60

VERTICAL 4: EMERGING TECHNOLOGIES
(Common to B.Tech. - Artificial Intelligence and Data Science)

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	2	0	2	4	3	50	50
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	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

MANDATORY COURSES
(Common to All UG Programs)

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

Name of the Programme : Computer Science and Engineering										
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						23
3	ESC	5	10							15
4	PCC			18	21	15	10			64
5	PEC					3	6	9		18
6	OEC						3	3		06
7	EEC		1	1	2	5	2	4	8	23
8	Non/ Credit					0	0			00
Total		**22**	**22**	**23**	**23**	**23**	**23**	**21**	**8**	**165**

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 SYLLABUS
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:60 Periods

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**	**3**	**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

UNIT I: 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:45 Periods

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.
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.
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 etc.	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			
CO2	2	2	1	2	1		2	3	3	2			
CO3	2	2	1	2	1		2	3	3	2			
CO4	2	2	1	3	1		2	3	3	2			
CO5	2	2	1	3	1		2	3	3	2			
Avg.	2	2	1	2.4	1		2	3	3	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 INDIAN 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:45 Periods

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	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	3				
CO2							2	2	3				
CO3							2	2	3				
CO4							2	2	3				
CO5							2	2	3				
Avg.							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 usedin 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:45 Periods

List of Experiments

S. 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: 30 Periods
	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) By AyshaViswamohan, 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 noncrystalline material.
Total:45 Periods

List of Experiments

S. No	List of Experiments (Any Seven Experiment)
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: 30 Periods
	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 fibre 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 calgon 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:45 Periods

List of Experiments

S.No	List of Experiments (Any Seven Experiment)
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: 30 Periods
	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	2		2		
CO2	3							1	2		2		
CO3	3							1	2		2		
CO4	3							1	2		2		
CO5	3							1	2		2		
Avg.	3							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: 60 Periods

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.
5	Reema Thareja, “Python Programming using problem solving approach”, 2019, Oxford University Press.
6	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021
7	Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.https://www.python.org/
8	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	2
CO2	2	2	1	2	1		2	1	2	2		2	2
CO3	2	2	1	2	1		2	1	2	2		2	2
CO4	2	2	1	3	1		2	1	2	2		2	2
CO5	2	2	1	3	1		2	1	3	2		2	2
Avg.	2	2	1	3	1		2	1	3	2		2	2

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	Programming in C	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										
4	U24HS223	Technical English for Engineers	HSMC	2	0	2	4	3	50	50
PRACTICAL COURSES										
7	U24EE232	Engineering Practices Laboratory 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:60 Periods

Learning Resources

1	Rosen. K.H., "Discrete Mathematics and its Applications", 7th Edition, 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, 30th Reprint, 2011
3	Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, 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:45 Periods

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.
8	G.W. Hanson, Fundamentals of Nanoelectronics, Pearson Education (Indian Edition) 2009.

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			1	1		2		
CO2	3	1			2			1	1		2		
CO3	3	1			2			1	1		2		
CO4	3	1			2			1	1		2		
CO5	3	1			2			1	1		2		
Avg.	3	1			2			1	1		2		

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:45 Periods

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	2	1	1	1	1	2	3	2
CO2	3	3	3	3	2	1	1	1	1	1	2	3	1
CO3	3	3	3	3	2	2	1	1	1	1	2	3	2
CO4	3	3	3	3	1	1	1	1	1	1	1	2	1
CO5	3	3	3	3	1	2	1	1	1	1	1	2	1
Avg.	3	3	3	3	1.8	1.6	1	1	1	1	1.6	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:45 Periods

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		2	2	1	3		
CO2	3	2	1	2	2			2	2	1	2		
CO3	3	3	1	2	3			2	2	1	2		
CO4	3	1		1	1			2	2	1	2		
CO5	3	2	1	2	2	1		2	2	1	3		
Avg.	3	2.2	1	1.8	2	1		2	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 KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V: SCIENTIFIC TAMIL & TAMIL COMPUTING **3**

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

Total:15 Periods

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)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand 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:30 Periods

List of Experiments

S. 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: 30 Periods
	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 LABORATORY 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: 60 Periods

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	3	2		3		
CO5	3	2	2				2	3	2		3		
Avg.	3	2.4	2.3				2	3	2		2.5		

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 and functions.
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: 60 Periods

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	3	3	1	2	2			1	2	1	3		
CO2	3	2	1	2	2			1	1	1	2		
CO3	3	3	1	2	3			1	1	1	2		
CO4	3	1		1	1			2	1	1	2		
CO5	3	2	1	2	2			1	2	1	3		
Avg.	3	2.2	1	1.8	2			1.2	1.4	1	2.4		

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 • 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	10
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: 60 Periods

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		

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	U24MA321	Probability and Queuing Theory	BSC	3	1	0	4	4	40	60
2	U24CS311	Operating Systems	PCC	3	0	0	3	3	40	60
3	U24CS321	Data Structures	PCC	3	0	0	3	3	40	60
4	U24CS331	Object Oriented Programming Using Java	PCC	3	0	0	3	3	40	60
5	U24CS341	Software Engineering	PCC	3	0	0	3	3	40	60
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	U24CS372	Operating System Laboratory	PCC	0	0	4	4	2	60	40
9	U24EM312	Design Thinking and Innovation	EEC	0	0	2	2	1	100	NIL
				15	**1**	**14**	**30**	**23**		

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	U24MA321	3	1	0	4	60	40	60	40	-	100		40	60	45	50
2	U24CS311	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	U24CS321	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	U24CS341	3	0	0	3	60	40	60	40	-	100		40	60	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	U24CS372	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
9	U24EM312	0	0	2	1	-	-	-	-	-	-	-	100	-	-	50

(W) – Weightage

U24MA321	PROBABILITY AND QUEUEING THEORY	L	T	P	C
		3	1	0	4

Course Objective:

- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions with applications to engineering which can describe the real-life phenomenon.
- To understand the concept of queueing models and their applications in engineering.
- To understand the significance of advanced queueing models.
- To provide the required mathematical support for real life problems and develop probabilistic models which can be used in several areas of science and engineering.

Detailed Syllabus

UNIT I: PROBABILITY AND RANDOM VARIABLES 9+3 Probability – 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 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: RANDOM PROCESSES 9+3 Classification – Stationary process: SSS process and WSS process– Markov process – Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.
UNIT IV: QUEUEING MODELS 9+3 Markovian queues – Birth and Death processes –Kendal's Notation -– Little’s formula-Single and multiple server queueing models (M/M/1):(Infinite /FIFO),(M/M/s):(Infinite /FIFO),(M/M/1):(k /FIFO),(M/M/s):(k /FIFO)
UNIT V: ADVANCED QUEUEING MODELS 9+3 Finite source models – M/G/1 queue – Pollaczek Khinchin formula – M/D/1– Series queues – Open and Closed Jackson networks.
Total:60 Periods

Learning Resources

1	Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., “Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.
2	Ibe, O.C., “Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Edition, 2014.
3	M.B.K .Moorthy, K. Subramania, A. Santha, "Probability and Queueing Theory", Scitech Publications,2015.
4	T. Veerarajan, "Probability, Statistics and Random Process",3rd edition, Tata McGraw Hill Publishing Company limited, 2008.
5	Taha, H.A., "Operations Research", 11th Edition, Pearson India Education Services, Delhi, 2023.
6	Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2016.
7	Scott L. Miller, Donald. G. Childers, "Probability and Random Process”, An imprint of Elsevier,2011.

8	J. Medhi, Stochastic Models in Queueing Theory, 2nd Edition, Academic Press, 2003 (Elsevier India Edition, 2006).

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply a fundamental knowledge of the Probability Concepts.	Apply
CO2	Apply the concepts based on two Dimensional Random variables.	Apply
CO3	Apply random Process technique to find simple solutions to the Mathematical Problems.	Apply
CO4	Apply the concepts and acquire skills in queuing Models.	Apply
CO5	Apply real Life Time phenomenon which evolve with respect to time in a probabilistic manner.	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)

U24CS311	OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the fundamental principles and functions of operating systems.
- To explore process management for efficient computing.
- To analyze advanced memory management and its role in performance optimization.
- To understand storage management, file systems and their implementation.
- To gain insights into virtualization, and mobile operating systems.

Detailed Syllabus

UNIT I: INTRODUCTION AND PROCESS **8**

Operating Systems Overview and Evolution - Objectives and Functions - Structures – Operating Systems Services - User Operating System Interface - System Calls – System Services - Design and Implementation - Process Concept - Process Scheduling - Operations on Processes - Inter- process Communication.

UNIT II: PROCESS MANAGEMENT **10**

Threads - Multithread Models – Threading Issues; CPU Scheduling - Scheduling algorithms - Process Synchronization - The Critical-Section problem – Peterson's Solution – Mutex Locks – Semaphores – Monitors – Liveness – Classical problems of synchronization; Deadlock - Methods, prevention, avoidance, detection, Recovery.

UNIT III: MEMORY MANAGEMENT	**10**
Contiguous Memory Allocation – Paging - Structure of the Page Table – Swapping; Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – Copy on Write - Page Replacement - Allocation of Frames.	
UNIT IV: STORAGE MANAGEMENT	**10**
Disk Scheduling, - Disk Management – RAID Structure; I/O Systems – I/O Hardware - Kernel I/O subsystem; File-System Interface - File concept - Access methods - Directory Structure - Directory Organization and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management - Recovery.	
UNIT V: VIRTUAL MACHINES AND MOBILE OS	**7**
Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.	
	Total:45 Periods

Learning Resources:

1	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “Operating System Concepts”, 10th Edition, John Wiley and Sons Inc., 2018.
2	William Stallings, "Operating Systems: Internals and Design Principles", 9 th Edition, Prentice Hall, 2019.
3	Andrew S. Tanenbaum, Herbert Bos, “Modern Operating Systems”, Pearson, 5th Edition, 2022.
4	Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, "Operating Systems: Three Easy Pieces", 2020.
5	Daniel Bovet and Marco Cesati, “Understanding the Linux Kernel”, 3rd Edition, O'Reilly Media, 2020.
6	Richard Blum and Christine Bresnahan, “Linux Command Line and Shell Scripting Bible”, 4th Edition, Wiley, 2021.
7	https://archive.nptel.ac.in/Courses/106/105/106105214/
8	https://onlinecourses.nptel.ac.in/noc21_cs72
9	https://onlinecourses.nptel.ac.in/noc21_cs88

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Describe the basic components of operating system.	Understand
CO2	Apply scheduling and synchronization algorithms to manage processes efficiently.	Apply
CO3	Analyze different memory management techniques and their impact on system performance.	Analyze
CO4	Apply the file system and I/O management techniques to optimize storage performance.	Apply
CO5	Compare the features and architectures of virtualization and mobile operating systems.	Understand

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	3				2	2	2	3	3	3
CO2	3	3	3	3				2	2	2	3	3	3
CO3	3	3	2	3				2	2	2	3	3	3
CO4	3	3	3	3				2	2	2	3	3	3
CO5	3	2	2	3				2	2	2	3	3	3
Avg.	3	2.6	2.4	3				2	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. Tech. AI & DS)	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 Graphs - 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:45 Periods

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)

U24CS331	**OBJECT ORIENTED PROGRAMMING USING JAVA (Common to B.Tech. AI & DS)**	**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 – Try and Catch - 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 – ListView – ComboBox – ChoiceBox – Text Controls –ScrollPane. Layouts – FlowPane – HBox and VBox – Border Pane – StackPane – GridPane.Menu-Menu bars-MenuItem.	
	Total:45 Periods

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)

U24CS341	SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the software life cycle models.
- To understand the importance of the software development process.
- To understand the significance of UML models.
- To apply designing and testing principles in software development process.
- To develop correct and robust software products

Detailed Syllabus

UNIT I: INTRODUCTION **9**

Introduction to Software Engineering – Software Process – Perspective Process Model – Specialized Process Model – Specialized Process Model – Unified Process Model – Agile process – Extreme programming- XP Process

UNIT II: REQUIREMENTS ANALYSIS AND MODELLING **9**

Requirements Engineering – Functional and Non-Functional Requirements – Eliciting Requirements – Developing Use case – Requirement Model - Negotiation Requirements – Validation Requirements – Requirement Analysis – Modelling: Domain Analysis and Modelling – Scenario Based Modelling – UML Model – Data Modelling – Class Based Modelling.

UNIT III: SOFTWARE DESIGN **9**

Design process – Design Concepts-Design Model– Architectural Design – Architectural styles, Architectural Design, Architectural Mapping using Data Flow– User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV: SOFTWARE TESTING STRATEGIES **9**

Introduction to Software Testing – Software Testing Life Cycle (STLC) – Strategic Approach to Software Testing – Strategic Issues – Test Strategies for Conventional Software – Unit Testing – Integration Testing – System Testing – The Art of Debugging – Conventional Applications: Basis Path Testing – Control Structure Testing – Black Box Testing – White Box Testing – Model Based Testing – Testing Object Oriented Applications- CASE TOOLS.

UNIT V: SOFTWARE PROJECT MANAGEMENT **9**

Software Project Management: Estimation – LOC, FP Based Estimation, Six sigma and CMM levels, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection – Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

Total:45 Periods

Learning Resources:

1	R.S. Pressman, "Software Engineering – A Practitioner's Approach", Nineth Edition, McGraw Hill, International Edition, 2024.
2	Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3	Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Third Edition, Pearson Education, 2009.
4	Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
5	https://nptel.ac.in/courses/106/105/106105182/
6	https://www.udemy.com/topic/software-testing/

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Compare various Software Development Lifecycle Models	Apply
CO2	Develop the UML model for software projects.	Apply
CO3	Develop suitable models for designing application software.	Apply
CO4	Apply software testing procedures in software development process.	Apply
CO5	Construct the software project management and software maintenance practices.	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	3	2	3	3	3
CO2	3	3	2	2	2			3	3	2	3	3	3
CO3	3	3	2	2	2			3	3	2	3	3	3
CO4	3	3	2	2	2			3	3	2	3	3	3
CO5	3	3	2	2	2			3	3	2	3	3	3
Avg.	**3**	**3**	**2**	**2**	**2**			**3**	**3**	**2**	**3**	**3**	**3**

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

U24CS352	DATA STRUCTURES LABORATORY	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: 60 Periods

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.	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	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

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

U24CS362	**OBJECT ORIENTED PROGRAMMING LABORATORY**	**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 orr.

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 real-world 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 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.
10	Develop a JavaFX-based desktop application that utilizes various controls, layouts, and menus to create an interactive user interface. Implement features such as a to-do list manager, a student record system, or a simple inventory management system, ensuring a user-friendly experience with responsive design.
11	Write a java program that connects to a database using JDBC. Develop a Java-based application that connects to a database using JDBC. Implement functionality to insert user data, such as a registration form for a library management system, employee records for an HR system, or product details for an inventory management system Develop a Java-based application that connects to a database using JDBC. Implement functionality to manage and delete records, such as removing outdated user information from a customer database or deleting inactive product listings from an inventory system.
	Total: 60 Periods

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

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

U24CS372	OPERATING SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To understand and practice basic UNIX commands and shell programming.
- To implement and analyze CPU scheduling algorithms.
- To simulate memory management techniques.
- To develop programs for file organization and allocation strategies.
- To install, configure, and manage operating systems using virtualization

List of Experiments

Sl. No	List of Experiments
1	Install a Windows operating system on a new computer, ensuring proper partitioning, driver installation, and system configuration
2	Illustrate basic UNIX commands to manage files, handle processes, and navigate directories effectively. Provide real-world scenarios where these commands are useful.
3	You are working as a system administrator, and your organization requires frequent backups of important files. Write a shell script that automates the process of copying specific files from one directory to another at regular intervals. Additionally, modify the script to perform simple arithmetic operations, such as calculating the total size of the copied files. Test and demonstrate your script with sample files.
4	Develop a program that creates a child process using the fork() system call. The parent process should wait for the child process to complete before exiting. Display the Process ID (PID) of both parent and child processes using getpid(). Additionally, implement proper resource management by closing any unnecessary file descriptors using the close() system call.

5	Design and implement a scheduling that allows users to input process details (arrival time, burst time, priority, etc.) and visualize the execution of different CPU scheduling algorithms (FCFS, SJF, Round Robin, and Priority Scheduling). Analyze the turnaround time and waiting time for each algorithm and compare their efficiency
6	A company wants to develop a multi-process application where one process generates real-time sensor data, and another process analyzes it. Implement a solution using inter-process communication (IPC) with pipes or shared memory to enable seamless data transfer between these processes. Demonstrate how the sender and receiver processes interact and ensure efficient data handling.
7	Develop a multi-threaded program where multiple processes attempt to write to a shared resource (e.g., a log file or a critical section of memory). Use semaphores to ensure mutual exclusion, preventing race conditions and ensuring only one process accesses the resource at a time. Test the implementation with multiple concurrent processes and analyze its effectiveness.
8	A bank manages loan requests from multiple customers. To prevent resource deadlock, the bank follows a safe resource allocation strategy. Develop a program that takes customer loan requests, checks for safe resource allocation using the Banker's Algorithm, and determines whether the request should be granted or denied. Test your program with different scenarios to validate its effectiveness in avoiding deadlocks.
9	A multi-user banking system processes multiple transactions simultaneously. To prevent deadlocks, the system needs an efficient resource allocation strategy. Develop a simulation where multiple processes request resources dynamically. Implement a deadlock prevention technique such as resource ordering, preemption, or circular wait avoidance. Demonstrate how your algorithm ensures that deadlocks do not occur while maintaining system efficiency.
10	A university’s computer lab is experiencing memory fragmentation issues due to inefficient memory allocation. As a system developer, design and implement a paging technique that efficiently manages memory allocation and translation between logical and physical addresses. Your solution should include a page table for address mapping and handle page faults effectively. Simulate a scenario where multiple processes request memory, and demonstrate how paging resolves fragmentation issues.
11	Design and implement a memory management system that simulates dynamic memory allocation using First Fit, Best Fit, and Worst Fit strategies. Given a set of memory block sizes and incoming process sizes, develop a program that efficiently allocates memory and evaluates the performance of each strategy in terms of fragmentation and allocation success rate.
12	Design and develop a memory management system that simulates page replacement in an operating system. Implement FIFO, LRU, and Optimal page replacement algorithms to manage page faults efficiently. Compare the performance of these algorithms by running different reference string inputs and analyze which algorithm minimizes page faults the most in various scenarios.
13	A company maintains employee records in a file system. Each employee's details (ID, Name, Department, and Salary) need to be stored efficiently. Implement a program that organizes these records using Sequential, Indexed, and Linked file organization methods. Compare their efficiency in terms of search time and storage utilization.
14	Design and develop a program that simulates file storage in an operating system by implementing Sequential, Indexed, and Linked file allocation strategies. Given a set of files with varying sizes, your program should allocate disk blocks efficiently, handle file access requests, and display the allocation structure for each method.



15	Design and develop a disk scheduling application that allows users to input a sequence of disk requests and visualize the execution of FCFS, SSTF, and LOOK scheduling algorithms. Compare their performance based on seek time and total head movement.
16	Install a Linux guest operating system using VMware or VirtualBox.
	Total: 60 Periods

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Apply the basic UNIX commands and shell scripting for process and file management.	Apply
CO2	Analyze the various CPU scheduling algorithms.	Apply
CO3	Compare memory allocation and page replacement techniques.	Analyze
CO4	Apply file organization and allocation strategies for storage systems.	Apply
CO5	Apply the disk scheduling algorithms for optimal performance.	Apply

Course Articulation Matrix

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

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

U24EM312	DESIGN THINKING AND INNOVATION	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: 30 Periods

Learning Resources:

1	Pavan Soni, Design your thinking, Penguin Random House India Pvt, Ltd., India, 2022
2	Don Norman, The Desing 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:/ /npt el.ac.in/ courses/107 101086
6	Design Thinking and Innovation NPTEL Cours Ravi Poovaiah, IIT Bombay https:/ /onlinecourses.swa yam2.ac.in/ aic23_g e17/preview
7	Design Thinking A Premier NPTEL Course, Prof. Ashwin Mahalingam, Prof. Bala Ramadurai, IIT Madras https:/ /onlinecourses.npt el.a c.in/ noc22 mg32/ 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

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	U24CS411	Computer Network Architecture and Protocols	PCC	3	0	0	3	3	40	60
2	U24CS421	Database Management Systems	PCC	3	0	0	3	3	40	60
3	U24CS431	Theory of Computation	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	NIL
THEORY CUM PRACTICAL COURSES										
6	U24CS453	Web Technologies	PCC	1	0	4	5	3	50	50
PRACTICAL COURSES										
7	U24CS462	Database Management Systems laboratory	PCC	0	0	4	4	2	60	40
8	U24CS472	Networks 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	**0**	**18**	**32**	**23**		

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	U24CS411	3	0	0	3	60	40	60	40	-	100		40	60	45	50
2	U24CS421	3	0	0	3	60	40	60	40	-	100		40	60	45	50
3	U24CS431	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	U24CS462	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
8	U24CS472	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

U24CS411	COMPUTER NETWORK ARCHITECTURE AND PROTOCOLS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the protocol layering and physical level communication.
- To Apply data-link layer functions and protocols to configure and troubleshoot wired and wireless communication systems.
- To explore the functions of the network layer and the various routing protocols.
- To Implement and manage transport protocols to ensure reliable end-to-end communication services.
- To familiarize the application protocols for internet and network services.

Detailed Syllabus

UNIT I: INTRODUCTION AND PHYSICAL LAYER Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.	**9**
UNIT II: DATA-LINK LAYER Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.	**9**
UNIT III: NETWORK LAYER Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP, RARP, ICMP, DHCP Distance Vector Routing-Link State Routing	**9**
UNIT IV: TRANSPORT LAYER Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.	**9**
UNIT V: APPLICATION LAYER WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP	**9**
	Total:45 Periods

Learning Resources

1	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
2	William Stallings, Data and Computer Communications, 11th Edition, Pearson, 2022.
3	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022.
4	Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks" 6th Edition, Pearson, 2021.
5	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Sixth Edition, March 2021.
6	W. Richard Stevens, "TCP/IP Illustrated, Volume 1: The Protocols", Addison-Wesley,2021.
7	https://nptel.ac.in/courses/106/105/106105183
8	https://www.coursera.org/learn/computer-networking
9	https://www.edx.org/course/computer-networking-essentials
10	https://www.youtube.com/playlist?list=PLBlnK6fEyqRjD1KYvT6pgTZq-W4zYxT3i
11	https://www.geeksforgeeks.org/computer-network-tutorials/



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 computer networks, protocol architectures, and physical layer technologies.	Understand
CO2	Apply data-link layer protocols and MAC techniques in both wired and wireless network environments.	Apply
CO3	Analyze IP addressing and network-layer protocols to evaluate efficient routing and communication strategies.	Analyze
CO4	Apply transport layer protocols to establish reliable and controlled end-to-end communication.	Apply
CO5	Apply application-layer protocols to support services such as web access, file transfer, email, and network monitoring.	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)

U24CS421	**DATABASE MANAGEMENT SYSTEMS (Common to B. Tech AI&DS)**	**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:45 Periods

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)

U24CS431	THEORY OF COMPUTATION	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the foundations of computation including automata theory
- To construct regular expressions for regular languages.
- To apply CFG for designing Push down automata
- To model the Turing machine and its variants.
- To analyze the undecidability of languages

Detailed Syllabus

UNIT I: FINITE AUTOMATA **9**

Automata theory- Need of automata theory - Introduction to formal proof – Additional forms of proof –Inductive Proofs- Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – NFA with Epsilon transitions – Equivalence of NFA ,DFA and Epsilon NFA – Minimization of DFA

UNIT II: REGULAR EXPRESSION AND REGULAR LANGUAGE **9**

Regular Expression - Operators of regular expression –Building regular expression - Algebraic laws for Regular expressions - Regular expression to FA - DFA to Regular expression – Regular Language –Closure properties of regular language – Pumping Lemma for regular Languages

UNIT III: CONTEXT FREE GRAMMAR AND PUSH DOWN AUTOMATA **9**

Types of Grammar - Chomsky‘s hierarchy of languages -Context-Free Grammar– Derivations and Parse trees – Ambiguity in grammar–Context Free Language - Push Down Automata (PDA): Deterministic Pushdown Automata-Definition – Languages of pushdown automata- Moves - Instantaneous descriptions - CFG to PDA-PDA to CFG

UNIT IV: NORMAL FORMS AND TURING MACHINES **9**

Normal forms for CFGs: Chomsky Normal Form- Greibach Normal Form – Closure properties of CFLs - Pumping lemma for CFLs-Turing Machine : Basic model - Definition and representation - Instantaneous Description - Language acceptance by TM - TM as Computer of Integer functions –Programming Techniques for Turing Machine

UNIT V: UNDECIDABILITY **9**

Unsolvable Problems and Computable Functions –PCP-MPCP- Recursive and recursively enumerable languages – Properties - Universal Turing machine -Tractable and Intractable problems- P and NP completeness – Kruskal’s algorithm – Travelling Salesman Problem

Total:45 Periods

Learning Resources:

1	Hopcroft J.E., Motwani R. & Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2008-Reprint
2	Harry R Lewis and Christos H Papadimitriou , "Elements of the Theory of Computation", 2nd Edition, Prentice Hall of India, 2015.
3	Peter Linz, "An Introduction to Formal Language and Automata", 7th Edition, Jones & Bartlett, 2023.
4	K.L.P. Mishra and N. Chandrasekaran, “Theory of Computer Science: Automata Languages and Computation”, 3rd Edition, Prentice Hall of India, 2010.-Reprint
5	https://nptel.ac.in/courses/106104148
6	https://www.geeksforgeeks.org/theory-of-computation-automata-tutorials/
7	https://www.edx.org/course/automata-theory
8	https://www.udemy.com/course/theory-of-computation-toc/
9	https://www.coursera.org/courses?query=theory%20of%20computation

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 automata theory, including formal proofs and finite automata.	Understand
CO2	Apply regular expressions for modeling finite automata	Apply
CO3	Apply context free grammar for modeling Pushdown Automata	Apply
CO4	Design Turing machine for computational functions	Apply
CO5	Discuss about the undecidability of languages	Understand

Course Articulation Matrix

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

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

U24CS441	**DESIGN AND ANALYSIS OF ALGORITHM (Common to B. Tech AI&DS)**	**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:45 Periods

Learning Resources:

1	Anany Levitin, ''Introduction to the Design and Analysis of Algorithms ", 3rd Edition, Pearson Education
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 • Profit, loss and discounts • Ratio and proportion: Ratio – compound ratio, inverse ratio. Proportion – direct proportion, inverse proportion • Mixture and alligation: Mixture, alligation, mean concentration • Problems based on ages	20

• 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:30 Periods

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. Tech AI&DS)	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

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 :15 Periods

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. i) 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: 60 Periods
	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**

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

U24CS462	DATABASE MANAGEMENT SYSTEMS LABORATORY (Common to B. Tech AI&DS)	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, nested queries, 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 enrollment 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
	Total: 60 Periods

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**

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

U24CS472	NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To Evaluate the behaviour of various communication protocols across different network scenarios.
- To Compare routing algorithms based on performance metrics and design principles.
- To Interpret network simulation results to assess topology design and protocol performance.

List of Experiments

Sl. No	List of Experiments
1	Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2	Examine how a basic HTTP web client uses TCP sockets to connect to a server, send a GET request, and receive a web page. Understand the role of TCP in reliable data transfer, the structure of HTTP messages, and how socket programming enables low-level web communication.
3	Analyze the use of TCP sockets in implementing network applications such as an a)Echo Client-Server b)Chat system. Understand how TCP ensures reliable, bidirectional communication, and examine how socket programming enables message transmission, reception, and real-time interaction between networked systems.

4	Explore the simulation of a Domain Name System (DNS) using UDP sockets, focusing on how hostname-to-IP resolution is performed. Understand the role of UDP in connectionless communication and evaluate how socket programming is used to replicate DNS query-response behavior.
5	Classify network traffic by capturing packets using a tool like Wireshark. Understand the structure of various protocol headers (such as TCP, UDP, IP, and HTTP) and evaluate how data is transmitted across networks by interpreting packet-level information.
6	Compare the simulation of ARP and RARP protocols to understand how IP addresses are mapped to MAC addresses and vice versa. Evaluate the role of these protocols in network layer communication and examine how socket programming or data structures can be used to mimic address resolution behavior.
7	Analyze and study the network behavior under different congestion scenarios using Network Simulator tools.
8	Compare and study the performance characteristics of TCP and UDP protocols under various network conditions through simulation.
9	Distinguish the simulation of Distance Vector and Link State routing algorithms to understand how routing tables are built and updated in a network. Evaluate the efficiency, convergence behavior, and information exchange mechanisms used in dynamic routing protocols.
10	Analyze the simulation of an error detection and correction mechanism such as Cyclic Redundancy Check (CRC). Understand how redundancy bits are used to detect transmission errors and evaluate the effectiveness of CRC in ensuring data integrity during communication.
	Total: 60 Periods

Learning Resources:

1	Computer Networks, Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education /PHI 2021
2	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Apply the basic network diagnostic tools and protocol analysers to examine network behavior.	Apply
CO2	Develop socket-based network applications using TCP and UDP protocols for client-server communication.	Analyze
CO3	Simulate core networking protocols and services like DNS, ARP/RARP using programming construct	Analyze
CO4	Analyze routing and congestion control mechanisms through simulation tools like NS2	Analyze
CO5	Evaluate error detection and correction techniques and protocol performance through experiments and simulation.	Analyze

Course Articulation Matrix

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

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

U24CS482	DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY (Common to B.Tech. AI & DS)	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:

	(i) 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: (i) 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: (i) 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.) (ii) 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: (i) 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: 60 Periods

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 backtracking **and** 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		
CO2	3	3	3	3	2	2	2	2	3	2	3		
CO3	3	3	3	3	2	2	2	2	3	2	3		
CO4	3	3	3	3	2	3	2	2	3	2	3		
CO5	3	3	3	3	2	3	2	2	3	2	3		
Avg.	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**3**		

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: 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.

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.	Analyse
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	U24CS511	Mobile Computing	PCC	3	0	0	3	3	40	60
2	U24CS521	Compiler Design	PCC	3	0	0	3	3	40	60
3	U24EM511	Aptitude and Reasoning – II	EEC	2	0	0	2	2	100	NIL
4	U24MG511	Leadership and Team Management	HSMC	2	0	0	2	2	40	60
5		Professional Elective –I	PEC	-	-	-	-	3	-	-
6		Mandatory Course – I*	MC	3	0	0	3	0	100	NIL
THEORY CUM PRACTICAL COURSES										
7	U24CS533	Embedded Systems and IoT System Design	PCC	1	0	4	5	3	50	50
8	U24CS543	Artificial Intelligence and Machine Learning	PCC	3	0	2	5	4	50	50
PRACTICAL COURSES										
9	U24CS552	Mobile Application Development Laboratory	PCC	0	0	4	4	2	60	40
10	U24EM522	Soft Skills and Personality Development - II	EEC	0	0	2	2	1	100	NIL
								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	U24CS511	3	0	0	3	60	40	60	40	-	100	-	40	60	45	50
2	U24CS521	3	0	0	3	60	40	60	40	-	100	-	40	60	45	50
3	U24EM511	2	0	0	2	-	-	-	-	-	-	-	100	-	-	50
4	U24MG511	2	0	0	2	60	40	60	40	-	100	-	40	60	45	50
5	PEC – I	-	-	-	3	-	-	-	-	-	-	-	-	-	45	50
6	MC – I	3	0	0	0	-	-	-	-	-	-	-	100	-	-	50
7	U24CS533	1	0	4	3	-	-	60	40	100	-	100	50	50	45	50
8	U24CS543	3	0	2	4	60	40	60	40	100	70	30	50	50	45	50
9	U24CS552	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
10	U24EM522	0	0	2	1	-	-	-	-	-	-	-	100	-	-	50

(W) – Weightage

U24CS511	MOBILE COMPUTING	L	T	P	C
		3	0	0	3

Course Objective:

- To Understand the basics of mobile computing and evolution of wireless technologies.
- To Learn the architecture and services of LTE and 5G mobile communication systems.
- To Understand mobile network protocols and routing in ad hoc and IoT networks.
- To Learn transport and application layer concepts, including cloud and mobile application security.
- To Develop basic knowledge of mobile platforms, app development, and modern tools like Kotlin and Flutter.

Detailed Syllabus

UNIT I: INTRODUCTION TO MOBILE COMPUTING	**9**
Introduction to Mobile Computing – Applications of Mobile Computing – Evolution of Mobile Communication Technologies (1G to 6G) – Multiple Access Techniques: SDMA, TDMA, FDMA, CDMA, OFDMA – Spread Spectrum – MAC Protocols – 5G NR Overview and Emerging 6G Trends – Spectrum Bands (Sub-6 GHz, mmWave).	
UNIT II: MOBILE TELECOMMUNICATION SYSTEMS	**9**
Introduction to Cellular Systems – LTE Architecture – 5G System Architecture – Services: eMBB, URLLC, mMTC – Protocol Stack – Handover and Roaming in Cellular Networks – Frequency Allocation – Routing – Mobility Management – Security in LTE and 5G – Network Slicing – Edge Computing.	
UNIT III: MOBILE NETWORK LAYER	**9**
Mobile IP – DHCP – Ad Hoc Networks – MANET, VANET, FANET – Proactive Routing Protocols: DSDV, OLSR – Reactive Routing Protocols: DSR, AODV – Hybrid Routing: ZRP – Multicast Routing: ODMRP – IoT Networking: NB-IoT, LoRaWAN – Security Issues	
UNIT IV: MOBILE TRANSPORT AND APPLICATION LAYER	**9**
Mobile TCP – QUIC – HTTP/2 and HTTP/3 – REST APIs – Cloud-based Mobile Applications – Content Delivery Networks – Edge Computing – Mobile Streaming – Application Layer Security: OAuth, JWT, HTTPS.	
UNIT V: MOBILE PLATFORMS AND APPLICATIONS	**9**
Mobile Device Operating Systems – Android and iOS Architecture – Mobile App Development Models: Native, Hybrid, Progressive Web Apps – Mobile Development Platforms: Kotlin for Android Development, Flutter for Cross – Platform Development – UI/UX Principles – M-Commerce – Digital Payment Systems: UPI, NFC – Mobile App Security – AI in Mobile Applications.	
	Total:45 Periods

Learning Resources

1	Jochen Schiller, —Mobile communications, 2nd Edition, Pearson Education, 2013
2	William Stallings, —Wireless Communications and Networks, 2nd Edition, Pearson.2020
3	Rappaport, Wireless Communications – Principles and Practice, Pearson.2011
4	Misra & Woungang, Guide to Wireless Ad Hoc Networks, Springer.2009

5	3GPP (3rd Generation Partnership Project) – Official standards for LTE and 5G. https://www.3gpp.org
6	Cisco Networking Academy – Wireless & Mobile Networks. https://www.netacad.com
7	Mobile Computing / Wireless Communication Courses, Prof. Ranjan Bose, IIT- Delhi , NPTEL. https://nptel.ac.in/courses/117102062.

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 mobile computing, wireless technologies (1G–6G), and multiple access techniques.	Understand
CO2	Apply LTE and 5G architectures, services, and mobility management techniques.	Apply
CO3	Apply mobile network layer protocols and routing techniques in ad hoc and IoT networks.	Apply
CO4	Analyze transport and application layer protocols, cloud integration, and mobile security mechanisms.	Analyze
CO5	Apply mobile applications using modern platforms and frameworks like Android, Kotlin, and Flutter.	Apply

Course Articulation Matrix

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

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

U24CS521	**COMPILER DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To learn the various phases of compiler.
- To impart knowledge on various parsing techniques.
- To understand intermediate code generation and run-time environment
- To make the students effectively generate machine code.
- To learn to implement code optimization.

Detailed Syllabus

UNIT I: INTRODUCTION TO COMPILERS & LEXICAL ANALYSIS **8**

Introduction – Translators – Compilation and Interpretation – Language processors – The Phases of Compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Language for Specifying Lexical Analyzers – Lex tool.

UNIT II: SYNTAX ANALYSIS	**11**
Role of Parser – Grammars – Context-free grammars – Writing a grammar – Top-Down Parsing – General Strategies – Recursive Descent Parser – LL(1) – Predictive Parser – Bottom up parsing – Shift Reduce Parser – LR Parsers – SLR Parser – Canonical LR Parser – LALR Parser - Error Handling and Recovery in Syntax Analyzer – YACC tool	
UNIT III: SYNTAX DIRECTED TRANSLATION & INTERMEDIATE CODE GENERATION	**9**
Syntax directed Definitions- Evaluation order for syntax directed definitions-Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Back patching	
UNIT IV: RUN-TIME ENVIRONMENT AND CODE GENERATION	**9**
Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack and Heap allocation – Issues in the Design of a code generator – Basic Blocks and Flow graphs – Design of a simple Code Generator – Optimal Code Generation for Expressions.	
UNIT V: CODE OPTIMIZATION	**8**
Principal Sources of Optimization – Peep-hole optimization – DAG – Optimization of Basic Blocks – Global Data Flow Analysis – Efficient Data Flow Algorithm – Recent trends in Compiler Design.	
	Total:45 Periods

Learning Resources:

1	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers: Principles, Techniques and Tools”, Updated 2e, Pearson Education, 2023.
2	Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, Reprint 2004
3	Steven S. Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2007.
4	Keith D Cooper and Linda Torczon, Engineering a Compiler‖, Morgan Kaufmann Publishers Elsevier Science, 3rd edition 2022.
5	V. Raghavan, Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, Reprint 2017
6	Allen I. Holub, Compiler Design in C‖, Prentice-Hall Software Series, Reprint 1993
7	“Compiler Design”, Prof. Sanjeev K Aggarwal, IIT Kanpur, NPTEL “https://nptel.ac.in/courses/106104072”
8	https://www.geeksforgeeks.org/compiler-design-tutorials/
9	https://www.coursera.org/courses?query=compilers

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the different phases of compiler and design a lexical analyzer for a simple language	Understand

CO2	Apply different parsing algorithms to develop the parsers using given grammar.	Apply
CO3	Illustrate syntax-directed translation and generate simple intermediate code	Apply
CO4	Apply the storage allocation strategies for generating simple code.	Apply
CO5	Apply the code optimization techniques.	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	-
CO2	3	3	2	2	3	-	-	-	-	-	2	2	-
CO3	3	3	2	2	2	-	-	-	-	-	2	2	-
CO4	3	3	2	2	2	-	-	-	-	-	2	2	-
CO5	3	3	2	2	2	-	-	-	-	-	2	2	-
Avg	3	3	2	2	3	-	-	-	-	-	2	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	20

• Heights and distance • Logarithms • Surds and indices • Mensuration – 2D, 3D • Date interpretation – pie chart, bar chart, table chart. Data sufficiency in logical reasoning	
Reasoning: • Symbols and notations • Mathematical operators and Venn diagrams • Puzzles • Cubes and Dice • Clocks and Calendars • Critical Reasoning • Non-verbal reasoning • Verbal Ability	10
	Total: 30 Periods

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

- 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.
Total :30 Periods

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	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: 15 Periods

List of Experiments

S. 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. 1. Smart Home Automation using IoT 2. IoT-based Smart Agriculture System 3. IoT-based Environmental Monitoring System 4. IoT-based Smart Parking System 5. IoT-based Industrial Application System 6. IoT-based EV Charging & Fleet Monitoring System
	Total: 60 Periods
	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. Sudip Misra, 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.	Analyzing
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.	Evaluating
CO4	Develop cloud-enabled IoT systems for real-time data monitoring and visualization.	Creating
CO5	Design IoT-based solutions for domains such as smart homes, agriculture, industries, and environment monitoring.	Creating

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)

U24CS543	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	2	4

Course Objective:

- To introduce the fundamental concepts of Artificial Intelligence, intelligent agents, and problem-solving techniques.
- To provide knowledge of search strategies, reasoning methods, and decision-making approaches used in AI systems.
- To develop understanding of supervised machine learning models for regression and classification tasks.
- To equip with knowledge of unsupervised learning techniques and ensemble methods for data analysis and model improvement.
- To introduce the basic concepts of reinforcement learning for solving sequential decision-making problems.

Detailed Syllabus

UNIT I: FOUNDATIONS OF ARTIFICIAL INTELLIGENCE **9**

Introduction to Artificial Intelligence — AI definition, history, types and applications; Intelligent agents — types of agents, agent architecture, environment types; Problem-solving — problem formulation, state space, goals, operator; Uninformed (Blind) search strategies — BFS, DFS, Depth-Limited Search, Iterative Deepening; Informed search strategies — Best-First Search, Greedy Search, A* Search.

UNIT II: AI REASONING AND DECISION MAKING **9**

Heuristic search —Hill climbing, Simulated Annealing, and Local Search. Adversarial search — Minimax, Alpha-Beta pruning. Constraint Satisfaction Problems — CSP formulation, backtracking. Basic probabilistic reasoning — conditional probability, Bayes rule, Naïve Bayes classifier (conceptual). Simple Bayesian network examples (basic structure & inference).

Unit III: **SUPERVISED MACHINE LEARNING** **9**

Machine Learning basics — Types of ML, dataset types, Preprocessing, train-test split, model evaluation (accuracy, confusion matrix). Regression models — Linear regression, Gradient Descent, error metrics (MSE/MAE). Classification models — Logistic regression, K-Nearest Neighbour (KNN), Decision Trees. Support Vector Machines (concepts only). Overfitting, underfitting, regularization (L1/L2), cross-validation.

Unit IV: **UNSUPERVISED LEARNING & ENSEMBLE METHODS** **9**

Clustering — K-Means clustering, Hierarchical clustering. Dimensionality reduction — PCA (basic concept). Ensemble Learning — Bagging, Random Forests, Boosting, Gaussian Mixture Model, Model selection — Bias-variance tradeoff, accuracy, confusion matrix.

Unit V: BASICS OF REINFORCEMENT LEARNING **9**

Introduction to Reinforcement Learning - Key elements, History; Understanding Rewards & Policies; Markov Decision Process (MDP) – Property, Building an MDP; Q-Learning — Algorithm, Implementation; Building Policy and value iteration, playing with Policy vs value. Real time application.

Total: 45 Periods

List of Experiments:

S. No	Experiments
1.	Design and implement BFS, DFS, and Uniform Cost Search (UCS) to find a path between two locations in a city map. Compare the performance of each algorithm in terms of path cost and time complexity.

2.	Develop a grid-based pathfinding system for a warehouse robot using the A* search algorithm. The robot must navigate from a start position to a goal while avoiding obstacles.
3.	Design an AI agent for a two-player game (e.g., Tic-Tac-Toe) using the Minimax algorithm. Enhance performance using Alpha-Beta pruning.
4.	Develop a Naïve Bayes classifier to classify emails or messages as spam or not spam using a real-world dataset.
5.	Build a regression model (Linear/Multiple Regression) to predict house prices based on features such as area, location, and number of rooms.
6.	Implement Decision Tree and KNN classification on an educational or medical dataset or Irish dataset.
7.	Apply K-Means clustering on customer data to segment users based on purchasing behaviour.
8.	Implement Bagging, Random Forest, and Boosting techniques to detect fraudulent transactions in a financial dataset.
9.	Design a Q-Learning agent to control traffic signals at an intersection to minimize waiting time and congestion.
10.	Develop a Q-Learning-based agent to play a simple game (Gridworld or Snake) and maximize cumulative reward.
	Total: 30 Periods
	Total: 45 + 30 = 75 Periods

Learning Resources

1.	Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2.	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020
3.	Micheal Lanham, “Hands-on Reinforcement Learning for Games” Packt, Firat Edition, 2020. Hands-On Reinforcement Learning for Games - Google Books
4.	Aurelien Geron, “Hands – on Machine Learning with Scikit – Learn, Keras & TensorFlow” 2nd Edition, O’Reilly, 2019
5.	Bernd Klein, “ Machine learning with Python Tutorial” bodenseo, 2021, Machine Learning with Python Tutorial | InfoBooks.org
6.	Reinforcement Learning Algorithms with Python by Andrea Lonza,2019, Packt. Reinforcement Learning Algorithms with Python - Google Books
7.	“Introduction to Machine Learning”, Prof. Balaraman Ravindran, IIT Madras, NPTEL, Introduction to Machine Learning - Course

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Apply fundamental concepts of Artificial Intelligence, intelligent agents, and search techniques to solve real-world problems.	Apply

CO2	Analyze AI reasoning and decision-making techniques including heuristic search, adversarial search, constraint satisfaction, and probabilistic models.	Analyze
CO3	Apply supervised machine learning algorithms for regression and classification tasks on real-world datasets.	Apply
CO4	Analyze unsupervised learning techniques and ensemble methods for clustering and model improvement.	Analyze
CO5	Apply basic Reinforcement Learning techniques for sequential decision-making problems.	Apply

Course Articulation Matrix

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

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

U24CS512	MOBILE APPLICATION DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To understand the components and structure of mobile application development frameworks for Android and windows OS-based mobiles.
- To understand how to work with various mobile application development frameworks.
- To learn the basic and important design concepts and issues of development of mobile applications.
- To understand the capabilities and limitations of mobile devices.

List of Experiments

Sl. No	List of Experiments
1	**Student Workshop Registration App (GUI Components)** Develop a mobile application to register students for a workshop. The application should collect Student Name, Email ID, and Mobile Number using GUI components and display the submitted details when the Submit button is clicked. Implement labels, text fields, and buttons**.**
2	**Course Feedback Collection System (Layouts & Event Handling)** Design an application to collect feedback from students about a course. The application should include Student Name, Course Name, Rating (1–5), Comments. Use appropriate layout managers and implement Submit and Reset buttons with event handling.

3	**Mini Graphics Editor (Drawing Primitives)** Develop a graphical application that draws a simple house scene using basic primitives such as line, rectangle, circle, and ellipse. The program should demonstrate coordinate positioning and graphical drawing methods**.**
4	**Employee Management System (Database Connectivity)** Develop a database-driven mobile application to manage employee records including Employee ID, Name, Department, and Salary. Implement CRUD operations (Insert, View, Update, and Delete) with a user-friendly interface.
5	**Assignment Reminder Application (Notification Manager)** Develop a reminder application that allows students to set task reminders for assignments**.** The app should generate system notifications with title, message, and icon.
6	**Parallel Processing Demonstration (Multithreading)** Implement an application that demonstrates multithreading by creating multiple threads to perform tasks such as printing numbers, displaying system time, or performing simple calculations simultaneously.
7	**Location Tracking App (GPS)** Develop a location-based mobile application that retrieves the user's current location. The application should display latitude and longitude after obtaining location permissions.
8	**Quick Alert Messaging App (Alert Dialog)** Design an application that allows users to enter a message and display it in an alert dialog box when the Send Alert button is pressed.
9	**Simple Email Sender Application** Develop a mobile application that allows the user to compose and send an email**.** Inputs include recipient email address, subject, and message body**.** Display a confirmation message after sending the email.
10	**Personal Daily Activity Manager** Design a mobile application to manage daily activities such as user registration, adding tasks, and displaying saved information. Use appropriate GUI components and event handling**.**
	Total: 60 Periods

Learning Resources

1	Jochen Schiller, —Mobile communications, 2nd Edition, Pearson Education, 2013
2	William Stallings, —Wireless Communications and Networks, 2nd Edition, Pearson.2020
3	Rappaport, Wireless Communications – Principles and Practice, Pearson.2011
4	Misra & Woungang, Guide to Wireless Ad Hoc Networks, Springer.2009
5	**3**GPP (3rd Generation Partnership Project) – Official standards for LTE and 5G. https://www.3gpp.org
6	Cisco Networking Academy – Wireless & Mobile Networks. https://www.netacad.com
7	Mobile Computing / Wireless Communication Courses - IIT- Delhi , Prof. Ranjan Bose ,NPTEL, https://nptel.ac.in/courses/117102062.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Develop mobile applications using GUI components and layout managers for user interaction.	Apply
CO2	Implement event handling and alert mechanisms in mobile applications.	Apply
CO3	Design database-driven mobile applications to perform CRUD operations for data management.	Create
CO4	Develop mobile applications using device features such as notifications, GPS, and multithreading.	Apply
CO5	Design and build real-world mobile applications integrating different components and functionalities.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	3	2	2	2	2	2	2	2	1
CO2	2	2	2	2	3	2	2	2	2	2	2	3	3
CO3	2	3	3	2	3	3	3	3	1	2	2	3	3
CO4	2	2	3	3	3	3	3	3	2	2	2	3	3
CO5	2	3	3	2	3	3	3	3	2	2	2	3	2
Avg.	2.2	2.4	2.6	2	3	2.6	2.6	2.6	1.8	2	2	2.8	2.8

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: 15 Periods

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

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	PCC	3	0	0	3	3	40	60
2	U24CS621	Cryptography and Network Security	PCC	3	0	0	3	3	40	60
3	U24MG611	Project Management	HSMC	2	0	0	2	2	40	60
4	U24MG621	Entrepreneurship	HSMC	2	0	0	2	2	40	60
5		Professional Elective - II	PEC	-	-	-	-	3		
6		Professional Elective - III	PEC	-	-	-	-	3		
7		Open Elective – I	OEC	-	-	-	-	3		
8		Mandatory Course – II	MC	3	0	0	3	0	100	NIL
PRACTICAL COURSES										
9	U24CS632	Cloud Computing Laboratory	PCC	0	0	4	4	2	60	40
10	U24CS642	Network Security Laboratory	PCC	0	0	4	4	2	60	40
								23		

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	U24CS621	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				3										45	50
6	PEC – III				3										45	50
7	OEC – I				3										45	50
8	MC – II	3	0	0	0	-	-	-	-	-	-	-	100	-	-	50
9	U24CS632	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
10	U24CS642	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50

(W) – Weightage

U24CS611	CLOUD COMPUTING	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 :45 Periods	

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 Parallel 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 Poulton
4	Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, Mastering Cloud Computing McGraw Hill 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	PO 10	PO 11	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)

U24CS621	Cryptography and Network Security	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the fundamental concepts of network security.
- To gain comprehensive knowledge of symmetric key cryptography.
- To study the principles and mathematical basis of public key cryptography.
- To understand and evaluate message authentication mechanisms.
- To explore the practical security mechanisms and system-level protection.

Detailed Syllabus

UNIT I: INTRODUCTION **9**

Security trends – Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies – Model of network security – Security attacks, services mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

UNIT II: SYMMETRIC KEY CRYPTOGRAPHY	**9**
MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures – Modular arithmetic- Euclid"s algorithm- Congruence and matrices -Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard – RC4 - Key distribution	
UNIT III: PUBLIC KEY 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 - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography	
UNIT IV: MESSAGE AUTHENTICATION AND INTEGRITY	**9**
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509	
UNIT V: SECURITY PRACTICE AND SYSTEM SECURITY	**9**
Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.	
Total: 45 Periods	

Learning Resources

1	William Stallings, Cryptography and Network Security: Principles and practice, PHI 8th Edition, (2022/2023)
2	Behrouz A. Foruzan, Cryptography and Network Security, 3rd Edition, Tata McGraw Hill 2015.
3	C K Shyamala , N Harini ,Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd
4	Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2
5	Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.
6	"Cryptography and Network security", Prof. Sourav Mukhopadhyay, IIT Kharagpur, NPTEL, https://onlinecourses.nptel.ac.in/noc25_cs16/preview

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 networks security, security architecture, threats and vulnerabilities	Understand
CO2	Apply the different cryptographic operations of symmetric cryptographic algorithms	Apply
CO3	Apply the different cryptographic operations of public key cryptography	Apply

CO4	Apply the various Authentication schemes to simulate different applications.	Apply
CO5	Apply various Security practices and System security standards	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PSO1	PSO2
CO1	3	2	2	-	2	-	-	-	2	-	2	2	2
CO2	3	2	2	2	3	-	-	-	2	-	2	2	2
CO3	3	2	2	2	3	-	-	-	2	-	2	2	2
CO4	2	2	2	2	3	-	-	-	2	-	2	2	3
CO5	2	2	2	2	2	-	-	-	2	-	2	2	2
Avg	2.6	2.0	2	2	2.6	-	-	-	2	-	2.0	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 **9**

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 **9**

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 **9**

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	**9**
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	**9**
Quality assurance and quality control - quality audit- methods of enhancing quality.	
Total: 30 Periods	

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:

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

- 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	**9**
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	**9**
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	**9**
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	**9**
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)	**9**
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: 30 Periods

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, 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)

U24CS632	CLOUD COMPUTING LAB	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: 60 Periods	

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)

U24CS642	Network Security Laboratory	L	T	P	C
		0	0	4	2

Course Objective:

- To implement symmetric and asymmetric cryptographic algorithms.
- To develop and test digital signature techniques for secure communication.
- To use tools like Wireshark and tcpdump for analyzing network traffic.
- To perform security protocol analysis and simulate common network attacks.
- To configure and evaluate IDS, Firewall, and VPN for network protection.

List of Experiments

Sl No	List of Experiments
1	Analyze and implement symmetric encryption mechanisms by developing secure data protection workflows using DES and AES algorithms, and evaluate their comparative performance and robustness.
2	Design and implement asymmetric cryptographic solutions using RSA, and critically examine secure key establishment processes through practical deployment of the Diffie–Hellman key exchange protocol.
3	Develop and validate digital signature schemes to ensure authentication, non-repudiation, and message integrity across different communication scenarios.
4	Configure and utilize network monitoring tools such as Wireshark and tcpdump to capture, interpret, and analyze TCP/UDP traffic, and perform in-depth examination of protocol datagrams in real-time client-server interactions.
5	Evaluate the mechanisms of SSL/TLS by implementing secure communication channels and systematically verifying message confidentiality, integrity, and certificate-based trust models.
6	Investigate and simulate various network attacks including eavesdropping, dictionary-based password cracking, and man-in-the-middle (MITM) exploits, and analyze their impact on communication security.

7	Perform advanced traffic sniffing experiments using ARP poisoning techniques to assess the vulnerabilities of LAN environments and analyze intercepted packets
8	Implement the operation of intrusion detection systems (IDS) and analyze the detected threats, alerts, and system responses.
9	Design and implement a network monitoring system using Python that performs real-time packet capture, analyzes traffic patterns, computes performance metrics such as packet count and protocol distribution, detects abnormal activities (like traffic spikes or potential attacks), and generates alerts for suspicious behavior..
10	Study, configure, and evaluate Firewall and VPN solutions to design secure network architectures and enforce organizational security policies.
	Total:60 Periods

Learning Resources

1	Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN 13:9780133354690
2	Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.
3	The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dreamtech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.
4	Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013, ISBN-10: 1284031675, ISBN-13: 978-1284031676.
5	Linux Firewalls, by Michael Rash, No Starch Press, 2007, ISBN: 978-1-59327-141-1.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Implement and analyze DES, AES, RSA, and Diffie–Hellman to ensure secure key management and data confidentiality.	Analyze
CO2	Design and evaluate digital signature methods for authentication, integrity, and non-repudiation.	Evaluate
CO3	Analyze Wireshark and tcpdump to capture and analyze TCP/UDP network traffic.	Analyze
CO4	Assess SSL/TLS security and investigate attacks like eavesdropping, dictionary attacks, MITM, and ARP poisoning.	Analyze
CO5	Configure and analyze IDS, Firewalls, and VPNs to create secure network environments.	Analyze

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	3
CO2	3	3	2	3	2	3	-	-	-	2	-	3	3
CO3	3	2	3	3	2	3	-	-	-	2	-	3	2
CO4	3	3	2	3	2	3	-	-	-	2	-	3	3
CO5	3	2	3	3	3	3	-	-	-	2	-	3	3
Avg.	3	2.6	2.4	2.8	2.2	3	-	-	-	2	-	3	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 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	-	-
4		Professional Elective V	PEC	-	-	-	-	3	-	-
5		Professional Elective VI	PEC	-	-	-	-	3	-	-
6		Open Elective – II	OEC	-	-	-	-	3	-	-
PRACTICAL COURSES										
7	U24CS712	Mini Project	EEC	0	0	4	4	2	60	40
8	U24CS722	Summer Internship	EEC	-	-	-	-	2	100	NIL
				-	-	-	-	**21**		

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				3										45	50
4	PEC – V				3										45	50
5	PEC – VI				3										45	50
6	OEC – II				3										45	50
7	U24CS712	0	0	4	2	-	-	-	-	100	-	100	60	40	45	50
8	U24CS722				2	-	-	-	-	-	-	100	-	-	-	50

(W) – Weightage

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

Course Objective:

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

- 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: 30 Periods

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:

After completion of this course, students will be able to:

- 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: 45 Periods

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 (Seven QC tools, Six Sigma, Benchmarking, FMEA, QFD, TPM) 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, and outline the implementation and audit requirements of ISO 9001 and ISO 14001 standards.	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)

U24CS712	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: 60 Periods

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.	Analyze
CO3	Demonstrate technical skills and professional practices relevant to their field.	Apply
CO4	Evaluate their performance, learning outcomes, and industry practices through structured reports.	Evaluate
CO5	Create comprehensive documentation and presentations summarizing internship experiences and outcomes.	Create

Course Articulation Matrix

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

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

U24CS722	**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 students is 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**		**3**	**3**	**2**
CO2	**2**	**3**	**2**		**2**			**2**	**2**		**3**	**2**	**2**
CO3	**2**	**2**	**2**		**2**			**2**	**2**		**2**	**3**	**3**
CO4	**2**	**2**	**2**		**2**			**2**	**2**		**2**	**2**	**2**
CO5	**2**	**2**	**2**		**2**			**2**	**2**		**2**	**2**	**3**
Avg.	**2.2**	**2.4**	**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	U24CS812	Capstone Project/ Industry Internship	EEC	0	0	16	16	8	60	40
				0	**0**	**16**	**16**	**8**		

U24CS812	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		3	3	2
CO2	2	3	2		2			2	2		3	3	2
CO3	2	2	3		3			2	2		2	3	3
CO4	2	2	2		2			2	2		2	2	2
CO5	2	2	2		3			2	2		2	2	3
Avg.	2.2	2.4	2.2		2.4			2	2		2.4	2.6	2.4

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

PROFESSIONAL ELECTIVES
VERTICAL 1: FULL STACK DEVELOPMENT
(Common to B.Tech - Artificial Intelligence and Data Science)

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 approach to Configuration Management - The Atern Principles - Atern Philosophy - Rationale for using Atern - Refactoring - Continuous integration - Automated Build Tools - Scaling Agile for large projects: Scrum of Scrums - Team collaborations - Scrum - Estimate a Scrum Project - Track Scrum Projects - Communication in Scrum Projects - Best Practices to Manage Scrum.
Total: 45 Periods

Learning Resources

1	Robert C. Martin, “Agile Software Development, Principles, Patterns, and Practices”, First Edition, Pearson Education India, 2002.
2	“Succeeding with Agile: Software Development Using Scrum”, Pearson, 2010.
3	Robert C Martin, Micah Martin, “Agile Principles, Patterns and Practices in C#”, Pearson Education, 2007
4	Steve McConnell ,”More Effective Agile: A Roadmap for Software Leaders”, Construx Press,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 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: 15 Periods

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: 1. Empathize 2. Define 3. Ideate 4. Prototype 5. 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: 60 Periods
	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

UNIT I: 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: 15 Periods

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 a cross 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:60 Periods
	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 Services 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 E C2 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:30 Periods	

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: 30 Periods
	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	1.6	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: 30 Periods	
Total: 30 + 30 = 60 Periods	

Learning Resources

1	“DevOps” by Anuradha A. Puntambekar-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)

U24CSFS06	**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: 30 Periods

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:30 Periods
	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	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.
4	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
5	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
6	https://developer.mozilla.org/en-US/docs/Web/Security
7	https://developers.google.com/web/fundamentals/security

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 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/ PO	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	2.5	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 life cycle 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 WebDriver.
- To Develop skills in using TestNG and Cucumber tools for structured test automation and behavior-driven development.

Detailed Syllabus

UNIT 1: 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 2: 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 3: 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 4: 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 5: 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 – Creating Feature Files – Step Definitions – Integrating Selenium with Cucumber – Running Cucumber Tests – Cucumber HTML and JUnit Reports	
	Total: 30 Periods

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: 30 Periods
	Total: 30 + 30 = 60 Periods

Learning Resources

1	Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2	Srinivasan Desikan & Gopalaswamy Ramesh, “Software Testing: Principles and Practices”, Pearson Education, 2006.
3	Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" – Second Edition 2018.

4	Cedric Beust & Hani Suleiman, “Next Generation Java Testing: TestNG and Advanced Concepts”, Addison-Wesley, 2007.
5	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 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 life cycle 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 and 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 ELECTIVES
VERTICAL 2: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
(Partially Common to B.Tech – Artificial Intelligence and Data Science)

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSML01	Data Analytics	PEC	2	0	2	4	3	50	50
2	U24CSML02	Deep Learning Techniques	PEC	2	0	2	4	3	50	50
3	U24CSML03	Text and Speech Analysis	PEC	2	0	2	4	3	50	50
4	U24CSML04	Computer Vision	PEC	3	0	0	3	3	40	60
5	U24CSML05	Generative AI Fundamentals	PEC	3	0	0	3	3	40	60
6	U24CSML06	Game Theory	PEC	2	0	2	4	3	50	50
7	U24CSML07	Ethics and AI	PEC	3	0	0	3	3	50	50

U24CSML01	DATA ANALYTICS	L	T	P	C
		2	0	2	3

Course Objective:

- To understand the foundational concepts of data analytics and basic analytical techniques.
- To learn essential methods for discovering patterns and grouping data.
- To gain knowledge of stream data processing and real-time analytics concepts.
- To understand graph-based data representation and basic graph analytics techniques.
- To learn the fundamentals of NoSQL databases and their role in big data analytics.

Detailed Syllabus

UNIT I: FOUNDATIONS OF DATA ANALYTICS **6**

Introduction to Data Analytics – Types of Data Analytics – Predictive Analytics – Simple Linear Regression – Multiple Linear Regression – Time-Series Basics: Auto Regression, Moving Average, ARIMA (Intro only) – Data Pre-processing: Data Cleaning, Data Integration, Transformation, Normalization – Data Reduction – Descriptive Analytics: Measures of Central Tendency and Measures of Dispersion.

UNIT II: PATTERN DISCOVERY AND CLUSTERING **6**

Association Rule Mining – Frequent Itemset Mining (Basic Concepts and Apriori Algorithm) – Association Rules to Correlation Analysis – Introduction to Constraint-based Association Mining – Cluster Analysis: Types of Data – Overview of Major Clustering Methods – Partitioning Methods -Hierarchical Clustering

UNIT III: DATA STREAMS AND REAL-TIME ANALYTICS **6**

Introduction to Data Streams – Stream Data Model – Basics of Stream Processing – Sampling and Filtering in Streams – Counting Distinct Elements – Sliding Window Concepts – Introduction to Real-Time Analytics Applications – Case Study: Real-Time Sentiment Analysis / Basic Event Analytics.

UNIT IV: INTRODUCTION TO GRAPH ANALYTICS **6**

Basics of Graph Analytics – Graph Models – Representing Data as Graphs – Graph Structure and Network Organization – Applications of Graph Analytics – Centrality Measures: Degree, Closeness, Between ness – Introduction to Community Detection: Girvan–Newman , Label Propagation

UNIT V: BIG DATA AND NOSQL FOR ANALYTICS **6**

NoSQL Databases - Schema-less Models - Increasing Flexibility for Data Manipulation - Key Value Stores - Document Stores - Tabular Stores - Object Data Stores - Graph Databases

HiveSharding-Hbase - Analyzing big data with twitter - big data for E-Commerce - Big data for blogs
Total: 30 Periods

List of Experiments

Sl. No	List of Experiments
1	Perform data cleaning and preprocessing on a real-world healthcare or retail dataset to improve data quality by handling missing values, inconsistencies, and outliers for accurate analysis.
2	Implement simple and multiple linear regression models to predict house prices, analyze feature influence, and evaluate model performance.
3	Apply the ARIMA model to perform time-series forecasting on sales or demand data by identifying trends and seasonality.
4	Generate association rules using the Apriori algorithm to discover relationships between items for market basket analysis.
5	Perform clustering using K-Means clustering and hierarchical clustering techniques to segment customers based on behavior and attributes.
6	Process and analyze streaming data using sampling and sliding-window methods for real-time traffic or sensor data analytics.
7	Calculate graph centrality measures and detect communities in a network to analyze social networks and identify influential nodes.
8	Perform CRUD operations on a NoSQL database for a student course registration system to efficiently manage and retrieve data.
	Total: 30 Periods
	Total 30 + 30 = 60 Periods

Learning Resources

1	A. Rajaraman, J. Ullman, “Mining Massive Data Sets”, 3rd Edition, Cambridge University Press, 2020.
2	David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, No SQL, and Graph”, 2013.
3	Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning, Data Mining, Inference, and Prediction”, 2nd ed. 2009, Corr. 9th printing 2017, Springer.
4	G James, D. Witten, T Hastie, R. Tibshirani, “An Introduction to Statistical Learning: With Applications in R”, 2nd Edition, Springer, 2021.
5	Mohammed J. Zaki, Wagner Meira, “Data Mining and Analysis: Fundamental Concepts and Algorithms”, Second Edition Cambridge, 2020
6	E. Alpaydin, “Introduction to Machine Learning”, 4th Edition, 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 core data analytics concepts and apply basic statistical and regression techniques.	Understand
CO2	Apply association rule mining and clustering techniques for pattern discovery.	Apply

CO3	Demonstrate basic stream processing methods and real-time analytical approaches.	Apply
CO4	Analyze simple graph structures using centrality and community detection concepts.	Analyse
CO5	Analyse various NoSQL data models and select appropriate models for analytical needs.	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	3	2	2	2	-	-	-	-	-	2	-	3
CO3	2	2	2	3	3	-	-	-	-	-	2	-	3
CO4	2	3	2	3	2	-	-	-	-	-	2	-	3
CO5	2	2	1	-	3	-	-	-	-	-	2	-	3
Avg.	2.4	2.4	1.8	2.7	2.4	-	-	-	-	-	2	-	2.8

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

U24CSML02	Deep Learning Techniques	L	T	P	C
		2	0	2	3

Course Objective:

- To explain fundamental concepts of deep learning, neural networks, and learning paradigms.
- To apply neural network architectures such as CNNs and RNNs for solving real-world problems in vision and sequence data.
- To implement and experiment the model performance.
- To evaluate different deep learning models including autoencoders and generative models for representation learning and data generation.
- To implement model evaluation, conversion, and deployment techniques for developing deep learning-based applications.

Detailed Syllabus

Unit I: INTRODUCTION TO DEEP LEARNING **6**

Introduction to Deep Learning - Difference between Machine Learning, and Deep Learning - Neural Network Basics – Neurons, Layers, Activation Functions – Loss Functions – Optimizers (SGD, Adam) – Forward and Backward propagation – Training, Validation, Testing – Overfitting and Regularization (Dropout, Early Stopping).

Unit II: CONVOLUTIONAL NEURAL NETWORKS (CNN) **6**

Introduction to CNN – Operations, Filters, Padding, Stride – Pooling Techniques – CNN Architecture (LeNet, basic models) – Image Classification Workflow – Feature Maps – Data Augmentation Techniques – Transfer Learning Basics.

Unit III: RECURRENT NEURAL NETWORKS **6**

Introduction to sequence data - Need for Sequence Models – RNN Basics – Vanishing Gradient Idea – LSTM / GRU Concepts – Word Embeddings – Simple Text Classification – Sentiment Analysis Basics.

Unit IV: AUTOENCODERS AND GENERATIVE MODELS **6**

Autoencoder architecture – Encoder and Decoder Concepts – Denoising Autoencoders – Latent Space Concepts – GAN Introduction – Generator and Discriminator basics – Simple Image Generation.

Unit V: DEPLOYMENT OF DEEP LEARNING MODELS **6**
Saving and Loading Models – Model Evaluation Metrics – Introduction to Model Deployment – Introduction to TensorFlow Lite (TFLite) – Introduction to ONNX Runtime – Converting Models to TFLite/ONNX – Building Simple DL Applications Using Flask/Streamlit.
Total: 30 Periods

List of Experiments

Sl. No	List of Experiments
1.	Implement a perceptron model to simulate logical operations such as AND, OR, and NOT used in decision-making systems.
2.	Build and train a feed-forward neural network to predict customer churn based on real-world business datasets.
3.	Develop a Convolutional Neural Network (CNN) model to recognize handwritten digits for applications such as postal and banking systems.
4.	Design a CNN-based model to classify product images and improve performance using data augmentation techniques.
5.	Implement an LSTM-based model to classify messages or emails as spam or non-spam.
6.	Develop a deep learning model to analyse and classify sentiments from user-generated content such as reviews or tweets.
7.	Build an autoencoder model to compress and reconstruct images for efficient storage and transmission.
8.	Implement a GAN model to generate synthetic images for applications in media and content creation.
9.	Convert a trained deep learning model into a platform-independent format and perform inference in a different runtime environment.
10.	Develop a deep learning model for a simple application for real-world usage.
	Total: 30 Periods
	Total: 30+30= 60 Periods

Learning Resources

1	François Chollet, “Deep Learning with Python”, 2nd Edition, Manning, 2021.
2	Ivan Vasilev et al., “Python Deep Learning”, 3rd Edition, Packt, 2023.
3	Charu C. Aggarwal, “Neural Networks and Deep Learning”, Springer, 2021.
4	Nikhil Buduma, “Fundamentals of Deep Learning”, Updated Edition, O’Reilly, 2021.
5	Ian Goodfellow et al., “Deep Learning”, Updated Online Edition, MIT Press, 2020+.
6	Eugene Charniak, “Deep Learning: A Beginner’s Guide”, MIT Press, 2020.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Interpret and explain the working of neural networks, and training strategies used in deep learning systems.	Understand
CO2	Develop and train deep learning models for applications like classification and prediction.	Apply
CO3	Implement RNN/LSTM-based models for sequence-based applications.	Apply
CO4	Analyze the performance of autoencoders and GANs.	Analyze



CO5	Implement deep learning applications by converting models into formats like TFLite/ONNX and integrating them into real-world systems.	Apply

Course Articulation Matrix

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

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

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: 30 Periods	

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: 30 Periods
	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 and 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 digit al camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.
Unit II: FEATURE DETECTION, MATCHING AND SEGMENTATION 9 Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.
Unit 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 rangefinding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.
Unit V: IMAGE-BASED RENDERING AND RECOGNITION 9 View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.
Total: 45 Periods

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	1	1	-	-	1	1	3	1	1	1
CO2	2	2	2	1	1	-	-	1	1	2	2	1	1
CO3	2	3	3	1	2	-	-	1	1	1	1	2	1
CO4	2	3	3	1	2	-	-	1	1	3	1	2	1
CO5	2	2	2	1	2	-	-	1	1	3	2	2	2
Avg.	1.8	2.4	2.4	1	1.6	-	-	1	1	2.4	1.4	1.6	1.2

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: 45 Periods

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: 30 Periods

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	YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press.
6	Zhu Han, DusitNiyato, WalidSaad, TamerBasar 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)

U24CSML07	ETHICS AND AI	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the concepts of morality and ethics in Artificial Intelligence.
- To explore various ethical initiatives in the field of Artificial Intelligence.
- To study the standards and regulations governing Artificial Intelligence.
- To analyze the social and ethical issues related to robot ethics.
- To examine the challenges and opportunities in the development and application of ethical Artificial Intelligence.

Detailed Syllabus

UNIT I: INTRODUCTION **9**

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust - Responsible AI principles: Fairness, Transparency, Safety, Security, Privacy, Accountability

UNIT II: ETHICAL INITIATIVES IN AI **9**

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization

UNIT III: AI STANDARDS AND REGULATION **9**

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

UNIT IV: ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS 9 Robot-Robo ethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Robo ethics Taxonomy. Human-Robot Interaction Safety & Emotional AI Ethics in Autonomous Weapon Systems & Workplace Robotics
UNIT V: AI AND ETHICS- CHALLENGES AND OPPORTUNITIES 9 Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.
Total:45 Periods

Learning Resources

1	Paula Boddington, “AI Ethics: A Textbook”, Springer, 2023.
2	Mark Coeckelbergh, *“AI Ethics”*, The MIT Press Essential Knowledge Series, April 2020.
3	Luciano Floridi et al., “Ethics of Artificial Intelligence and Robotics”, Stanford Encyclopedia of Philosophy (Updated Edition), 2021.
4	OECD, “OECD Framework for the Classification of AI Systems: A Tool for Effective AI Policies”, OECD Publishing, 2022.
5	UNESCO, “Recommendation on the Ethics of Artificial Intelligence”, UNESCO Publishing, 2021.
6	European Commission, “Ethics Guidelines for Trustworthy AI”, Updated Version, 2021.

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 morality and ethics in Artificial Intelligence.	Understand
CO2	Examine international ethical initiatives in AI and evaluate ethical issues through real-world case studies.	Analyze
CO3	Interpret AI standards, regulations, and design processes to address ethical concerns.	Apply
CO4	Analyze social and ethical implications of robotics.	Analyze
CO5	Evaluate the challenges and opportunities in AI ethics.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	2	2	3	-	1	-	2	1
CO2	2	3	-	2	-	2	-	3	1	1	-	2	2
CO3	3	2	2	2	3	2	-	3	-	1	-	3	2
CO4	2	3	-	1	-	2	2	3	2	1	-	2	2
CO5	2	3	1	2	2	3	2	3	1	2	-	3	3
Avg.	2.4	2.6	1.5	1.75	2.5	2.2	2	3	1.3	1.2	-	2.4	2

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

PROFESSIONAL ELECTIVES
VERTICAL 3: CYBER SECURITY

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	ASSESSMENT	
				L	T	P			CIA	ESE
1	U24CSCS01	Information Security	PEC	3	0	0	3	3	40	60
2	U24CSCS02	Modern Cryptography	PEC	3	0	0	3	3	40	60
3	U24CSCS03	Ethical Hacking	PEC	3	0	0	3	3	40	60
4	U24CSCS04	Secure Software Systems	PEC	3	0	0	3	3	40	60
5	U24CSCS05	Security and Privacy in Cloud	PEC	3	0	0	3	3	40	60
6	U24CSCS06	Cyber Forensics	PEC	3	0	0	3	3	40	60
7	U24CSCS07	Cryptocurrency and Blockchain Technologies	PEC	3	0	0	3	3	40	60

U24CSCS01	INFORMATION SECURITY	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the basics of Information Security
- To learn the legal, ethical and professional issues in Information Security
- To learn the aspects of risk management
- To introduce the design of logical security frameworks using standards, policies, and models such as ISO, NIST, and security architectures for organizational continuity.
- To learn the technological aspects of Information Security

Detailed Syllabus

UNIT I: INTRODUCTION **9**

History, What is Information Security? Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT II: SECURITY INVESTIGATION **9**

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies

UNIT III: SECURITY ANALYSIS **9**

Risk Management - Identifying and Assessing Risk - Assessing and Controlling Risk - Systems: Access Control Mechanisms - Information Flow and Confinement Problem.

UNIT IV: LOGICAL DESIGN **9**

Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity

UNIT V: PHYSICAL DESIGN **9**

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel

Total: 45 Periods

Learning Resources:

1	Michael E. Whitman and Herbert J. Mattord, “Principles of Information Security”, Cengage Learning, 7th Edition, 2022.
2	Charles P. Pfleeger, Shari Lawrence Pfleeger, and Jonathan Margulies, “Security in Computing”, Pearson Education, 6th Edition, 2022.
3	William Stallings, “Foundations of Security: Principles and Practices”, Pearson Education, 2nd Edition, 2021.
4	Bruce Schneier, “Applied Cryptography: Protocols, Algorithms, and Source Code in C”, Wiley, 3rd Edition, 2023.
5	Mark Stamp, “Information Security: Principles and Practice”, Wiley, 3rd Edition, 2021.
6	Information Security by Dr. J. Kokila ,IIIT, Tiruchirappalli. Swayam https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed89
7	https://www.iso.org/isoiec-27001-information-security.html
8	https://www.nist.gov/cyberframework

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Discuss the basics of information security	Understand
CO2	Describe the need for information security through the study of threats, attacks, and legal and ethical issues.	Understand
CO3	Demonstrate the aspects of risk management.	Apply
CO4	Implement various Information Security System standards to enhance security measures.	Apply
CO5	Develop and apply security techniques using cryptography, intrusion detection, and access control mechanisms.	Apply

Course Articulation Matrix

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

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

U24CSCS02	Modern Cryptography	L	T	P	C
		3	0	0	3

Course Objective:

- To learn about Modern Cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudorandom permutation.
- To construct Basic cryptanalytic techniques.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

Detailed Syllabus

UNIT I: INTRODUCTION **9**

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption. Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II: FORMAL NOTIONS OF ATTACKS **9**

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NMCCA2,Inter-relations among the attack model

UNIT III: RANDOM ORACLES **9**

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)

UNIT IV: BUILDING A PSEUDORANDOM PERMUTATION **9**

The LubyRackoff Construction: Formal Definition, Application of the LubyRackoff Construction to the construction of Block Ciphers, The DES in the light of LubyRackoff Construction.

UNIT V: MESSAGE AUTHENTICATION CODES **9**

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC,Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification,Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.

Total:45 Periods

Learning Resources

1	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)
3	OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available),

	Part 1 and Part 23
4	William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd Edition, 2006.
5	BehrouzA.Foruzan, Cryptography and Network Security, 3rd Edition,Tata McGraw Hill 2015.
6	ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Interpret the basic principles of cryptography and general cryptanalysis.	Understand
CO2	Determine the concepts of symmetric encryption and authentication.	Apply
CO3	Identify the use of public key encryption, digital signatures, and key establishment.	Understand
CO4	Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.	Analyze
CO5	Determine the use of Message Authentication Codes.	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	2
CO2	2	3	2	2	2	-	-	-	2	-	2	2	2
CO3	2	2	2	3	2	-	-	-	2	-	2	2	3
CO4	3	2	2	2	3	-	-	-	2	-	2	2	3
CO5	2	3	3	3	3	-	-	-	2	-	2	2	2
Avg.	2.4	2.6	2.4	2.6	2.4	-	-	-	2	-	2	2	2.4

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

U24CSCS03	ETHICAL HACKING	L	T	P	C
		3	0	0	3

Course Objective:

- To understand the basics of computer-based vulnerabilities.
- To explore different foot printing, reconnaissance and scanning methods.
- To expose the enumeration and vulnerability analysis methods.
- To understand hacking options available in Web and wireless applications.
- To explore the options for network protection.

Detailed Syllabus

UNIT I: INTRODUCTION **9**

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport

Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware – Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security.
UNIT II: FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS 9 Foot printing Concepts – Foot printing through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence – Foot printing through Social Engineering – Foot printing Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall
UNIT III: ENUMERATION AND VULNERABILITY ANALYSIS 9 Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Os
UNIT IV: SYSTEM HACKING 9 Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – War driving Wireless Hacking - Tools of the Trade
UNIT V: NETWORK PROTECTION SYSTEMS 9 Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.. URL Obfuscation- buffer overflow- DNS poisoning -ARP poisoning -Identity Theft - IoT Attacks – BOTs and BOTNETs
Total:45 Periods

Learning Resources

1	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010
2	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3	The Web Application Hacker’s Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.
4	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.
5.	“Ethical Hacking “,By Prof. Indranil Sen Gupta , IIT Kharagpur ,https://onlinecourses.nptel.ac.in/noc22_cs13/preview

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	To express knowledge on basics of computer based vulnerabilities	Understand
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods.	Understand
CO3	To demonstrate the enumeration and vulnerability analysis methods	Apply

CO4	To gain knowledge on hacking options available in Web and wireless applications.	Understand
CO5	To acquire knowledge on the options for network protection	Understand

Course Articulation Matrix

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

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

U24CSCS04	SECURE SOFTWARE SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:

- To understand software security concepts, threats, and memory attack defences.
- To apply secure design practices to prevent common software vulnerabilities.
- To design secure architectures and implement effective risk management strategies for identifying, evaluating, and mitigating security threats.
- To perform security testing and penetration testing to find vulnerabilities.
- To implement secure coding practices and security-focused project management.

Detailed Syllabus

UNIT I: NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS 9

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security –Managing secure Software Development - Properties of Secure Software – Influencing the security properties of software- Memory- Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks.

UNIT II: SECURE SOFTWARE DESIGN 9

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

UNIT III: SECURE SOFTWARE ARCHITECTURE & SECURITY RISK MANAGEMENT 9

Secure Software Architecture & Design – Architectural Risk Analysis – Security Principles, Guidelines and Attack Patterns- Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

UNIT IV: SECURITY TESTING 9

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation -Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

UNIT V: SECURE CODING & PROJECT MANAGEMENT **9**
Considerations for Secure coding – Code Analysis – Code Practices - Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice
Total: 45 Periods

Learning Resources

1	Engineering Secure Software Systems – Dr. S. Subashini, S. Yogeswari, R. Karthiga Devi, R. Sindhiya, Kiwi Publishers, 2025.
2	Julia H. Allen, “Software Security Engineering”, Pearson Education, 2009
3	Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011
4	Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.
5	Bryan Sullivan and Vincent Liu, “Web Application Security, A Beginner's Guide”, Kindle Edition, McGraw Hill, 2025
6	Lee Allen, “Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)”, Kindle Edition, Packt Publishing,2025

Course Outcomes

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

CO	Course Outcome Statement	Knowledge Level
CO1	Understand software security principles, threats, and memory-based attacks to ensure secure software development.	Understand
CO2	Apply secure requirements engineering and design principles to prevent vulnerabilities in software systems.	Apply
CO3	Apply secure software architecture principles and risk management practices to minimize and mitigate software security threats.	Apply
CO4	Apply security testing and penetration testing techniques to identify and mitigate software vulnerabilities.	Apply
CO5	Apply secure coding practices and integrate security governance into software project management.	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	3	-	2	-	-	2	2	-	2	2	2
CO3	3	3	3	2	2	-	-	2	2	-	2	2	2
CO4	3	3	2	3	3	-	-	2	2	-	2	2	3
CO5	3	2	2	-	2	-	-	2	2	-	3	2	3
Avg.	3	2.6	2.4	2.5	2.25	-	-	2	2	-	2.2	2	2.4

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

U24CSCS05	SECURITY AND PRIVACY IN CLOUD	L	T	P	C
		3	0	0	3

Course Objective:

- To understand fundamental concepts of cloud security, security services, and basic cryptographic mechanisms.
- To learn cloud security architecture, design principles, and data protection strategies in cloud environments.
- To explore identity management, access control models, and authentication mechanisms in cloud systems.
- To analyze cloud security design patterns and secure cloud communication interfaces.
- To understand monitoring, auditing, and security management practices for maintaining secure cloud operations.

Detailed Syllabus

UNIT I: FUNDAMENTALS OF CLOUD SECURITY CONCEPTS	**9**
Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.	
UNIT II: SECURITY DESIGN AND ARCHITECTURE FOR CLOUD	**9**
Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.	
UNIT III: ACCESS CONTROL AND IDENTITY MANAGEMENT	**9**
Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention.	
UNIT IV: CLOUD SECURITY DESIGN PATTERNS	**9**
Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.	
UNIT V: MONITORING, AUDITING AND MANAGEMENT	**9**
Proactive activity monitoring - Incident Response, monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management.	
	Total: 45 Periods

Learning Resources

1	Vic (J.R.) Winkler,Securing the Cloud: Cloud Computer Security Techniques and Tactics,Elsevier (Syngress), 2nd Edition, 2021.

2	Ben Potter, Alex Mackey, Marko Hellen,Cloud Security Handbook: Find Out How to Effectively Secure Cloud Environments,Packt Publishing, 2020 Edition.
3	Chris Dotson,Practical Cloud Security: A Guide for Secure Design and Deployment,O'Reilly Media, 2020 Edition.
4	Prashant Priyam, Abhishek Goyal,Cloud Security and Privacy,Springer, 2021 Edition.
5	Dr. Gurpreet S. Dhillon,Cloud Computing Security: Foundations and Challenges,Springer, 2022 Edition.
6	Nishith Pathak,Cloud Security: Concepts, Methodologies, Tools, and Applications,IGI Global, 2021 Edition.

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain cloud security concepts, security services, and cryptographic techniques used in cloud environments.	Understand
CO2	Apply cloud security design principles and implement data protection mechanisms such as encryption and secure isolation.	Apply
CO3	Implement identity and access management techniques including authentication, authorization, and multi-factor authentication.	Apply
CO4	Apply appropriate cloud security design patterns to protect cloud infrastructure and services from security threats.	Apply
CO5	Apply monitoring, auditing, and incident response techniques to maintain secure cloud operations.	Apply

Course Articulation Matrix

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

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

U24CSCS06	**CYBER FORENSICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

- To learn the fundamentals of cybercrime and cyber forensics.
- To understand the familiar digital evidence collection procedures and forensic tools.
- To understand cyber laws and the admissibility of evidence with case studies.
- To employ forensic tools and techniques for investigating iOS devices.
- To utilize forensic tools and methods for analysing Android devices.

Detailed Syllabus

UNIT I: INTRODUCTION TO CYBER CRIME AND FORENSICS	**9**
Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Role of ECD and ICT in Cybercrime - Classification of Cyber Crime. The Present and future of Cybercrime - Cyber Forensics -Steps in Forensic Investigation - Forensic Examination Process - Types of CF techniques - Forensic duplication and investigation - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.	
UNIT II: EVIDENCE COLLECTION AND FORENSICS TOOLS	**9**
Processing Crime and Incident Scenes – Digital Evidence - Sources of Evidence -Working with File Systems. - Registry - Artifacts - Current Computer Forensics Tools: Software/ Hardware Tools - Forensic Suite - Acquisition and Seizure of Evidence from Computers and Mobile Devices - Chain of Custody- Forensic Tools	
UNIT III: ANALYSIS AND VALIDATION	**9**
Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics - Analysis of Digital Evidence - Admissibility of Evidence - Cyber Laws in India - Case Studies	
UNIT IV: iOS FORENSICS	**9**
Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud	
UNIT V: ANDROID FORENSICS	**9**
Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security –Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools –Oxygen Forensics – MobilEdit – Android App Decompiling	
	Total:45 Periods

Learning Resources

1	Bill Nelson, Amelia Phillips, Christopher Steuart, — Guide to Computer Forensics and Investigations‖, Cengage Learning, India Sixth Edition, 2019.
2	CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, Version 11, 2021
3	Dejey, S. Murugan - Cyber Forensics, Oxford University Press, India, 2023
4	John R.Vacca, “Computer Forensics “, Cengage Learning, 2015.
5	MarjieT.Britz, “Computer Forensics and Cyber Crime: An Introduction 3rd Edition, Prentice Hall, 2018.
6	AnkitFadia “ Ethical Hacking, Second Edition, Macmillan India Ltd, 2012.
7	Kenneth C.Brancik “Insider Computer FraudII Auerbach Publications Taylor &Francis Group– 2016.
8	Cyber Forensics - GeeksforGeeks
9	Cyber Security: Digital Forensics | Coursera
10	“Internet Crimes and Cyber Security” , Prof. K.V.K Santhy, Prof. B Md Irfan, NALSAR University of Law, NPTEL Internet Crimes and Cyber Security - Course

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 cybercrime and cyber forensics, including investigation processes and techniques.	Understand



CO2	Apply appropriate forensic tools and techniques for evidence collection from digital devices.	Apply
CO3	Analyze and validate digital forensic data from various sources such as networks, emails, and mobile devices	Analyze
CO4	Apply appropriate forensic tools and techniques to examine and investigate iOS devices.	Apply
CO5	Use suitable forensic tools and methods to analyse evidence from Android devices.	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	2	3	-	2	3	-	2	-	-	-	2	2	3
CO3	2	3	3	3	2	-	2	-	-	-	2	2	3
CO4	3	1	2	2	3	-	-	-	2	-	3	2	3
CO5	3	3	2	2	2	-	-	-	2	-	2	2	2
Avg.	2.6	2.4	2.3	2.25	2.5	-	2	-	2	-	2.2	2	2.6

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

U24CSCS07	Cryptocurrency and Blockchain Technologies	L	T	P	C
		3	0	0	3

Course Objective:

- To learn the fundamentals of blockchain and distributed ledgers
- To understand the working of cryptocurrencies like Bitcoin and Ethereum
- To understand consensus mechanisms and cryptography
- To develop skills for smart contract design and decentralized applications (DApps)
- To explore real-world applications, security, and regulatory aspects

Detailed Syllabus

UNIT I: INTRODUCTION TO BLOCKCHAIN **9**

Blockchain – Structure – Characteristics – Types of Blockchain - Public Ledgers - Blockchain as Public Ledgers - Block in a Blockchain, Transactions in Blockchain - The Chain and the Longest Chain - Permissioned Model of Blockchain - Cryptographic – Hash Function- Properties of a hash function-Hash pointer and Merkle tree

UNIT II: BITCOIN AND CRYPTOCURRENCY **9**

A basic crypto currency- Payments and double spending -Bitcoin architecture- Bitcoin P2P Network- Transaction in Bitcoin networks -FORTH – the precursor for Bitcoin scripting- Bitcoin Scripts- Creation of coins -Block Mining - Block propagation and block relay

UNIT III : BITCOIN CONSENSUS **9**

Bitcoin Consensus- Proof of Work (PoW)- Hashcash PoW - Bitcoin PoW - Attacks on PoW - Bitcoin Miner- Mining Difficulty- Block Reward –Bitcoin Halving -Mining Pool - monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Permissioned model and use cases.

UNIT IV: HYPERLEDGER FABRIC & ETHEREUM **9**

Introduction to Hyperledger fabric -Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network – Ether - Transaction fee –Gas and Gas Price-Smart contract- Solidity – EVM - Mist Browser - web3 and DApps Interaction.

UNIT V: BLOCKCHAIN APPLICATIONS **9**
Smart contracts- Truffle Design and issue- DApps- NFT- Blockchain Applications in Supply Chain Management- Logistics - Smart Cities- Finance and Banking-Insurance - Case Study.
Total: 45 Periods

Learning Resources

1	Imran Bashir , Mastering Blockchain, Packt Publishing ,2023
2	Andreas M. Antonopoulos ,Mastering Bitcoin , O'Reilly ,2023
3	Arshdeep Bahga & Vijay Madisetti , Blockchain Applications : A Hands-On Approach, VPT, 2026
4	Daniel Drescher ,Blockchain Basics, Apress, 2026
5	Nir Kshetri , The Rise of Blockchain , Edward Elgar Publishing , 2022
6	Roger Wattenhofer, "Blockchain Science: Distributed Ledger Technology" CreateSpace Independent Publishing Platform, 2019.
7	"Blockchain and its application", Prof. Sandip Chakraborty, Prof. Shamik Sural, IIT Kharagpur, NPTEL. https://onlinecourses.nptel.ac.in/noc26_cs34
8	https://www.blockchain-council.org/certifications/blockchain-101-course
9	https://www.coursera.org/learn/blockchain-foundations-and-use-cases

Course Outcomes

At the end of the course, the students will be able to		
CO	**Course Outcome Statement**	**Knowledge Level**
CO1	Explain the fundamentals of blockchain and cryptographic principles.	Understand
CO2	Understand and analyze the working of Bitcoin and cryptocurrencies.	Understand
CO3	Compare and evaluate block chain consensus mechanisms.	Understand
CO4	Describe Hyperledger fabric and Ethereum.	Understand
CO5	Apply blockchain technology to real-world 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	-	-	-	3	2	2
CO2	3	3	3	-	3	2	2	-	-	-	3	2	2
CO3	3	3	3	-	3	2	2	-	-	-	3	2	2
CO4	3	3	3	-	3	2	2	-	-	-	3	2	2
CO5	3	3	3	-	3	2	2	-	-	-	3	2	2
Avg.	3	3	3	-	3	2	2	-	-	-	3	2	2

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

PROFESSIONAL ELECTIVE – IV

VERTICAL 4: EMERGING TECHNOLOGIES

(Common to B.Tech - Artificial Intelligence and Data Science)

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 – Pathfinding

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

UNIT V: 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.
Total: 30 Periods

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: 30 Periods
	Total: 30 + 30 = 60 Periods

Learning Resources

1	Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.
2	Jesse Schell, *The Art of Game Design: A Book of Lenses*, 3rd Edition, CRC Press, 2019.
3	Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison Wesley,2013.
4	Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress,2007.
5	Paul Craven, “Python Arcade games”, Apress Publishers,2016
6	David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press,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 Java 3D – 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: 45 Periods

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, MIT Press, 2019
3	RalfDoerner, 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, editors. “Emerging technologies of augmented reality: Interfaces and design”, IGI Global; 2006
7	Hale KS, Stanney KM, “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:30 Periods

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: 30 Periods
	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", Apress 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	PO 11	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.
- Analyze 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 neighbors - Support Vector Machine (SVM) in quantum space - Quantum Principal Component Analysis - Feature Maps - Linear Models - Probabilistic Models - Quantum Neural Networks	
	Total: 45 Periods

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 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

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	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)

U24CSET05	**SOFT COMPUTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- 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 – Flow Chart of GA – Genetic Representation: (Encoding) Initialization and Selection – Genetic Operators: Reproduction, Crossover, Mutation- Particle Swarm Optimization – Ant colony Optimization – Algorithmic steps and implementation -Convergence of Evolutionary Algorithm – 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 network parameters using Evolutionary algorithms - Introduction to Support Vector Machine - Case study of hybrid techniques – Familiarization of Neural Network, Fuzzy logic and ANFIS controller's toolbox
Total: 45 Periods

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 Chakraverty, 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	Describe the fundamental concepts of neural networks, architectures, and learning techniques.	Understand
CO2	Apply competitive neural network models such as Self-Organizing Maps and Learning Vector Quantization.	Apply
CO3	Explain fuzzy logic concepts, fuzzy inference systems, and their applications in control systems.	Understand
CO4	Apply evolutionary algorithms such as Genetic Algorithms, Particle Swarm Optimization, and Ant Colony Optimization for solving optimization problems.	Apply
CO5	Analyze hybrid intelligent systems including neuro-fuzzy models and optimization of neural networks using evolutionary techniques.	Analyze

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	1.6

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:

- To understand the basic technologies and protocols used in Industrial IoT.
- To illustrate the models and architectures of IIoT.
- To identify and apply different sensors for various IIoT applications.
- To Explain the various protocols used in IIoT.
- To 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: 45 Periods

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	2						2	2	2	2
CO2	2	2	2	2						2	2	2	2
CO3	2	2	2	2						2	2	2	2
CO4	2	2	2	2						2	2	2	2
CO5	2	2	2	2						2	2	2	2
Avg.	2	2	2	2						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.

UNIT II: SEARCH ENGINE OPTIMISATION

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- MAIL MARKETING

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: 15 Periods

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 aids its potential customer segments.
2	Create a Basic Brand Website (Using Wix/WordPress)
3	Perform keyword search for a skincare 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 backlink 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 Ads mock 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 Full Digital Marketing Funnel for a Product/Service End-to-End SEO Optimization for a Small Business Website
	Total: 60 Periods
	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, Cengage 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 – Substantial (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: 30 Periods

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: 30 Periods
	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 preprocess 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: 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: 30 Periods

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: 30 Periods
	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 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 Java 3D – 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: 45 Periods

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, MIT Press, 2019
3	RalfDoerner, 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, editors. “Emerging technologies of augmented reality: Interfaces and design”, IGI Global; 2006
7	Hale KS, Stanney KM, “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: 15 Periods

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: 6. Empathize

	7. Define 8. Ideate 9. Prototype 10. 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:** 6. Problem definition 7. User research 8. Ideation 9. Wireframes 10. 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: 60 Periods
	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)

U24OECS05	**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

UNIT I: 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: 15 Periods

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 a cross 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:60 Periods	
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	PSO 1	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- nonstructural 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: 45 Periods	

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: 45 Periods

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: 45 Periods

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

U24MC41	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: 45 Periods

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: 45 Periods

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	Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
6	https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
7	Benefits of healthy eating https://www.cdc.gov/nutrition/resources-publications/benefitsof-healthy-eating.html

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: 45 Periods

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: 45 Periods

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 (Reprint).
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: 45 Periods

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: 45 Periods

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: 45 Periods

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: 45 Periods

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 (Reprint).*
3	Quantitative Financial Analytics – *Edward E. Williams & John A. Dobelman, World Scientific, Latest Edition, 2017 (Reprint).*
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: 45 Periods

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

Upon completion of this course, the student should 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: 45 Periods

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

Upon completion of this course, the student should 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: 45 Periods

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

Upon completion of this course, the student should 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: 45 Periods

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 (Reprint).
5	The Theory of Public Administration – Nigro and Nigro, Harper & Row, Latest Edition (Reprint), 2017.

Course Outcomes

Upon completion of this course, the student should 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: 45 Periods

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

Upon completion of this course, the student should 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: 45 Periods	

Learning Resources

1	Public Policy: Concepts, Theory and Practice – B. Guy Peters, Routledge, 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

Upon completion of this course, the student should 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