Loyola-ICAM

College of Engineering and Technology (LICET)

(Autonomous)

Loyola Campus, Nungambakkam, Chennai – 600 034

Curriculum and Syllabi (R-2024)

B.Tech. Artificial Intelligence and Data Science

Loyola-ICAM

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CURRICULUM AND SYLLABI (R-2024)

CHOICE BASED CREDIT SYSTEM (CBCS)

B.Tech. Artificial Intelligence and Data Science

Vision of the Institution:

- To form responsible engineers, who would engineer a just society.

Mission of the Institution:

- To provide technical education in a Christian atmosphere to deserving students who are economically poor and socially marginalized
- To train young men and women of quality to be leaders in all walks of life and serve their fellow men with justice, truth and love
- To implement teaching learning processes that ensure guidance and mentoring for students throughout their period of study
- To provide higher education through academic collaboration and pursue research in international perspective of Engineering.

Department Vision

To form innovative Artificial Intelligence and Data Science experts who address real-world and societal challenges through a collaborative and interdisciplinary approach.

Department Mission

M1 : To provide students with a robust foundation in computing fundamentals while specializing in artificial intelligence and data science.

M2 : To develop innovative professionals by equipping students with hands-on experience and practical skills through interdisciplinary projects and industry partnerships.

M3 : To cultivate a culture of continuous learning that empowers students, to embrace evolving technologies and emerging trends.

Programme Educational Objectives:

PEO1 Graduates will have successful careers and demonstrate technical competence in artificial intelligence and data science.

PEO2 Graduates will engage in lifelong learning and professional development, to stay aligned with emerging technologies and evolving industry standards.

PEO3 Graduates will develop strong leadership and collaboration skills, prioritizing ethical responsibility to address societal challenges.

Programme Outcomes:

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)

Programme Specific Outcomes:

PSO1 Apply essential mathematical and statistical principles to interpret data and support the development of Artificial Intelligence and Data Science solutions.

PSO2 Adapt to and utilize scalable tools, platforms and research trends in AI&DS and allied technologies to develop efficient, secure and deployable solutions to address real world challenges.

PSO3 Demonstrate awareness of ethical, legal and social implications for responsible innovation and fairness in AI based solutions.

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CURRICULUM AND SYLLABI (R-2024)

CHOICE BASED CREDIT SYSTEM (CBCS)

B.Tech. Artificial Intelligence and Data Science

SEMESTER – I

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
THEORY COURSES								
1	MA24101	Calculus for Engineers	BSC	3	1	0	4	4
2	BE24101	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
3	CY24101	Applied Chemistry	BSC	3	0	0	3	3
4	HS24101	English for Professional Communication	HSMC	3	0	0	3	3
5	GE24101	Heritage of Tamils / தமிழர் மரபு	HSMC	1	0	0	1	1
LABORATORY INTEGRATED THEORY COURSES								
6	GE24112	Problem Solving using Python	ESC	2	0	4	6	4
LABORATORY COURSES								
7	CY24121	Engineering Chemistry Laboratory	BSC	0	0	2	2	1
8	GE24121	Engineering Practices Laboratory – Civil and Mechanical	ESC	0	0	2	2	1
FORMATION COURSES								
9	FC24101	Life Skills[$]	HSMC	2	0	0	2	1
			TOTAL	17	1	8	26	21

[$]Skill based courses

SEMESTER – II

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
THEORY COURSES								
1	MA24204	Probability and Statistics	BSC	3	1	0	4	4
2	AD24201	C and Elementary Data Structures	PCC	3	0	0	3	3
3	PH24201	Physics for Information Science	BSC	3	0	0	3	3
4	GE24201	Tamils and Technology/ தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1	1
LABORATORY INTEGRATED THEORY COURSES								
5	GE24111	Engineering Graphics	ESC	2	0	4	6	4
LABORATORY COURSES								
6	AD24221	C and Elementary Data Structures Laboratory	PCC	0	0	4	4	2
7	GE24122	Engineering Practices Laboratory – Electrical and Electronics	ESC	0	0	2	2	1
8	PH24121	Physics Laboratory	BSC	0	0	2	2	1
FORMATION COURSES								
9	GE24123	Design Thinking[$]	HSMC	0	0	2	2	1
10	FC24102	Cultural Identities and Globalization	HSMC	2	0	0	2	0
			TOTAL	14	1	14	29	20

[$]Skill based courses

SEMESTER – III

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
THEORY COURSES								
1	MA24301	Discrete Mathematics	BSC	3	1	0	4	4
2	AD24301	Artificial Intelligence	PCC	3	0	0	3	3
3	AD24302	Non-Linear Data Structures and Algorithms	PCC	3	0	0	3	3
4	BS24301	Environmental Science and Sustainability	BSC	3	0	0	3	3
LABORATORY INTEGRATED THEORY COURSES								
5	AD24311	Database Design and Management	PCC	2	0	4	6	4
6	CS24312	Object Oriented Programming in JAVA	PCC	2	0	4	6	4
LABORATORY COURSES								
7	AD24321	Artificial Intelligence Laboratory	PCC	0	0	3	3	1.5
8	AD24322	Non-Linear Data Structures and Algorithms Laboratory	PCC	0	0	3	3	1.5
FORMATION COURSES								
9	BS24321	System Discovery and Analysis	BSC	0	0	2	2	0
			TOTAL	16	1	16	33	24

SEMESTER – IV

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
THEORY COURSES								
1	MA24403	Transforms and Linear Algebra	BSC	3	1	0	4	4
2	AD24401	Machine Learning	PCC	3	0	0	3	3
3	CS24401	Operating Systems	PCC	3	0	0	3	3
LABORATORY INTEGRATED THEORY COURSES								
4	AD24411	Data Engineering	PCC	3	0	2	5	4
5	CS24311	Digital Principles and Computer Organisation	ESC	3	0	2	5	4
LABORATORY COURSES								
6	AD24421	Machine Learning Laboratory	PCC	0	0	3	3	1.5
7	CS24421	Operating Systems Laboratory	PCC	0	0	3	3	1.5
FORMATION COURSES								
8	AD24422	Project Driven Learning[$]	EEC	0	0	2	2	1
9	FC24301	Soft Skills[$]	HSMC	2	0	0	2	1
10	HS24321	Communication Skills Building Laboratory[$]	HSMC	0	0	2	2	1
			TOTAL	17	1	14	32	24

[$]Skill based courses

Foreign language course to be completed by the end of IV semester

SEMESTER – V

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
THEORY COURSES								
1	AD24501	Big Data Analytics	PCC	3	0	0	3	3
2	AD24502	Neural Networks and Deep Learning	PCC	3	0	0	3	3
3	GE24501	Project Management and Operations Management	HSMC	2	0	0	2	2
LABORATORY INTEGRATED THEORY COURSES								
4	AD24512	Data Visualization and Story Telling	PCC	3	0	2	5	4
5	CS24512	Computer Networks	PCC	3	0	2	5	4
6		Professional Elective – 1	PEC	-	-	-	-	3
LABORATORY COURSES								
7	AD24521	Big Data Analytics Lab	PCC	0	0	3	3	1.5
8	AD24522	Deep Learning Lab	PCC	0	0	3	3	1.5
FORMATION COURSES								
9	BS24502	Logical Reasoning and Aptitude Training	BSC	2	0	0	2	1[#]
10	FC24501	Universal Human Values and Service Learning[$]	HSMC	1	0	1[*]	1	1
			TOTAL	19	0	12	31	23

[$]Skill based courses

*Activities on non-working days/hours

Not included for GPA calculation

SEMESTER – VI

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
THEORY COURSES								
1	GE24502	Entrepreneurship and International Business Market	HSMC	2	0	0	2	2
LABORATORY INTEGRATED THEORY COURSES								
2	CS24611	Distributed and Cloud Computing	PCC	3	0	2	5	4
3		Professional Elective – 2	PEC	-	-	-	-	3
4		Professional Elective – 3	PEC	-	-	-	-	3
5		Professional Elective – 4	PEC	-	-	-	-	3
6		Open Elective – 1	OEC	-	-	-	-	3
FORMATION COURSES								
7	GE24621	Interdisciplinary Project[$]	EEC	0	0	2	2	1
8	GE24622	Problem Solving Techniques	EEC	0	0	2	2	1[#]
9	GE24503	Financial Literacy	HSMC	2	0	0	2	0
		TOTAL		13	0	12	25	19

[$]Skill based courses

Not included for GPA calculation

SEMESTER – VII

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
THEORY COURSES								
1		Open Elective – 2	OEC	-	-	-	-	3
2		Open Elective – 3	OEC	-	-	-	-	3
3	GE24701	Working to Engineer a Better World	HSMC	2	0	0	2	2
4		Audit Course	HSMC	2	0	0	2	0
LABORATORY INTEGRATED THEORY COURSES								
5	AD24711	Information Security	PCC	3	0	2	5	4
6		Professional Elective – 5	PEC	-	-	-	-	3
7		Professional Elective – 6	PEC	-	-	-	-	3
LABORATORY COURSES								
8	AD24721	Professional Project – I	EEC	0	0	4	4	2
FORMATION COURSES								
9	AD24722	Internship[$]	EEC	0	0	0	0	2
		TOTAL		-	-	-	-	22

[$]Skill based courses

SEMESTER – VIII

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
LABORATORY COURSES								
1	AD24821	Professional Project – II	EEC	0	0	20	20	10
		TOTAL					20	10

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI
Full Stack Development for CSE & AIDS	**Core AI & Intelligent Systems**	**Advanced AI**	**AI & Analytics for Industry**	**Data Centre Technologies CSE & AIDS**	**Diversified Vertical**
Cloud Application Development	AI Engineering	Explainable AI and Interpretability	AI for Industrial Applications	Data Warehousing and Data Mining Techniques	Quantum Computing
App Development	Recommender Systems	Generative AI	Healthcare Analytics	Virtualization	Augmented Reality / Virtual Reality
Full stack web application development	Soft Computing	Bio Inspired Optimization Techniques	Business Analytics	Cloud Services Management	Modern Cryptography
UI and UX Design	Text and Speech Analysis	Responsible AI	AI for Robotics	Security and Privacy in Cloud	GPU Architecture and programming
Software Testing and Automation	Image and Video Analytics	Image Generation	Business Intelligence for Fintech	Storage Technologies	Robotic Process Automation
Web Application Security	Computer Vision	Game Theory	Social Media Analytics	Software Defined Networks	Cryptocurrency and Blockchain Technologies
DevOps	MLOPS	Agentic AI	AI in Autonomous Vehicles	Stream Processing	Security and Trust in IoT
Principles of Programming Languages	ML Design Patterns	Cognitive Science	Ethics and AI	Fog and Edge Computing	Metaverse
-	-	AI Infrastructure and System Design	-	-	-

MA24101	Calculus for Engineers	BSC	L	T	P	C
			3	1	0	4

Course Objectives:

- To develop the usage of matrix algebra techniques and its applications, which are essential for engineers.
- To provide the students with the rules of differentiation.
- To impart the students with the concepts of functions of several variables.
- To make the students understand various techniques of integration.
- To acquaint the students with mathematical knowledge in evaluating multiple integrals and their applications.

UNIT I TRANSFORMATIONS 12

Stretching of an elastic membrane - eigenvalues and eigenvectors of a real matrix – properties – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms - Cayley Hamilton Theorem

UNIT II DIFFERENTIAL CALCULUS 12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Parametric differentiation- Maxima and Minima of functions of single variable

UNIT III FUNCTIONS OF SEVERAL VARIABLES 12

Partial differentiation – Total derivative – Partial differentiation of implicit functions – Jacobians – Taylor's series – Maxima and Minima of a function of two variables - Method of Lagrangian Multipliers - Evaluating extremum of single and two variable functions.

UNIT IV INTEGRAL CALCULUS 12

Techniques of Integration: Substitution rule, Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Moments and centre of mass.

UNIT V MULTIPLE INTEGRALS 12

Double integrals in Cartesian and Polar coordinates – Area enclosed by plane curves - Change of order of integration – Change of variables in double integrals - Triple integrals in Cartesian coordinates – Volume of solids - Change of variables from Cartesian to Spherical polar coordinates and Cylindrical polar coordinates.

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: To identify the eigenvalues and eigenvectors of a matrix and to execute diagonalization.
CO2: Identify the limit of functions and apply the rules of differentiation to differentiate functions.
CO3: Apply differentiation to functions of several variables
CO4: Evaluate extreme values of functions
CO5: Evaluate integrals using various techniques of integration
CO6: Evaluate multiple integrals in various coordinate systems and applications of multiple integrals

Suggested Activities

- Evaluation of eigenvalues and eigenvectors using scientific tool
- Plotting and visualizing curves, and extreme values using a scientific tool
- Plotting and visualizing surfaces, and extreme values using a scientific tool
- Evaluation of line integrals using scientific tool

- Evaluation of multiple integrals using a scientific tool
- Visualizing 2D and 3D functions using GeoGebra and Desmos

Text Books:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2018.
3. James Stewart, " Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.

References:

1. Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016.
2. Bali.N., Goyal.M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain.R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
5. Kuldeep Singh, “Engineering Mathematics Through Applications”, 2nd Edition, Bloomsbury Academic.
6. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.
7. Amos Gilat, “MATLAB: An Introduction with Applications”, 4th Edition, John Wiley.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	2	1	-	-
CO2	3	2	1	1	2	-	-	-	-	-	2	1	-	-
CO3	3	2	1	1	2	-	-	-	-	-	2	1	-	-
CO4	3	2	1	1	2	-	-	-	-	-	2	1	-	-
CO5	3	2	1	1	2	-	-	-	-	-	2	1	-	-
CO6	3	2	1	1	2	-	-	-	-	-	2	1	-	-
Avg.	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**-**

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

BE24101	Basic Electrical and Electronics Engineering	ESC	L	T	P	C
			3	0	0	3

Course Objectives

- To introduce the basics of Electric Circuits and analysis.
- To impart knowledge in the basics of working principles and application of Electrical Machines.
- To introduce analog devices and their characteristics.
- To educate on the fundamental concepts of digital electronics.

- To interpret the fundamentals of Sensors.

UNIT I ELECTRICAL CIRCUITS 9

DC Circuits: Basic circuit components - Ohm's Law - Kirchhoff's Laws – Nodal Analysis, Mesh analysis - Simple problems with Independent Sources – Introduction to AC Circuits - Purely resistive, Inductive & Capacitive excited by AC Source (Qualitative Treatment Only).

UNIT II ELECTRICAL MACHINES 9

Construction, Working principle, Types and Applications: DC Motor – DC Generator - Single phase Transformers - Stepper Motor - Servo Motor (Qualitative Treatment Only).

UNIT III ANALOG ELECTRONICS 9

Construction, Operation, Characteristics and Application of PN Junction diode – Zener diode – Bipolar Junction Transistor (Common Emitter Characteristics only) – Half wave and full wave Rectifiers.

UNIT IV DIGITAL ELECTRONICS 9

Review of number systems, Binary codes, Hamming and Parity code, Combinational logic - representation of logic functions - SOP and POS forms, K-Map representations- minimization using K maps (Simple Problems with 3 variables only).

UNIT V SENSORS 9

Introduction to Sensors - Photovoltaic - LDR - Piezo electric - RTD - Principle and application of IR sensor - Ultrasonic sensor.

Total Periods:45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the fundamental components of DC circuits.
CO2: Compute the electric circuit parameters for simple problems.
CO3: Explain the working principle and applications of electrical machines.
CO4: Describe the characteristics of analog electronic devices.
CO5: Explicate the basic concepts of digital electronics.
CO6: Explain the principles and applications of sensors.

Text Books:

1. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
2. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

References:

1. Kothari DP and I.J Nagrath, “Basic Electrical Engineering”, Fourth Edition, McGraw Hill Education, 2019.
2. Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, 2002.
5. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	1	-	-	-	2	-	-	-
CO2	2	2	1	-	-	-	1	-	-	-	2	-	-	-
CO3	2	1	1	-	-	-	1	-	-	-	2	-	-	-
CO4	2	2	1	-	-	-	1	-	-	-	2	-	-	-
CO5	2	2	1	-	-	-	1	-	-	-	2	-	-	-
CO6	2	2	1	-	-	-	1	-	-	-	2	-	-	-
Avg.	2	1.8	1	-	-	-	1	-	-	-	2	-	-	-

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

CY24101	Applied Chemistry	BSC	L	T	P	C
			3	0	0	3

Course Objectives:

- To familiarize the water quality criteria and interpret its significance in water purification.
- To identify various boiler troubles and its treatment techniques.
- To assimilate the preparation, properties, and applications of nanomaterials in various fields.
- To illustrate the principles of electrochemical reactions in the corrosion of materials and methods for corrosion prevention and protection of materials.
- To familiarize the students with the operating principles, working processes, and applications of energy conversion and storage devices.
- To impart knowledge about the types of sensors and their applications.

UNIT I WATER TECHNOLOGY 9

Water – Sources and Impurities, Water Quality Parameters: Definition and Significance of Colour, Odour, Turbidity, pH, Hardness, Alkalinity, TDS, COD and BOD, Fluoride and Arsenic. Municipal water treatment: Screening, Sedimentation, Coagulation, Sand filtration and Disinfection (Ozonation, UV treatment, Chlorination), Desalination of brackish water: Reverse Osmosis. Boiler troubles (Scale & Sludge, Caustic embrittlement, Boiler Corrosion, Priming & Foaming). Internal

Conditioning (Colloidal, Sodium Aluminate, Phosphate and Calgon Conditioning) and External Conditioning (Zeolite and Ion-Exchange Demineralization).

UNIT II NANO CHEMISTRY 9

Basics: Distinction between Molecules, Nanomaterials and Bulk materials; Size-Dependent Properties (Optical, Electrical, Mechanical, Magnetic and Catalytic). 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 ELECTROCHEMISTRY AND CORROSION 9

Electrochemical Cell, Redox reaction, Electrode Potential - Oxidation and Reduction Potential. Nernst Equation and Applications. Emf Series. Introduction to Corrosion - Chemical and Electrochemical Corrosion (Galvanic Corrosion, Concentration Cell Corrosion), Galvanic Series - Factors Influencing Corrosion. Corrosion Control - Material Selection and Design - Electrochemical Protection - Sacrificial Anodic Protection and Impressed Current Cathodic Protection. Protective Coatings - Metallic Coatings (Galvanizing, Tinning), Organic Coatings (Paints). Paints: Constituents and Functions.

UNIT IV STORAGE DEVICES AND ENERGY SOURCES 9

Batteries - Characteristics - Types of Batteries – Primary Battery (Alkaline Battery), Secondary Battery (Lead Acid, Lithium - Ion - battery) - Emerging Batteries – Nickel - Metal Hydride Battery, Aluminium Air Battery, Batteries for Automobiles and Satellites - Fuel Cells (Types) – H2-O2 Fuel Cell - Super capacitors - Types and Applications, Nuclear Energy – Nuclear Fission, Fusion, Differences, Characteristics – Nuclear Chain reactions – Light Water Nuclear Reactor – Breeder Reactor. Renewable Energy: Solar energy - Solar Cells, DSSC.

UNIT V CHEMICAL SENSORS 9

Sensors, Sensor Science and Technology, Types of Sensors. Chemical Sensors – Characteristics and Elements. Electrochemical Sensors – Voltammetry, Potentiometric Sensors, Amperometric Sensors, Polarization Techniques.

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Analyze the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2: Explain the various boiler problems and water treatment techniques.

CO3: Apply basic concepts of Nano chemistry in designing the synthesis of nanomaterials for engineering applications.

CO4: Apply the principles of electrochemistry in corrosion control.

CO5: Analyze different forms of energy resources for suitable applications in energy sectors.

CO6: Explain the types of sensors and their applications.

Suggested Activities

- Quiz
- Mind Mapping on type of nanomaterials
- Seminar
- Animated videos on reverse osmosis, nuclear power plant
- Demonstration of water parameter analysis
- Electroplating process by group of students
- Demonstration of sensors

Text Books:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi,2012.
3. Dara S.S., "A Textbook of Engineering Chemistry", Chand Publications, 2004.
4. B.K.Sharma, "Instrumental Methods of Chemical Analysis" , 28th Edition, Goel Publishing House. 2012.

References:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text Book of Nanoscience and Nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	1	-	-	-	-	1	-	-	-
CO2	3	2	2	1	-	1	-	-	-	-	1	-	-	-
CO3	2	-	-	1	-	2	-	-	-	-	-	-	-	-
CO4	3	2	2	1	-	2	-	-	-	-	2	-	-	-
CO5	3	1	2	1	-	2	-	-	-	-	2	-	-	-
CO6	3	1	2	1	-	2	-	-	-	-	2	-	-	-
Avg.	**2.8**	**1.6**	**1.7**	**1**	**-**	**1.67**	**-**	**-**	**-**	**-**	**1.3**	-	-	-

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

HS24101	English for Professional Communication	HSMC	L	T	P	C
			3	0	0	3

Course Objectives:

- To develop effective listening, speaking, reading, and writing skills for professional contexts.
- To cultivate formal correspondence skills for workplace communication.
- To analyze and apply rhetorical techniques in writing and speaking.
- To encourage self-expression through storytelling and reflective writing.
- To strengthen grammar and vocabulary for improved language proficiency.

UNIT I Communication basics **9**

Listening - Link verbal and nonverbal cues and listen to podcasts and news stories.
Reading - Read brochures and running headlines. Social media messages and electronic correspondence relevant to professional advancement
Writing - Formal letters
Speaking - Self-introduction - Dialogues and role plays, discussing news stories, asking doubts (clarification, direction, inquiring details…)
Grammar - Noun, Pronoun, Articles
Vocabulary - one-word substitution, phrasal verbs

UNIT II Professional Correspondence **9**

Listening - Listen to voicemails, presentations, and panel discussions
Reading - MoM - minutes of the meeting, memos, business and economic articles
Writing - Respond to Business Emails
Speaking - Inaugural speech, Vote of thanks, and mini-presentation
Grammar - Verb, concord, wh questions, and Yes/no, question tag
Vocabulary - Word forms (Prefix & suffix)

UNIT III Rhetoric Communication **9**

Listening - Monologue from plays and movies, and sale pitches (marketing and promotions)
Reading - Looking for ambiguity - Ethos, pathos, and logos (poem or play)
Writing - Essays - problem solution, cause and effect essay
Speaking - Deliver a monologue - situational scenarios
Grammar - Conjunctions, prepositions, interjections
Vocabulary - Discourse markers for contextual essays, idioms, and phrases

UNIT IV Extended narration **9**

Listening - Listen to documentaries, debates, discussions, and Toastmasters speech
Reading - Read professional resumes, LinkedIn profiles, newsletter
Writing - Blog writing, writing reviews

Speaking - Debate, group discussion
Grammar - Mixed tenses, Adverb
Vocabulary - Compound words, Collocation

UNIT V Language and self 9

Listening - Listen to tone, mood, and attitude. Find meanings based on the context, and listen to different accents.
Reading - An excerpt from an autobiography
Writing - Reflective journal and diary entries
Speaking - Narrate stories from personal experience
Grammar - Adjective, direct, and indirect speech
Vocabulary - Contextual meaning of words, Abbreviations, and acronyms

Total Periods: 45

Course Outcomes:
On completion of the course, the students will be able to
CO1: Demonstrate enhanced listening, speaking, reading, and writing skills tailored for professional environments.
CO2: Compose clear formal emails and letters for workplace communication.
CO3: Analyze and use rhetorical techniques to engage and persuade audiences.
CO4: Develop storytelling and reflective writing skills to share personal experiences.
CO5: Improve grammar and vocabulary for effective communication.
CO6: Foster teamwork and discussion abilities through debates and group presentations.

Suggested Activities

- Take a set of 15 messages and classify them into spam, alerts, scams, discount texts, news, cautionary, personnel, and informative.
- Reflective journal - write your own personal and learning experience so far at LICET. Page limit: 3 pages.
- Rhetoric Writing - Find a product or create a product and employ ethos, pathos, and logos to persuade the customers to buy your product. Write in 250 words.
- Creative writing - Create your account on Blogger and write reviews, articles, and stories.

Text Books:

1. English for Engineers and Technologists. Volume I by Orient Blackswan, 2022
2. English for Science & Technology - I by Cambridge University Press, 2023

References:

1. Interchange. Cambridge University Press. USA, 2022.
2. Embark. Cambridge University Press. USA, 2016.
3. A course in Technical English. Cambridge University Press. USA, 2023.

4. High School English Grammar & Composition. Wren & Martin's Regular & Multicolour Edition. S.Chand Publishing, 2016.
5. Interchange by Jack C. Richards, Fifth Edition, Cambridge University Press, 2017.
6. English for Academic Correspondence and Socializing. Adrian Wallwork, Springer, 2011.
7. The Study Skills Handbook. Stella Cortrell, Red Globe Press, 2019
8. www.uefap.com

MAPPING OF COs WITH POs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	1	1	3	-	2	3	-	3	-	-	-
CO2	-	-	-	1	1	3	-	2	3	-	3	-	-	-
CO3	-	-	-	1	1	3	-	3	3	1	3	-	-	-
CO4	-	-	-	1	1	3	1	1	1	2	3	-	-	-
CO5	-	-	-	1	1	3	-	2	3	-	3	-	-	-
CO6	-	-	-	1	1	3	-	3	3	1	3	-	-	-
Avg.	-	-	-	1	1	3	1	2.1	2.6	1.3	3	-	-	-

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

GE24101	HERITAGE OF TAMILS	HSMC	L	T	P	C
			1	0	0	1

Course Objectives:

This course enables the students to

- provide an insight to the students into the rich culture and heritage of the state
- provide the students with detailed information on the engineering techniques to construct architectural marvels practiced in Tamil Nadu
- make the students connect with their roots, appreciate, and preserve it.

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, Leather puppetry, 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 Periods:15

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the human values and rights in Tamil literature
CO2: Learn the art and culture being practiced by the people of Tamil Nadu
CO3: Understand various games and dance practices by the people of Tamil Nadu
CO4: Understand the Tamil Culture and Customs through Folklore
CO5: Learn the concepts of Sangam Literature and the bravery of Kings
CO6: Learn the life history of freedom fighters Vedic herbs and developments in lifestyle

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9. 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)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

GE24101	தமிழர் மரபு	HSMC	L	T	P	C
			1	0	0	1

அலகு I மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தொல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குக் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

Total Periods:15

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9. 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)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

GE24112	Problem Solving using Python	ESC	L	T	P	C
			2	0	4	4

Course Objectives:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To define Python functions and use function calls to solve problems.
- Learn to manage file operations, handle exceptions, and apply object-oriented programming principles in Python
- To familiarize with Python's module system, packages, and essential scientific libraries

UNIT I PROBLEM SOLVING AND INTRODUCTION TO PYTHON PROGRAMMING 7

Fundamentals of computational thinking, algorithmic problem solving and logical thinking, problem solving and decomposition, notations (pseudo code, flowchart) - Introduction to Python - Literals - Variables and Identifiers - Comments- Reserved words - Data Types - Operators and Expressions - Input and Output: Working with user input, displaying output, and formatting - Conditional if - alternative if - chained conditional - Iteration: state, while, for, break, continue, pass.

UNIT II DATA STRUCTURES AND MANIPULATION 5

Lists: List operations - List slices - List methods - List loop - Mutability - Aliasing - Cloning lists - List parameters - Lists as arrays - Advanced list processing - List Comprehension - Tuples: Tuple assignment - Tuple as return value - Dictionaries: Operations and Methods - Sets: Creating Sets - Operations and methods - Set comprehension.

UNIT III STRINGS AND FUNCTIONS 6

Functions - definition and use - Flow of execution - Parameters and arguments - Fruitful functions: Return values - Parameters - Local and global scope - Function composition - Recursion - Strings: string slices, immutability, string functions and methods, string module.

UNIT IV FILES, EXCEPTIONS, CLASSES AND OBJECTS 6

Files and exception: Text files - Reading and writing files - Command line arguments - Errors and exceptions - Handling exceptions - Classes and Objects: Defining classes - Creating Objects - Data abstraction - Class variables and Object variables - Working with objects and Methods.

UNIT V MODULES AND PACKAGES 6

Introduction to Modules and Packages- Basics of NumPy - N-dimensional Array in NumPy - Methods and Properties - Basics of SciPy - Broadcasting in NumPy - Array Operations - Array

Indexing in NumPy, Pandas - Introduction - Series - Data Frame - Matplotlib - Basics - Figures and Axes - Method subplot - Axis container.

Periods: 30

LIST OF EXPERIMENTS:

1. Identification and solving of simple real life or technical problems related to applications to specific discipline and developing algorithms/flowcharts.
2. Python programming using simple statements and expressions.
3. Solving problems using conditional statements.
4. Solving problems using iterative loops (Palindrome, Factorial, Prime Numbers).
5. Implementing real-time/technical applications using List.
6. Implementing real-time/technical applications using Tuples.
7. Implementing real-time/technical applications using Dictionaries.
8. Implementing real-time/technical applications using sets.
9. Implementing programs using functions.
10. Implementing programs using strings.
11. Implementing programs using modules.
12. Implementing programs using command line arguments.
13. Implementing real-time/technical applications using file handling (Word count- longest word - Copy file).
14. Implementing real-time/technical applications using exception handling.
15. Creating and Instantiating classes (Creating student class and object, Voter's age validation, Marks range validation (0-100)).
16. Implement programs using standard libraries (Pandas, Numpy, Scipy).
17. Generating basic plots using Matplotlib.
18. Developing a game activity using Pygame.

Periods: **60**

Total Periods: 90

Course Outcomes:

On completion of the course, the students will be able to

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop solutions to problems using control structures.
CO3: Process compound data using Python data structures.
CO4: Structuring python program into functions and to implement String handling functions.
CO5: Read and write data from/to files in Python programs and handle exceptions.
CO6: Understand object-oriented programming concepts through classes and objects.
CO7: Utilize Python modules and packages for performing data analysis.

Suggested Activities:

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Assign a project to create a small application that uses various Python data structures (lists, tuples, dictionaries, and sets) to manage and process a dataset (e.g., a contact list or inventory system).
- Data Analysis and Visualization using NumPy, Pandas, and Matplotlib - Provide a dataset (e.g., weather data, sales records) and ask students to perform data analysis using NumPy and Pandas, followed by visualizing the results using Matplotlib.
- External Learning - Recursion vs. Iteration.
- Flipped Learning - tkinter package
- Mini-project

Text Books:

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.

References:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. S.Sridhar, J.Indumathi, V.M.Hariharan, “Python Programming”, 3rd Edition, Pearson, 2024.
3. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
4. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021
5. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
6. https://www.python.org/
7. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	-	-	2	-	-	-	-	1	1	-	2	1
CO2	2	2	1	-	2	-	-	-	-	1	1	-	2	1
CO3	2	2	-	-	2	-	-	-	-	1	1	-	2	1
CO4	2	2	2	2	2	-	-	-	-	1	1	-	2	1
CO5	2	2	-	-	2	-	-	-	-	1	1	-	2	1
CO6	2	2	2	2	2	-	-	1	-	1	1	-	2	3
CO7	2	2	2	2	2	-	-	1	-	1	1	-	2	3
Avg.	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**2**	**2**

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

CY24121	Engineering Chemistry Laboratory	BSC	L	T	P	C
			0	0	2	1

Course Objectives

- To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity, hardness, DO, TDS, and Chloride.
- To demonstrate the synthesis of nanoparticles.
- To familiarize the students with the determination of the molecular weight of a polymer by a viscometer.
- To familiarize the students with electroanalytical techniques such as pH metry, Potentiometry, and Conductometry to determine impurities in aqueous solutions.
- To understand the factors influencing corrosion.

LIST OF EXPERIMENTS:(Minimum of 7 experiments to be conducted)

1. Estimation of HCl using Na2CO3 as primary standard
2. Determination of alkalinity in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Determination of strength of given hydrochloric acid using pH meter.
8. Conductometric titration of strong acid vs strong base.
9. Estimation of iron content of the given solution using potentiometer.
10. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline/thiocyanate method).
11. Estimation of sodium and potassium present in water using a flame photometer.
12. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
13. Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol-Gel method.
14. Corrosion experiment-weight loss method.
15. Conductometric titration of barium chloride Vs Sodium Sulphate - Precipitation method.

Total Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1: Analyze the quality of water samples with respect to their acidity, alkalinity.

CO2: Determine the hardness and chloride content of the water sample.

CO3: Demonstrate precipitation method for synthesis of nanoparticles.

CO4: Determine the molecular weight of the polymer.

CO5: Estimate the amount of analyte by conductometry.

CO6: Quantitatively analyze the impurities in solution by electroanalytical techniques.

References:

1. Engineering Chemistry Laboratory Manual – Department of SH-Chemistry, LICET, 2024.
2. Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014).

Laboratory Requirements:

1.Conductivity meter – 15 Nos.
2. pH meter - 15 Nos.
3. Potentiometer - 15 Nos.
4.Viscometer - 35 Nos.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	2	-	-	-	-	2	-	-	-
CO2	3	2	1	-	-	2	-	-	-	-	2	-	-	-
CO3	2	1	2	-	-	2	-	-	-	-	-	-	-	-
CO4	2	1	2	-	-	1	-	-	-	-	1	-	-	-
CO5	3	1	2	-	1	2	-	-	-	-	2	-	-	-
CO6	3	1	2	-	1	2	-	-	-	-	2	-	-	-
Avg.	2.7	1.3	1.7	-	1	1.8	-	-	-	-	1.8	-	-	-

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

GE24121	**Engineering Practices Laboratory - Civil and Mechanical**	**ESC**	**L**	**T**	**P**	**C**
			0	**0**	**2**	**1**

Course Objectives:

- Familiarize students with basic tools and equipment used in engineering.
- Develop practical skills in Mechanical, Civil and 3D Printing practices.
- Encourage teamwork and collaboration in a lab environment.
- Foster an understanding of safety protocols and procedures.

INTRODUCTION AND SAFETY PRACTICES

Overview of lab rules, expectations, and safety protocols**,** Personal Protective Equipment (PPE), handling tools and equipment safely, emergency procedures.

MECHANICAL PRACTICES

Workshop Tools: Identification and usage of basic mechanical tools (hammers, wrenches, screwdrivers, etc.). **Basic Machining:** Introduction to lathe and drilling machines. Practicing Facing, Turning, and Drilling. **Sheet Metal Works:** Making a dustpan and funnel.

CIVIL PRACTICES

Plumbing: Exposure to different plumbing components. Exposure to plumbing repair methods and troubleshooting of existing connections. Practicing pipe connection to the wash basin from the water tank. **Carpentry:** A study on carpentry procedure. Making joints like the Tee joint and the Dovetail joint. Exposure and usage of power tools.

ADDITIVE MANUFACTURING PRACTICES

Welding: Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding, CO2, gas, and MIG welding techniques. **Foundry:** Introduction to the foundry process and tools. Mold preparation for solid and split patterns. **3D Printing:** Basics of 3D printing and simple projects.

ASSEMBLING AND FITTING

Introduction to Systems - Dismantling and Assembling of Mixer/IC Engines/Refrigerator and Air Conditioner

Total Periods: 30

Course Outcomes:
On completion of the course, the students will be able
CO1: To perform basic machining operations
CO2: To perform operations on the given sheet metal
CO3: To understand the concepts of additive manufacturing methods like Welding, Moulding and 3D Printing
CO4: To understand the rudimentary concepts of refrigeration and air conditioning systems
CO5: To do basic household works like Plumbing, Carpentry Joints
CO6: To identify the components of Mixer/IC Engines/Refrigerator/AC.

Text Books:
1.Workshop Technology by W.A.J. Chapman
2.Electrical Engineering Fundamentals by Vincent Del Toro
3.Basic Civil Engineering by M.S. Palanichamy

MAPPING OF COs WITH POs AND PSOs

COs	Pos											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	2	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	2	-	-	-	-	-	-
CO3	2	-	-	-	2	-	-	2	-	-	-	-	-	-
CO4	2	-	-	-	1	-	-	2	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	2	-	-	-	-	-	-
CO6	1	-	-	-	-	-	-	2	-	-	-	-	-	-
Avg.	1.6	-	-	-	1.5	-	-	2	-	-	-	-	-	-

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

FC24101	Life Skills	HSMC	L	T	P	C
			2	0	0	1

Course Objectives

- To enhance self-awareness and understanding of personal strengths, weaknesses, and potential.
- To develop mechanisms to navigate through emotions and stress.
- To build effective interpersonal skills and maintain healthy social relationships.
- To foster and develop strategies for holistic well-being.
- To reflect on personal growth.

UNIT I Knowing Thyself **6**

- Knowing Thyself
  - Strengths, Limitations, Characteristics, Habits and Experiences

- Sense of SELF
    - Self Awareness, Self Image, Self-esteem, Self Love, Self Respect
- Three Dimensions of SELF
    - 1) Ideal Self, 2) Social Self, and 3) Real Self
- Personality Types
    - 1) Introvert, 2) Extrovert, and 3) Ambivert

UNIT II Emotional Competence 6

- Understanding emotions
- Understanding the patterns of thoughts, feelings, and behaviors (Cognitive Behavior Theory)
- Handling stress, anxiety, and fear (flight mode) / anger (fright mode)
- Happy chemicals (4 chemicals - Dopamine, Oxytocin, etc)
- Positive Thinking

UNIT III Interpersonal Skills 6

- Interpersonal relationships
- Communicating Positive Expressions (Empathy, Trust, Forgiveness, Gratitude, Compassion)
- Personal and Social Associations - Family systems, Relationship management
- Building personal, social, and digital intelligence
- Sense of OTHERS
- Gender Equity

UNIT IV Dimensions of Well-being 6

- Intellectual Well-being
- Emotional Well-being
- Spiritual Well-being
- Physical Well-being
- Social Well-being

UNIT V Life to the fullest 6

- Happiness v/s Having fun
- Self-Retrospection and Positive Transformation
- Synthesis, Personal Reflection, and Way Forward

Total Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1: Identify their strengths and weaknesses and demonstrate self-awareness through reflective practices.

CO2: Demonstrate the ability to recognize emotions and handle stress.

CO3: Enhance interpersonal skills to build strong and positive relationships.

CO4: Adapt to a comprehensive understanding of well-being, and be able to implement strategies for maintaining mental health.

CO5: Develop a deeper understanding of personal and social relationships, and identify areas for growth.
CO6: Synthesize learning into a cohesive life plan for future growth.

Suggested Activities

- Cognitive behavior therapy
- PLOT
- SLOT
- SWOT
- Johari Window

References:

1. Bradberry, Travis, and Jean Greaves. *Emotional Intelligence 2.0*. TalentSmart,2009.
2. Republic of Philippines, Department of Education. K to 12 Senior High School Core Curriculum. - Personal Development, May 2016.
3. US Department of Education, Career Guidance and Counselling Programs. Rich South High School Horizon Program: (Rich Town Park Illinois: Rich South High School, 1998)

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	3	3	3	-	-	-	-	-
CO4	-	-	-	-	-	3	3	-	3	-	3	-	-	-
CO5	-	-	-	-	-	3	3	-	-	-	3	-	-	-
CO6	-	-	-	-	-	-	3	-	-	-	-	-	-	-
Avg.	-	-	-	-	-	2.8	3	3	3	-	3	-	-	-

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

MA24204	Probability and Statistics	BSC	L	T	P	C
			3	1	0	4

Course Objectives

- This course aims to provide the required skill to apply statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two-dimensional random variables.
- To acquaint the knowledge of testing hypotheses for small and large samples which plays an important role in real-life problems.
- To introduce the basic ANOVA techniques

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – The axioms of probability – Conditional probability – Total Probability - Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (without proof)

UNIT III TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit

UNIT IV ANOVA TECHNIQUES 12

One-way and Two-way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling

Total Periods: 60

Course Outcomes:
On completion of the course, the students will be able to
CO1: To introduce the basic concepts of probability and random variables
CO2: To apply standard distributions in real-life phenomena
CO3: To introduce the concepts of two-dimensional random variables
CO4: To apply the concept of testing of hypothesis for large samples and small samples in real life problems
CO5: To apply the basic concepts ANOVA technique
CO6: To understand the concepts of statistical quality control

Suggested Activities
- Generate random variables using scientific tool
- Generate two dimensional random variables using scientific tool
- Performing Z-test using scientific tool
- Performing analysis of variance using scientific tool

- Visualizing control charts using scientific tool

Text Books:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

References:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	-	-	2	3	-	-
CO2	3	2	2	2	2	-	-	-	-	-	2	3	-	-
CO3	3	2	2	2	2	-	-	-	-	-	2	3	-	-
CO4	3	2	2	2	2	-	-	-	-	-	2	3	-	-
CO5	3	2	2	2	2	-	-	-	-	-	2	3	-	-
CO6	3	2	2	2	2	-	-	-	-	-	2	3	-	-
Avg.	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

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

AD24201	**C and Elementary Data Structures**	**PCC**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives:

- To develop proficiency in fundamental concepts of C programming
- To understand and apply advanced C features
- To learn the concepts of Abstract Data Types and Lists
- To comprehend stack and queue ADTs and its applications
- To implement Searching, Sorting, and Hashing Techniques

UNIT I C Programming Fundamentals 9

Introduction-Data Types – Variables – Operations – Expressions and Statements – Control Statements and Looping – Functions – Arrays – Single and Multi-Dimensional Arrays, String Manipulation

UNIT II C Programming - Advanced Features 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling –Dynamic Memory Allocation- Preprocessor Directives.

UNIT III Abstract Data Types and List 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

UNIT IV Stack and Queue 9

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

UNIT V Searching, Sorting and Hashing Techniques 9

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

Total Periods: 45

Course Outcomes:
On completion of the course, the students will be able to
CO1: Develop C Programs for any real world/technical application.
CO2: Apply advanced features of C in solving problems.
CO3: Design and implement list ADTs.
CO4: Design, implement, and analyse queues and stacks with its applications.
CO5: Implement and appropriately use sort, search and hashing techniques for any application.
CO6: To enhance problem-solving skills and write optimized code using data structures and algorithms.

Suggested Activities

- Flipped Learning on recursion vs iteration. Program to perform the same functionality using recursion and iteration
- Flipped Learning on File Handling followed by an in-class activity where students write a program that reads data from a file using file handling functions and utilizes pointers for data processing.

- Implement Bubble Sort, Selection Sort, and Insertion Sort. Extend this by implementing Merge Sort. Compare their performance on different input sizes and patterns (e.g., sorted, reverse sorted, random).
- Develop a simple library management system where books are stored as records (structure/union) with features like adding, deleting, searching for books (using hash tables), and listing books in a sorted order (using sorting algorithms).

Text Books

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2. ReemaThareja, "Programming in C", Second Edition, Oxford University Press, 2016.

Reference Books

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education,1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2008

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	-	2	-	-	1	-	1	2	-	-	-
CO2	2	2	2	1	2	-	-	1	-	1	2	-	-	-
CO3	2	3	2	1	2	-	-	1	-	1	2	-	-	-
CO4	2	3	2	2	2	-	-	1	-	1	2	-	-	-
CO5	2	3	2	2	2	-	-	1	-	1	2	-	-	-
CO6	2	2	3	2	3	-	-	1	-	2	2	-	-	-
Avg.	**2**	**2.67**	**2.16**	**1.6**	**2.16**	**-**	**-**	**1**	**-**	**1**	**2**	**-**	**-**	**-**

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

PH24201	Physics for Information Science	BSC	L	T	P	C
			3	0	0	3

Course Objectives:

- To make the students understand the basics of elastic properties of matter and Thermal Physics
- To instill knowledge of oscillations and waves and make them able to apply this knowledge in engineering situations.
- To establish a sound grasp of foundational principles of quantum mechanics and enable them to perform basic quantum mechanical calculations.

- To introduce the basics principles of photonics and fibre optic communication to students
- To make students understand the applications of quantum mechanics in solid state physics to decipher the electrical properties of materials.

UNIT I PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity –Hooke's law - stress-strain diagram for ductile and brittle materials – uses- Bending of beams –Bending moment - Young's modulus determination - Cantilever - uniform and non-uniform bending (Theory and experiment) - I shaped girders.
Thermal conduction in solids – Fourier's law - thermal conductivity -Thermal resistance - Determination of thermal conductivity-Lee's disc method: theory and experiment.

UNIT II OSCILLATIONS AND WAVES 9

Simple harmonic motion - Torsional pendulum – Damped oscillations –Shock Absorber - Forced oscillations and Resonance (qualitative)–Applications of resonance - Electrical analogy of mechanical oscillators - waves on a string - progressive waves - stationary waves- Energy transfer of a wave.

UNIT III QUANTUM MECHANICS 9

Black body radiation – Planck's hypothesis and black body radiation formula (qualitative)- Wave particle duality–de Broglie hypothesis– Uncertainty Principle – The Schrodinger Wave equation (time-dependent and time-independent) – Physical interpretation of wave function - Normalization - Particle in an infinite potential well - Energy values and wave functions - Quantum mechanical tunneling. Scanning tunneling microscope.

UNIT IV PHOTONICS AND FIBRE OPTICS 9

Laser – characteristics – Spontaneous and Stimulated emission-Einstein's coefficients - population inversion - Metastable states - Basic components of a laser system - CO_2 laser, Semiconductor laser - Industrial and medical applications - Optical Fibres – Total internal reflection – Numerical aperture and acceptance angle – Fibres optic communication system.

UNIT V QUANTUM THEORY OF SOLIDS 9

Electrons in metals - Classical free electron theory- quantum free electron theory Fermi-Dirac statistics – Density of energy states. Fermi energy and free electron density. Drawbacks of quantum free electron theory- Electrons in a periodic potential- Kronig-Penney Model (qualitative) -Band theory. Classification of solids based on energy band structure.

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Illustrate applications of mechanical and thermal properties of materials in engineering systems.

CO2: Estimate the vibrational stability of an engineering system which employs periodic motion.

CO3: Calculate basic measurable quantities of simple quantum mechanical models.

CO4: Apply the characteristics of lasers for material processing and in the medical field.

CO5: Outline the operational principle of fiber optic communication systems.

CO6: Apply quantum mechanical principles towards the formation of energy bands.

Text Books:

1. Avadhanulu M N, Kshirsagar P G, “A Textbook of Engineering Physics”, S Chand & Co Ltd, Ninth Revised Edition, 2012.
2. Hitendra K Malik, A K Singh " Engineering Physics McGraw Hill Education; Second edition (3 August 2017)
3. Gaur R K, Gupta S L, “Engineering Physics”, Dhanpat Rai Publishers, 2012.

References:

1. Serway R A, Jewett J W, “Physics for Scientists and Engineers”, Cengage Learning, 2010.
2. Halliday D, Resnick R, Walker J, “Principles of Physics”, Wiley, 2015.
3. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	1	-	-	-
CO2	2	1	1	1	-	-	-	-	-	-	1	-	-	-
CO3	2	1	1	1	-	-	-	-	-	-	1	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	1	-	-	-
CO5	2	1	1	1	-	-	-	-	-	-	1	-	-	-
CO6	2	1	1	1	-	-	-	-	-	-	1	-	-	-
Avg.	**2**	**1**	**1**	**1**	-	-	-	-	-	-	**1**	-	-	-

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

GE24201	TAMILS AND TECHNOLOGY	HSMC	L	T	P	C
			1	0	0	1

Course Objectives:

This course enables the students to

- Understand the art of making things and developments in the lifestyle of people
- Understand the various methods of constructing buildings
- Understand the techniques being used in Architecture by Tamils
- Understand and apply the concepts of Tamils with modern technology

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)- Thirumalai Nayakar Mahal - 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 gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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

Total Periods:15

Course Outcomes:

On completion of the course, the students will be able to:
CO1: Know the gradual improvement in the life history of Tamils
CO2: Construct buildings with the impact of the past with the present
CO3: Learn to manufacture remarkable things with the help of technology

CO4: Apply new Concepts in agriculture to the upliftment of the future society
CO5: Apply the ancient skills to find out the measurements of oceans
CO6: Apply the concepts of Tamil with modern technology

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9. 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)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

GE24201	தமிழரும் தொழில்நுட்பமும்	HSMC	L	T	P	C
			1	0	0	1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவு தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற

வழிபாட்டுத் தலங்கள் –நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தொ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம் 3

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

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

Total Periods:15

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9. 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)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

GE24111	Engineering Graphics	ESC	L	T	P	C
			2	0	4	4

Course Objectives:

- To draw engineering curves and freehand sketch of simple objects.
- To draw orthographic projection of solids and sections of solids.
- To draw development of solids
- To draw isometric and perspective projections of simple solids.

CONVENTIONS AND GEOMETRIC CONSTRUCTION (Not for examinations) **1**

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING **6+11**

Basic curves used in engineering practices: Construction of conic sections by eccentricity method - Construction of cycloidal curves - Construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles - Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+11

Projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 6+11

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV SECTION AND DEVELOPMENT OF SOLIDS 6+12

Sectioning of simple solids like prisms, pyramids, cylinders, and cone in a simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other - obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection - isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones - Perspective projection of simple solids - Prisms, pyramids and cylinders by visual ray method.

COMPUTER AIDED DRAFTING (Demonstration Only, Not for Exam) 3

The Concepts of Computer Aided Drafting for Engineering drawing, Computer graphics & Geometrical modelling (2D Orthographic Views) and 3D drafting (Isometric Views) using design software.

Total Periods: 90

Course Outcomes:

On completion of the course, the students will be able to

CO1: Construct the conic curves, involutes and cycloids.

CO2: Visualize and construct multiple views of solid.

CO3: Solve practical problems involving projection of lines and planes.

CO4: Draw the projection of simple solids.

CO5: Draw the sectional views of simple solids, obtain true shape and develop sectioned solids.

CO6: Draw the isometric and perspective projections of simple solids.

Text Books:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Jayapoovan T, "Engineering Graphics using AUTOCAD", Vikas Publishing ,7 th Edition.
3. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

References:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS10711 — 2001: Technical products Documentation — Size and layout of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation —Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
4. 5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

Special points applicable to Semester End Examinations on Engineering Graphics:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	-	2	-	-	-	2	-	2	-	-	-
CO2	3	1	2	-	2	-	-	-	2	-	2	-	-	-
CO3	3	1	2	-	2	-	-	-	2	-	2	-	-	-
CO4	3	1	2	-	2	-	-	-	2	-	2	-	-	-
CO5	3	1	2	-	2	-	-	-	2	-	2	-	-	-
CO6	3	1	2	-	2	-	-	-	2	-	2	-	-	-
Avg.	3	1	2	-	2	-	-	-	2	-	2	-	-	-

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

AD24221	C and Elementary Data Structures Laboratory	PCC	L	T	P	C
			0	0	4	2

Course Objectives:

- To familiarize with C programming constructs.
- To develop applications in C using Structures and Pointers.
- To implement Abstract Data Types.
- To implement linear data structures – lists, stacks and queues.
- To implement Searching, Sorting, and Hashing Techniques.

LIST OF EXPERIMENTS:

1. Implementing basic C programs and control structures
2. Arrays: single and multi-dimensional arrays
3. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
4. String handling functions and operations
5. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
6. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
7. Implementation of Linked List.
8. Implementation of Stack using Arrays and Linked List.
9. Implementation of Queue using Arrays and Linked List.
10. Implementation of Stack and Queue applications.
11. Implementation of Insertion Sort, Heap Sort.
12. Implementation of Quick Sort, Merge Sort.
13. Implement any application using Linear Search.
14. Implementation any application using Binary Search

Total Periods:60

Course Outcomes:
On completion of the course, the students will be able to

CO1: Students will demonstrate the ability to effectively use control structures, functions, and recursion to create modular and maintainable code.
CO2: Design and develop applications in C using structures, union, and pointers.
CO3: Design and implement ADTs.
CO4: Design, implement, and analyse list, queues, and stacks according to the needs of various applications.
CO5: Appropriately use sort, search, and hashing techniques for a given application.

Laboratory Requirements:

S. No.	Description of Equipment	Required numbers (for batch of 30 students)
1	Stand alone desktops (Windows/Linux) with C Compiler	30

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	-	2	-	-	3	-	1	2	-	1	-
CO2	2	2	2	1	2	-	-	3	-	1	2	-	1	-
CO3	2	3	2	1	2	-	-	3	-	1	2	-	1	-
CO4	2	3	2	2	2	-	-	3	-	1	2	-	1	-
CO5	2	3	2	2	2	-	-	3	-	1	2	-	1	-
Avg.	**2**	**2.8**	**2**	**1.5**	**2**	**-**	**-**	**3**	**-**	**1**	**2**	**-**	**1**	**-**

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

GE24122	**Engineering Practices Laboratory – Electrical and Electronics**	**ESC**	**L**	**T**	**P**	**C**
			0	**0**	**2**	**1**

Course Objectives:

- To learn the basics of electronic components.
- To understand the internal structure and working of the measuring instruments.
- To construct a prototype circuit on a breadboard and verify.
- To understand the process behind the PCB fabrication.
- To introduce the functionality of various electrical components namely switches, fuse, and meters to perform wiring various electrical joints in common household electrical wire work.
- To introduce the methods for measuring electrical quantities

LIST OF EXPERIMENTS:

Electrical

1. Introduction to Electrical Components switches, fuses, indicators, and lamps
2. Basic switchboard wiring with lamp, fan, three-pin socket, and energy meter
3. Staircase wiring
4. Fluorescent Lamp wiring with introduction to CFL and LED types
5. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit

Electronics

1. Study of electronic components resistor, capacitor, inductor, transistor and diode.
2. Introduction to CRO, DSO, MSO, FG and their working principles.
3. Circuit prototyping and verification.
4. Build a printed circuit board and verify the desired output.

Total Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1: Identify and describe the function of various electronic components, leading to successful application in circuit design.

CO2: Accurately interpret and apply measurement data in practical scenarios.

CO3: Build a prototype of a circuit and validate its output.

CO4: Gain knowledge of PCB fabrication processes, including design, etching, and assembly.

CO5: Understand the working of electrical switches, measuring instruments, and wiring layouts used in domestic applications and carry out basic electrical wiring work.

CO6: Comprehend the concepts of current, voltage, power, and power factor using various measuring instruments

Laboratory Requirements:

S. No.	Description of equipment	Required numbers (for a batch of 30 students)
1.	Resistors, Capacitors, Inductors – sufficient quantities. Bread Boards	15 nos.
2.	CRO, MSO, DSO, FG, Power Supply	5 Nos.
3.	PCB etching kit (Ferric Chloride, Drilling machine, Layout design)	15 kits
4.	Soldering iron, paste, lead, desoldering pump	15 nos. each
5.	Single way switch, Two way switch, fuses, indicators, 230 V - 60W incandescent lamp	5 nos. each
6.	Basic switchboard wiring kit and Energy meter	5 nos. each
7.	Staircase wiring kit	5 nos. each
8.	Fluorescent Lamp wiring kit, CFL and LED lamps	5 nos. each
9	1φ Auto Transformer, Voltmeter, Ammeter, Rheostat, Capacitor, Choke	5 nos. each
10.	Multimeters	6 nos.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	2	1	2	1	-	-	-	-	-
CO2	2	1	1	2	1	-	-	2	1	-	-	-	-	-
CO3	2	1	1	1	1	-	-	2	1	-	-	-	-	-
CO4	2	1	1	1	1	-	-	2	1	-	-	-	-	-
CO5	2	1	1	1	1	-	1	2	1	-	-	-	-	-
CO6	2	1	1	2	1	2	-	2	1	-	-	-	-	-
Avg.	**2**	**1**	**1**	**1.3**	**1**	**2**	**1**	**2**	**1**	-	**-**	**-**	**-**	**-**

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

PH24121	Physics Laboratory	BSC	L	T	P	C
			0	0	2	1

Course Objectives:

- To learn the measurements of various elastic moduli of materials
- To learn determination of thermal properties of materials.
- To study different optical phenomena involving ordinary light.
- To measure the characteristic properties of lasers.
- To understand the characteristics of oscillatory motion.
- To learn measurement of rigid body moment of inertia.

LIST OF EXPERIMENTS (any six experiments):

1. Non-uniform bending - Determination of Young's modulus
2. Uniform bending – Determination of Young's modulus
3. Lee's Disc Experiment - Determination of thermal conductivity of bad conductors.
4. Torsional pendulum - Determination moment of inertia of regular and irregular objects.
5. Simple harmonic oscillations of cantilever
6. Ultrasonic interferometer – determination of sound velocity and liquids compressibility
7. Viscosity of Liquids
8. Air wedge - Determination of thickness of a thin sheet/wire
9. Optical fibre -Determination of Numerical Aperture and acceptance angle
10. Spectrometer-Determination of the wavelength of light using grating
11. (a) Laser- Determination of the wavelength of the laser using grating
    (b) Compact disc- Determination of width of the groove using laser.

Total Periods: 30

Course Outcomes:
On completion of the course, the students will be able to
CO1: Determine various moduli of elasticity of materials
CO2: Determine thermal properties of solids
CO3: Analyze various optical phenomena involving ordinary light.
CO4: Determine the characteristic properties of lasers.
CO5: Measure characteristic properties of systems executing oscillatory motion.
CO6: Determine the moment of inertia of rigid bodies

Text Books:

1. Engineering Physics Practicals by Dr. P. Mani, Dhanam Publications, 2023
2. Practical Physics by Gordon L Squires, Cambridge University Press; 4th Edition, 2001

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	-	-	-	2	-	-	1	-	-	-
CO2	2	1	1	2	-	-	-	2	-	-	1	-	-	-
CO3	2	1	1	2	-	-	-	2	-	-	1	-	-	-
CO4	2	1	1	2	-	-	-	2	-	-	1	-	-	-
CO5	2	1	1	2	-	-	-	2	-	-	1	-	-	-
CO6	2	1	1	2	-	-	-	2	-	-	1	-	-	-
Avg.	2	1	1	2	-	-	-	2	-	-	1	-	-	-

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

GE24123	**Design Thinking**	HSMC	L	T	P	C
			0	0	2	1

Course Objectives:

- Students will understand the different learning methodologies
- Students will learn the art of observation and visualization
- Students will understand the need for empathy in problem-solving
- Students will learn how to work in a team
- Students will learn to use different design thinking tools to solve problems

Module 1	An Insight to Learning: Understanding the Learning Process and Kolb's Learning Styles	2
Module 2	Journey of my life: Visualization and Wheel of Life. *Introduction to project*	4
Module 3	Observation: Listening vs hearing, Beyond observations and Mind maps	2
Module 4	Teamwork: Divergent thinking and Brainstorming	2
Module 5	Customer Journey: Journey mapping	2
Module 6	Conflict management: Balancing priorities, Reacting and Responding, Constraints to opportunities	2
Module 7	Empathy: Persona and Empathy map	2
Module 8	Design Thinking Model: 5-step process: Empathize, define, ideate, prototype, and scale	2
Module 9	Appreciation: The wonder of recognition, Articulation and Influence	2
Module 10	Project presentation	10

Total Periods:30

Course Outcomes:

On completion of the course, the students will be able to

CO1: To understand various learning processes and stages

CO2: To observe and visualize different scenarios

CO3: To empathize with a customer

CO4: To develop a journey map based on experiences

CO5: To understand the art of conflict management

CO6: To use design thinking as a tool to solve problems

Suggested Activities:

- Solve real-life problems using Design Thinking

Text Books:

1. Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Pavan Soni, Penguin Random House India, Pvt. Ltd. 2020
2. Developing Thinking Skills (The Way to Success), E. Balagurusamy, 2024, Khanna Publishing House
3. The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods, Michael Lewrick, Patrick Link, Larry Leifer, Wiley, March 2020

References:

1. Internet Reference: https://www.interaction-design.org/
2. Internet Reference: https://online.hbs.edu/
3. Internet Reference: https://dschool.stanford.edu/

MAPPING OF COs WITH POs AND PSOs

COs	Pos											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	1	1	-	-	3	-	1	-
CO2	-	-	-	-	-	2	-	-	-	-	3	-	1	-
CO3	-	-	-	-	-	2	2	2	2	-	3	-	1	-
CO4	-	-	-	-	-	2	-	-	-	-	3	-	1	-
CO5	-	-	-	-	-	2	2	2	2	-	3	-	1	-
CO6	-	-	-	-	-	3	2	3	2	2	3	-	1	-
Avg.	-	-	-	-	-	**2.1**	**1.7**	**2**	**2**	**2**	**3**	-	**1**	-

FC24102 Cultural Identities and Globalisation HSMC L T P C

2 0 0 0

Course Objectives:

- To enable students to reflect on their own cultural identity in relation to their socialisation.
- To encourage cultural diversity that underpins the formation of identity and social behaviours.
- To give exposure to the varied cultural influences on the parent culture.
- To prepare to address the challenges and tensions in the globalised society.

UNIT I Exploring Social and Cultural Identity 5

Identity formation & environmental interaction

- Race/ethnicity
- Gender
- Language
- Religion
- Socialisation (contact with different cultures)

UNIT II Regional and Cultural Influence on Social Behaviour and Identity 6

- Assimilation, Amalgamation and Hybridisation
- Cultural Behaviour - dialect, traditions, social behaviour (customs), etiquette (work culture), habits, cuisine and regional variation

UNIT III Dissemination of Mass Culture Practices 6

- Cultural Imperialism
- Colonisation and Globalization - Cultural turn
- Manufacturing pop culture - Language, food, movies, music, fashion, cosmetics.

UNIT IV Socio-Cultural Changes via Globalisation 6

- Indian globalisation through trade liberalisation
- Increased migration flow with economic opportunities
- Cultural exchange, global networks
- Urbanisation - impact on family ideology and social structure

UNIT V Embracing Global Identities 7

- Challenges and tension
- Adaptable to changing society - etiquettes (in cross-cultural workspace) and social behaviours
- Building understanding and tolerance

Total Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1: Engage in conversations with themselves in relation to their local culture and society.

CO2: Realise the nuances of identity formation through various means of socialisation.

CO3: Critically assess the countless social and cultural behaviours that influence their identity and behaviour.

CO4: Examine the role of globalisation and liberalisation in urbanisation and cultural imperialism.

CO5: Adapt to the cross-cultural changes and engage in global networking.

CO6: Respond appropriately in a multicultural space by building tolerance and understanding.

Suggested Activities

- Exercise on identity formation - creation of mind maps / storyboards
- A mini presentation on “Identifying one's own culture amidst the influence of the diverse cultural environment” - expressing only one cultural aspect (language, attire, habits, food, …)
- Opinion piece speech - Deliver a short speech expressing personal opinions
- Survey report - Comparison chart (5 exchanges) by engaging conversations with a elderly stranger or grandparents
- Produce a 30-second reel showcasing their understanding of the social etiquette of a specific country.

References:

1. Brooks, Ann. Popular Culture: Global Intercultural Perspectives. United Kingdom, Bloomsbury Publishing, 2014.
2. Verkuyten, Maykel. Identity and Cultural Diversity: What Social Psychology Can Teach Us. United Kingdom, Taylor & Francis, 2013, pp. 1-27.
3. Savage, Michael, et al. Globalization and Belonging. United Kingdom, SAGE Publications, 2004, pp. 29-77.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	-	2	1	-	2	-	-	-
CO2	-	-	-	-	-	2	-	-	1	-	-	-	-	-
CO3	-	-	-	-	-	2	-	-	1	-	2	-	-	-
CO4	-	-	-	-	-	2	-	2	1	-	2	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	2	-	2	1	-	2	-	-	-
Avg.	-	-	-	-	-	**2**	-	**2**	**1**	-	**2**	-	-	-

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

Course Code	Course Name	Category	L	T	P	C
MA24301	Discrete Mathematics	BSC	3	1	0	4

Course Objectives:

- To develop logical skills for reasoning and constructing mathematical arguments using propositional and predicate calculus
- To equip students with the foundational techniques in combinatorics
- To familiarise with the basic concepts of graph theory
- To provide an understanding of algebraic structures and related applications in computer science
- To understand the concepts and significance of Lattices and Boolean algebra which are widely used in computer science and engineering

UNIT I LOGIC AND PROOFS 12

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference

UNIT II COMBINATORICS 12

Mathematical induction – Pigeonhole principle – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle

UNIT III GRAPHS 12

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connected Graphs – Eulerian and Hamiltonian Graphs

UNIT IV ALGEBRAIC STRUCTURES 12

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphisms (Applications only) – Isomorphisms (Applications only) - Ring (Definition only)- Field (Definition only)

UNIT V LATTICES AND BOOLEAN ALGEBRA 12

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Boolean Algebra and properties

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Apply propositional and predicate calculus equivalences, and inference rules for valid mathematical arguments

CO2: Apply combinatorial techniques to solve problems

CO3: Identify and analyse properties of graph models inclusive of Eulerian and Hamiltonian graphs

CO4: Understand concepts of semi-groups, monoids, and groups in algebraic systems.

CO5: Understand the structure of lattices

CO6: Understand the concept of Boolean algebra

Suggested Activities:

- Create logic puzzle incorporating quantifiers (∀, ∃).
- Solve the Tower of Hanoi puzzle with different disk counts.
- Model a city's tourist spots and paths using a graph.
- Create a network diagram (e.g., of websites or devices) and analyze connectivity using graph theory concepts.

Text Books:

1. Rosen, K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
2. Tremblay, J.P. and Manohar.R, " Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.

References:

1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3. Koshy, T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.
4. Veerarajan, T., "Discrete Mathematics with Graph Theory and Combinatorics", Mc Graw Hill Publishers, India, 2017.
5. J.A. Bondy , U.S.R. Murty, "Graph Theory With Applications" , North Holland, New York, 1976
6. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Dover Publication, 2016.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	-	-	-	-	-	-	-	2	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	2	-	-
CO4	3	2	1	2	-	-	-	-	-	-	-	2	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	2	-	-
CO6	3	2	1	2	-	-	-	-	-	-	-	2	-	-
Avg.	3	2	1	1.5	-	-	-	-	-	-	-	2	-	-

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

Course Code	Course Name	Category	L	T	P	C
AD24301	Artificial Intelligence	PCC	3	0	0	3

Course Objectives:

- Study about uninformed and Heuristic search techniques
- To model and solve game-playing and constraint satisfaction problems
- Learn the different ways to represent knowledge in the knowledge base of an Intelligent Agent
- Perform logical and probabilistic reasoning
- To comprehend the use of software agents

UNIT I INTELLIGENT AGENTS AND PROBLEM SOLVING 10

Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments – Structure of agents. Problem solving agents – Search algorithms – Uninformed search strategies - Informed search - Heuristic search strategies – Heuristic functions - Local search and optimization problems

UNIT II GAME PLAYING AND CSP 9

Game theory – Optimal Decisions in Games – Alpha-Beta Search – Monte-Carlo tree search – Stochastic games – Partially observable games. Constraint satisfaction problems – Constraint propagation – Backtracking search for CSP – Local Search for CSP.

UNIT III LOGICAL REASONING 9

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

UNIT IV PROBABILISTIC REASONING AND REINFORCEMENT LEARNING 9

Acting under uncertainty – Fuzzy Logic – Bayesian inference – naïve Bayes models. Probabilistic reasoning – Bayesian networks – Exact inference – Approximate inference – Reinforcement learning – Markov Decision Processes

UNIT V SOFTWARE AGENTS 8

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

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Comprehend intelligent agent frameworks and apply various informed and uninformed strategies to problem solving.

CO2: Apply appropriate search algorithms to solve game playing and constraint satisfaction problems

CO3: To represent knowledge in prepositional and predicate logic and be able to apply inference mechanisms

CO4: Perform probabilistic reasoning under uncertainty

CO5: Analyze the architecture and interaction strategies of software agents in multi-agent systems

CO6: Design and implement an intelligent agent-based system to solve real world or simulated problems.

Suggested Activities

- Implement and compare BFS, DFS, A* on a maze-solving or pathfinding problem (e.g., 8-puzzle).
- Flipped classroom–Comparing of Different Algorithms
- Modelling real world problems such as sudoku as a CSP and solve it using backtracking + constraint propagation
- Ethical Agent Debate - Discuss how agents should make ethical decisions.

Text Books:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.

References:

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	2	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-	2	-
CO5	3	3	2	2	2	-	-	-	-	-	-	-	2	-
CO6	2	3	3	2	2	-	-	-	-	-	-	-	2	-
Avg.	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

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

Course Code	Course Name	Category	L	T	P	C
AD24302	Non-Linear Data Structures and Algorithms	PCC	3	0	0	3

Course Objectives:

- To basics non-linear data structures – trees and graphs.
- To analysis different algorithm design techniques
- To explain dynamic programming and greedy techniques for solving various problems.
- To examine the limitations of algorithmic power and handling it in different problems.

UNIT I TREES 9

Overview of Non-Linear data structures – Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees: Balancing – Heaps - Binary Heap

UNIT II GRAPHS 9

Graph Definition – Representation of Graphs – Types of Graphs – Breadth first traversal – Depth first traversal — Bi-connectivity – Euler circuits – Finding shortest path: Dijkstra's algorithm – Minimum Spanning Tree: Prim's algorithm, Kruskal's algorithm

UNIT III ALGORITHM ANALYSIS 8

Algorithm analysis: Time and space complexity - Asymptotic Notations and its properties best case, Worst case and average case analysis – Recurrence relation: substitution method - Lower bounds – searching: linear search, binary search and Interpolation Search

UNIT IV DESIGN PARADIGMS 12

Divide and Conquer methodology: Finding maximum and minimum – Quick Sort – Merge Sort - Dynamic programming: Elements of dynamic programming – Matrix chain multiplication - Optimal Binary Search Trees - Floyd-Warshall Algorithm. Greedy Technique: Elements of the greedy strategy - Activity-selection problem — Huffman Trees - Backtracking: n-Queens problem - Subset Sum Problem – Branch and Bound: Knapsack problem - Travelling Salesman Problem

UNIT V NP COMPLETE AND NP HARD 7

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation - NP-algorithms - NP-hardness and NP-completeness – Bin Packing problem - Problem reduction: TSP – 3-CNF problem

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Implement tree ADTs for efficient data organization
CO2: Solve graph algorithms using graph traversal algorithms
CO3: Evaluate algorithmic complexity using asymptotic notation
CO4: Apply algorithm design techniques such as divide and conquer, dynamic programming and greedy techniques to solve problems
CO5: Compare algorithm analysis for real-world problem optimization
CO6: To identify NP-complete problems and prove intractability

Suggested Activities

- Activities for Preorder, Inorder, and Postorder traversals through activity sheets
- Assign roles and simulate algorithms as a classroom roleplay.
- Solving Knapsack problems using dynamic programming, branch and bound and backtracking and greedy techniques.
- Group debate/discussion about tractable vs intractable problems with real-world examples.
- Analysis of algorithms - Code linear search, binary search, and interpolation search; analyze which works best under various data distributions.

Text Books:

1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures and Algorithms in Python" (An Indian Adaptation), Wiley, 2021.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.

References:

1. Narasimha Karumanchi, "Data Structures and Algorithmic Thinking with Python" Careermonk, 2015.
2. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015.
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.
4. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.
5. S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.
6. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	-
CO3	3	3	2	3	2	-	-	-	-	-	-	-	2	-
CO4	3	3	2	3	2	-	-	-	-	-	-	-	2	-
CO5	2	3	2	3	2	-	-	-	-	-	-	-	2	-
CO6	3	3	2	3	2	-	-	-	-	-	-	-	2	-
Avg.	3	3	2	3	2	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
BS24301	Environmental Science and Sustainability	BSC	3	0	0	3

Course Objectives:

- To introduce the basic concepts of environment, ecosystems.
- To emphasize on the biodiversity of India and its conservation.
- To familiarise with the causes and effects of different types of pollution in the environment.

- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability**.**
- To impart knowledge about waste management and their recovery methods.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles.

UNIT I ENVIRONMENT AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness. Ecosystem and Energy flow – food chain, food web, ecological pyramids-ecological succession. Types of biodiversity: genetic, species and ecosystem diversity – values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – endangered and endemic species of India, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 9

Causes, Effects and Preventive measures of Air, Water, Soil, Thermal and Noise Pollutions. Nuclear hazards and human health risks-case study. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection-Air act, Water act, Environmental protection act. Role of an individual in prevention of pollution.

UNIT III SUSTAINABILITY AND MANAGEMENT 9

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals - intervention areas- Climate change-global warming, acid rain, Ozone layer depletion- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT IV WASTE MANAGEMENT AND RESOURCE RECOVERY 9

Biodegradable, non-biodegradable wastes, Solid, Hazardous and E-Waste management.
Bio-medical waste management, Concept of waste to energy processes (WTE) - Combustion, Pyrolysis, Landfill gas (LFG) recovery. Recycling of spent batteries, end-of- life vehicle (ELV) recycling-Waste engine oil recycling-Solvent recovery, Barriers for material recycling-social, legal and economic factors-Environment impact of waste recycling.

UNIT V SUSTAINABILITY PRACTICES 9

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources-Ocean energy sources, Geothermal energy, Energy Cycles- carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economical and technological change.

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: To basics the functions of the environment, ecosystems.
CO2: To analyse the threats of biodiversity and their conservation.
CO3: To explain the types of environmental pollution and environment protection acts.

CO4: To recognize the different goals of sustainable development and environmental standards.
CO5: To correlate the different types of waste management and possible resource recovery methods.
CO6: To explain the sustainability practices pertaining to sustainable energy, sustainable habitat and sustainable urbanization.

Suggested Activities

- Quiz
- Mind Mapping
- Group discussion
- Seminar
- Animated videos

Text Books:

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. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998

References:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Text book of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	2.5	-	-	-	-	2	-	-	-
CO2	2	1	-	-	-	2.5	-	-	-	-	2	-	-	-
CO3	3	2	-	-	-	3	-	1	-	-	2	-	-	-
CO4	3	2	1	-	-	2	-	1	-	-	2	-	-	-
CO5	3	2	1	-	-	2	-	-	-	-	2	-	-	-
CO6	3	2	1	-	-	2	-	1	-	-	2	-	-	-
Avg.	2.7	1.6	1	-	-	2.33	-	1	-	-	2	-	-	-

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

Course Code	Course Name	Category	L	T	P	C
AD24311	Database Design and Management	PCC	2	0	4	4

Course Objectives:

- To introduce database development life cycle and conceptual modeling
- To learn SQL for data definition, manipulation and querying a database
- To learn relational database design using conceptual mapping and normalization
- To learn transaction concepts and serializability of schedules
- To learn data model and querying in object-relational and No-SQL databases

UNIT I CONCEPTUAL DATA MODELING 6

Database environment – Database system development lifecycle – Requirements collection – Database design -- Entity-Relationship model – Enhanced-ER model – UML class diagrams.

UNIT II RELATIONAL MODEL AND SQL 6

Relational model concepts – Integrity constraints – SQL Data manipulation – SQL Data definition – Views – SQL programming.

UNIT III RELATIONAL DATABASE DESIGN AND NORMALIZATION 6

ER and EER-to-Relational mapping – Update anomalies – Functional dependencies – Inference rules – Minimal cover – Properties of relational decomposition – Normalization (upto BCNF).

UNIT IV TRANSACTION MANAGEMENT 6

Transaction concepts – properties – Schedules – Serializability – Concurrency Control – Two-phase locking techniques.

UNIT V OBJECT RELATIONAL AND NO-SQL DATABASES 6

Mapping EER to ODB schema – Object identifier – reference types – rowtypes – UDTs – Subtypes and supertypes – user-defined routines – Collection types – Object Query Language; No-SQL: CAP theorem – Document-based: MongoDB data model and CRUD operations; Column-based: Hbase data model and CRUD operations.

Periods: 30

LIST OF EXPERIMENTS

1) Database design using Conceptual modelling (ER-EER) – top-down approach Mapping conceptual to relational database and validate using Normalization.
2) Create a database table, add constraints (Primary Key, Unique, Check, Not Null), insert rows, update and delete rows using SQL DDL and DML commands
3) Create a set of tables, add foreign key constraints and incorporate referential integrity.

4) Query the database tables using different 'where' clause conditions, implement aggregate functions and set operations.
5) Query the database tables to explore sub queries and join operations.
6) Write user defined functions and stored procedures in SQL.
7) Execute complex transactions and realize DCL and TCL commands.
8) Write SQL Triggers for insert, delete, and update operations in a database table.
9) Create PL/SQL code to demonstrate the purpose of implicit and explicit cursors.
10) Write PL/SQL code to trap a predefined and non-predefined Oracle Server error.
11) Create View and Index for database tables with a large number of records.
12) Database design using EER-to-ODB mapping
13) Object features of SQL-UDTs and sub-types, Tables using UDTs, Inheritance, Method definition
14) Create Document, column and graph-based data using NOSQL database tools.
15) Develop database applications using IDE.

Course Outcomes:

On completion of the course, the students will be able to

CO1: Design conceptual data models for real-world scenarios.

CO2: Implement relational databases using SQL

CO3: Normalize relational schemas up to BCNF by analyzing functional dependencies and minimizing anomalies.

CO4: Analyze transaction properties, schedules, and concurrency control mechanisms

CO5: Design object relational databases and query using object query language

CO6: Perform CRUD operations in NoSQL databases

Suggested Activities:

1. Case Study to ER Diagram Conversion (Team Activity)
2. Normalization of Real-World Data (Hands-On Exercise)
3. SQL Query Challenges & Competitive Quizzes
4. Comparative Analysis: Relational vs. NoSQL Databases
5. Oracle Academy SQL/PLSQL Certification (Industry-Aligned Learning)

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017.

References:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2. Feuerstein, Steven, and Bill Pribyl. "Oracle PL/SQL Programming", 6th ed., O'Reilly Media, 2014.
3. Sadalage, P. J., & Fowler, M., "NoSQL distilled: A brief guide to the emerging world of polyglot persistence", Addison-Wesley, 2013.

Periods: 60

Total Periods: 90

Laboratory Requirements:

S.No	Name of the Equipment/Software	Required numbers (for batch of 30 students)
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse	30
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30
3	Oracle Database 12 or higher, MySQL 5.7 or equivalent	30

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	-	3	-	-	2	-	-	2	-	2	-
CO2	3	2	3	-	3	-	-	2	-	-	2	-	2	-
CO3	3	3	3	2	3	-	-	2	-	-	2	-	2	-
CO4	3	3	2	2	3	-	-	-	-	-	2	-	-	-
CO5	3	2	3	-	3	-	-	-	-	-	2	-	2	-
CO6	3	2	3	2	3	-	-	2	-	-	2	-	2	-
Avg.	3	2	2	2	2	-	-	2	-	-	2	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
CS24312	Object Oriented Programming in Java	PCC	2	0	4	4

Course Objectives:

- To understand object oriented programming concepts and basics of Java programming language
- To know the principles of classes and inheritance
- To define interfaces and handle strings
- To define exception handling mechanisms
- To develop a java application with I/O operations, threads and generics classes
- To modularize Java applications using packages and efficiently manage data using the Collection Framework.

UNIT I INTRODUCTION TO OOP AND JAVA 6

Object oriented programming paradigms – Features of Object-Oriented Programming – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java

UNIT II CLASSES AND INHERITANCE 6

Defining classes in Java – Access modifiers - Constructors-Methods: Objects as Parameters – Returning Objects –Static: block, class, methods, and variables. Inheritance: Types of Inheritance – Super and final keywords – Method overloading and overriding – Dynamic Method Dispatch – Abstract Classes.

UNIT III INTERFACE, EXCEPTION HANDLING AND STRINGS 6

Interfaces: Implementing and extending interfaces - Exceptions – exceptions hierarchy- throwing and catching exceptions - built-in Exceptions – User defined Exception. Strings: Basic String class, methods and String Buffer Class.

UNIT IV I/O, GENERICS, MULTITHREADING 6

I/O Basics – Reading and Writing Console I/O– Reading and Writing Files (csv and txt file). Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Differences between multithreading and multitasking, thread life cycle, creating threads, Inter-thread communication.

UNIT V PACKAGES AND COLLECTIONS 6

Packages – Packages and Member Access – Importing Packages – Lambda Expressions – Collection Interfaces and classes: ArrayList, LinkedList, HashSet, TreeSet, HashMap, EnumMap.

Periods: 30

LIST OF EXPERIMENTS:

1. Develop java programs to solve simple problems (factorial, Fibonacci, binary search, selection/insertion sort)
2. Develop java programs using OOP principles.
3. Develop a java program to develop payslips for the employees with their gross and net salary. Define subclasses for Programmer, Assistant Professor, Associate Professor, Professor extending Employee.
4. Develop a Java Program to create an abstract class named Shape that contains two integers, and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area() that prints the area of the given shape.
5. Develop a Java program for implementation of interface.
6. Develop a program that takes as input the size of the array and the elements in the array and asks the user to enter a particular index and prints the element at that index. This program should generate different exceptions. To handle these exceptions, use exception handling mechanisms.
7. Develop a Java program to implement string handling mechanisms.
8. Develop a Java program to perform file operations (Count the number of times a character appears in a file, Copy the content from one file to another).
9. Develop applications to demonstrate features of generic classes.
10. Develop a Java program to implement a multithreaded application.
11. Develop a java program to search for an element in an array using generic classes.
12. Develop a java program to find the average of an array of elements using generic classes.
13. Create a Java program to demonstrate Java built in packages.
14. Create a Java program to create and use a user defined package.
15. Develop a Java program that demonstrates different Collection Framework classes and interfaces.
16. Develop a real-time GUI based Java application.

Periods: **60**

Total Periods: 90

Course Outcomes:

On completion of the course, the students will be able to

CO1: Apply the concepts of object-oriented programming to solve simple problems

CO2: Develop programs using classes and inheritance

CO3: Develop programs using interfaces and string methods

CO4: Make use of exception handling mechanisms to solve real world problems
CO5: Build Java applications with generics and multithreading concepts
CO6: Apply Java packages and collections to solve real-world problems

Suggested Activities

- Mini Project

Text Books:

1. Herbert Schildt, ―Java The complete reference, 11th Edition, McGraw Hill Education, 2019
2. Cay S. Horstmann, "Core Java Fundamentals", Volume 1, 11 th Edition, Prentice Hall, 2018.

References:

1. Paul Deitel, Harvey Deitel, "JAVA SE 8 for programmers", 3rd Edition, Pearson, 2015.
2. Oracle Academy Resources.

Laboratory Requirements:

1. INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse.
2. Windows 10 or higher operating system / Linux Ubuntu 20 or higher.
3. JDK 17 or above (Oracle or OpenJDK)/ Eclipse IDE for Java Developers / IntelliJ IDEA Community Edition / NetBeans / VS Code with Java Extension Pack.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	2	-	1	-
CO2	3	2	3	-	3	-	-	-	-	-	2	-	1	-
CO3	3	2	3	-	3	-	-	-	-	-	2	-	1	-
CO4	3	2	3	-	3	-	-	-	-	-	2	-	1	-
CO5	3	2	3	-	3	-	-	-	-	-	2	-	1	-
CO6	3	2	3	-	3	-	-	-	-	-	2	-	1	-
Avg.	**3**	**2**	**2.8**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**-**

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

Course Code	Course Name	Category	L	T	P	C
AD24321	Artificial Intelligence Laboratory		0	0	3	1.5

Course Objectives:

- To design and implement search strategies
- To implement game playing techniques
- To implement CSP techniques
- To develop systems with logical reasoning
- To develop systems with probabilistic reasoning

LIST OF EXPERIMENTS

1. Implement uninformed search strategies – BFS and DFS algorithm
2. Implement basic search strategies – 8-Puzzle, 8 - Queens problem, Cryptarithmetic.
3. Implement A* and memory bounded A* algorithms

4. Implement Minimax algorithm for game playing (Alpha-Beta pruning)
5. Solve constraint satisfaction problems (Sudoko Solver)
6. Implement local search algorithms (hill climbing and simulated annealing)
7. Representation of knowledge base
8. Implement forward chaining algorithm
9. Implement backward chaining
10. Implement resolution strategies
11. Build naïve Bayes models (Spam detection)
12. Implement Bayesian networks and perform inferences
13. Implement Reinforcement learning in a Grid-Based MDP Environment
14. Design an Agentic AI system
15. Mini-Project

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Design and implement search strategies
CO2: Implement game playing and CSP techniques
CO3: Develop logical reasoning systems using propositional and first-order logic.
CO4: Develop probabilistic reasoning systems
CO5: Develop reinforcement learning agents for MDP environments.
CO6: Integrate AI techniques to design an autonomous agent

Laboratory Requirements:

S.No	Name of the Equipment/Software	Required numbers (for batch of 30 students)
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse	30
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30
3	Oracle Database 12 or higher, MySQL 5.7 or equivalent	30

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	-	-	-	-	-	-	1	2	-
CO2	3	2	3	2	3	-	-	-	-	-	-	1	2	-
CO3	3	2	3	2	3	-	-	-	-	-	-	1	2	-
CO4	3	2	3	2	3	-	-	-	-	-	-	1	2	-
CO5	3	2	3	2	3	-	-	-	-	-	-	1	2	-
CO6	3	2	3	2	3	-	-	-	-	-	-	1	2	-
Avg.	**3**	**2**	**3**	**2**	**3**	-	-	-	-	-	-	1	**2**	-

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

Course Code	Course Name	Category	L	T	P	C
AD24322	Non-Linear Data Structures and Algorithms Laboratory		0	0	3	1.5

Course Objectives:

- To be able to implement fundamental data structures (trees, graphs, heaps).
- To design efficient traversal and pathfinding algorithms.
- To be able to apply algorithmic design paradigms (divide-and-conquer, transform-and-conquer).
- To formulate dynamic programming and greedy solutions.
- To perform critical analysis of algorithmic complexity and trade-offs.

LIST OF EXPERIMENTS

1. Implementations of tree representation and traversal algorithms
2. Implementation of Binary Search Trees
3. Implementation of Heaps
4. Graph representation and Traversal algorithms
5. Implementation of single source shortest path algorithm
6. Implementation of minimum spanning tree algorithms
7. Implement recursive and non-recursive algorithms and study the order of growth from log2n to n!
8. Implement Divide and Conquer techniques - Strassen's Matrix Multiplication, Quick Sort, Merge Sort
9. Implement Decrease and Conquer - Topological Sorting
10. Implement Transform and Conquer - Heap Sort
11. Solve Dynamic programming using matrix multiplication
12. Greedy Technique – Dijkstra's algorithm
13. Implement Backtracking algorithm
14. Implement Branch and Bound algorithm

Total Periods: 45

Coruse Outcomes:
On completion of the course, the students will be able to

CO1: Implement tree/graph traversals and BST operations efficiently
CO2: Design shortest-path and MST algorithms for weighted graphs
CO3: Formulate solutions using divide-and-conquer algorithms
CO4: Implement dynamic programming and greedy algorithms
CO5: Develop backtracking and branch-and-bound solutions for NP-hard problems
CO6: Compare algorithmic growth rates

References:

1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures and Algorithms in Python" (An Indian Adaptation), Wiley, 2021.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012
3. Narasimha Karumanchi, "Data Structures and Algorithmic Thinking with Python" Careermonk, 2015.
4. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015.

Laboratory Requirements:

S.No	Name of the Equipments/Software
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher
3	Dev C++ / Eclipse CDT / Code Blocks / CodeLite / equivalent open source IDE

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	-	-	3
CO2	3	3	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	3	2	3	2	-	-	-	-	-	-	-	-	3
CO4	3	3	2	3	2	-	-	-	-	-	-	-	-	3
CO5	3	3	2	3	2	-	-	-	-	-	-	-	-	3
CO6	2	3	2	3	2	-	-	-	-	-	-	-	-	3
Avg.	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	-	-	-	-	-	**3**

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

Course Code	Course Name	Category	L	T	P	C
BS24321	**System Discovery and Analysis**		**0**	**0**	**2**	**0**

Course Objectives:

- To identify key components of any hardware.
- To analyse individual components and its working.
- To how data and control flows within a system
- To identify the need, the user, and functional specifications of the system
- To develop the evolution of an electronic system through study and presentation

List of Components:

Any two components can be selected per semester

1) Installation of various Operating Systems.
2) CPU.
3) Wifi Access Point / Switch.
4) Printer
5) Raspberry Pi/ Arduino Board

System Discovery (6 periods)
System Analysis (18 periods)
Presentation + Documentation (6 periods)

Total Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

1. Identify and describe the essential components and architecture of commonly used hardware systems.

2. Evaluate and document system design requirements, including end-user needs, functional goals, constraints, and standards.
3. Use project management tools, bull and octopus diagrams to understand the existing system.
4. Disassemble and analyze systems to distinguish between hardware, software, and network components
5. Apply and articulate how information is processed, transmitted, and stored.
6. Propose an improvisation of any existing system by adopting a new design and technology.

Text Books:

- Laboratory Manual

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	-	1	-	-	-	3	1	-	1	-	-	-
CO2	2	2	-	1	-	-	-	3	1	1	1	-	-	-
CO3	2	2	-	1	-	-	-	3	1	1	1	-	-	-
CO4	2	2	-	2	-	-	-	3	1	-	1	-	-	-
CO5	2	2	-	2	-	-	-	3	1	-	1	-	-	-
CO6	2	2	-	1	-	-	-	3	1	-	1	-	-	-
Avg.	2	2	-	1.3	-	-	-	3	1	1	1	-	-	-

Course Code	Course Name	Category	L	T	P	C
MA24403	Transforms and Linear Algebra	BSC	3	1	0	4

Course Objectives:

- To acquaint the student with the concepts of Fourier transform techniques
- To introduce Z transform and difference equations and to equip with techniques for solving discrete time systems
- To provide a fundamental understanding of vector spaces, subspaces, and their properties
- To facilitate the understanding of the concepts of linear transformation and diagonalization
- To familiarise the concepts of inner product spaces and orthogonalisation

UNIT I FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT II Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms - Elementary properties(without proof) – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

UNIT III VECTOR SPACES 12

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

UNIT IV LINEAR TRANSFORMATION AND DIAGONALIZATION 12

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

UNIT V INNER PRODUCT SPACES 12

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

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Solve problems of engineering using Fourier transform

CO2: Apply Z-transforms to solve linear difference equations arising in discrete time systems

CO3: Apply the knowledge to solve problems involving linear combinations, independence, and dimension.

CO4: Develop the use of advanced algebraic techniques.

CO5: Design the concepts of linear transformations and diagonalization

CO6: Effectively use the concepts of orthogonalisation and least square method to solve problems

Text Books:

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3. Friedberg, A.H., Insel, A.J. and Spence, L., ―Linear Algebra, Prentice Hall of India, New Delhi, 2004
4. Kwak, J.H, Hong, S., -Linear Algebra, Birkhauser Publishers, Second Edition, Springer International Edition, 1997.

References:

1. Kolman, B. Hill, D.R., ―Introductory Linear Algebra, Pearson Education, New Delhi, First Reprint, 2009.
2. Kumaresan, S., ―Linear Algebra – A Geometric Approach, Prentice – Hall of India, New Delhi, Reprint, 2010.
3. Lay, D.C., ―Linear Algebra and its Applications, 5th Edition, Pearson Education, 2015.
4. Strang, G., ―Linear Algebra and its applications, Thomson (Brooks/Cole), New Delhi, 2005.
5. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
6. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
7. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
8. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

9. R. C. DiPrima and W. E. Boyce: Ordinary Differential Equations and Boundary Value Problems, Willey

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	1	-	-
Avg.	3	2	1	1	-	-	-	-	-	-	-	1	-	-

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

Course Code	Course Name	Category	L	T	P	C
AD24401	Machine Learning	PCC	3	0	0	3

Course Objectives:

- To understand the basic concepts of machine learning.
- To analysis and build supervised learning models.
- To apply and build unsupervised learning models.
- To evaluate the algorithms based on corresponding metrics identified

UNIT I INTRODUCTION TO MACHINE LEARNING 8

Introduction and motivation for machine learning; Types of Machine Learning, Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

UNIT II LINEAR MODELS 9

Linear classification – univariate linear regression – bivariate regression–multivariate linear regression – regularized regression – Logistic regression. Naïve Baye's–Discriminant Functions - Probabilistic Generative Models – Probabilistic Discriminative Models–Bayesian Logistic Regression.

UNIT III SUPERVISED LEARNING 11

Supervised Learning: Overview – Support vector machines: – soft margin SVM – going beyond linearity – generalization and overfitting – regularization – validation. Decision trees: Training and Visualizing a Decision Tree - Making Predictions - Estimating Class Probabilities - The CART Training Algorithm - Computational Complexity - Gini Impurity or Entropy - Ensemble methods: Bagging- Boosting- Boosting AdaBoost - Gradient Boosting – XG boost.

UNIT IV UNSUPERVISED LEARNING 9

Unsupervised learning: K-means, Hierarchical clustering - Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization. Dimensionality Reduction: Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis.

UNIT V DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS 8

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, Measuring classifier performance – confusion matrix, F1 Score, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: foundational concepts and theoretical frameworks of Machine Learning
CO2: Implement linear and probabilistic models for classification and prediction tasks
CO3: Apply supervised learning techniques to real-world problems
CO4: Design unsupervised learning solutions for clustering and dimensionality reduction
CO5: Evaluate ML models using rigorous experimental methodologies
CO6: Develop end-to-end ML solutions by integrating appropriate algorithms, validation techniques, and ethical considerations.

Suggested Activities

- Weekly coding assignments using Python, NumPy, Pandas, and Scikit-learn.
- Kaggle-based machine learning challenges.
- Research paper review and presentation.
- Industry expert talks on Machine Learning applications.
- End-semester mini project addressing a real-world problem.

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014.
3. Aurélien Géron – Hands – On Machine Learning with Scikit Learn, Keras and Tensor Flow, 2nd Edition. September2019, Reilly Media, Inc.,

REFERENCES:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2018.
4. Sebastain Raschka, Vahid Mirjalili , "Python Machine Learning", Packt publishing, 3rd Edition, 2019.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	-
CO5	2	3	2	2	2	-	-	-	-	-	-	-	3	-
CO6	3	3	3	2	3	-	-	-	-	-	-	-	3	-
Avg.	**3**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	-	-	-	-	**3**	**-**

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

Course Code	Course Name	Category	L	T	P	C
CS24401	Operating Systems	PCC	3	0	0	3

Course Objectives:

- To basics core operating system concepts and their role in modern computing environments.
- Analyse the management of processes and multithreaded programs.
- Study CPU scheduling algorithms and mechanisms for process synchronization.
- Design and address deadlock situations in concurrent systems.
- Examine memory management strategies and virtual memory implementations.
- Explore I/O systems and storage management techniques.

UNIT I Fundamentals of Operating Systems 7

Computer Systems Overview - Components, Architecture, and Functions - Evolution of Operating Systems - Historical milestones to modern trends - Operating System Structures - Monolithic, Layered, Microkernel, and Modular Approaches-System Calls and OS Services - User and Kernel Modes - System Programs and Utilities - Operating System Design and Implementation - Best Practices and Structuring Techniques.

UNIT II Process and Thread Management 8

Processes - Concepts, States, Process Control Block (PCB) - Operations on Processes - Creation and Termination - Threads - Models (1:1, N:1, M:N), Advantages, Threading Issues, Multithreading Models and Applications - Inter-Process Communication (IPC) - Shared Memory and Message Passing.

UNIT III CPU Scheduling and Synchronization 10

CPU Scheduling - Scheduling Criteria, Algorithms (FCFS, SJF, Round Robin, Priority, Multilevel Queue) - Process Synchronization - The Critical Section Problem - Synchronization Techniques – Semaphores, Mutexes, Monitors, Spinlocks and Livelocks - Classical Synchronization Problems - Producer-Consumer - Deadlocks - Conditions, Prevention, Avoidance, Detection, and Recovery.

UNIT IV Memory Management and Virtual Memory 10

Memory Management Overview - Contiguous and Non-contiguous Allocation – Paging - Page Tables, TLBs - Segmentation and Segmentation with Paging - Virtual Memory Concepts - Demand

Paging, Copy-on-Write (CoW) - Page Replacement Algorithms - FIFO, LRU, Optimal - Thrashing and Working Set Model - Frame Allocation Strategies.

UNIT V Storage and File System Management 10

Storage Systems - Disk Structures, Disk Scheduling (FCFS, SSTF, SCAN, C-SCAN) - File Systems - Architecture, Implementation, Directory Structures - File Access Methods, File Sharing and Protection - Free Space Management – Bitmaps, Linked Lists - I/O Systems - Device Management, Kernel I/O Interface, Application I/O Interface - Introduction to RAID Levels and Storage Virtualization Concepts.

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the structure and functionalities of modern operating systems and system calls.
CO2: Apply process management techniques, multithreading and inter-process communication.
CO3: Compare various CPU scheduling algorithms and implement synchronization.
CO4: Design solutions for deadlock handling in concurrent systems.
CO5: Compare and apply memory management techniques.
CO6: Understand file system structures, disk scheduling and storage management methods.

Suggested Activities

- Research and present a timeline of the evolution of operating systems (from batch systems to cloud-native OS like AWS Nitro).
- Mini Project: Build a producer-consumer model using multithreading concepts.
- Create a CPU Scheduling simulator

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, 10th Edition, Wiley, 2018.
2. Andrew S. Tanenbaum, Modern Operating Systems, 5th Edition, Pearson, 2022.

References:

1. Ramaz Elmasri, A. Gil Carrick, David Levine, Operating Systems – A Spiral Approach, McGraw Hill, 2010.
2. William Stallings, Operating Systems: Internals and Design Principles, 7th Edition, Prentice Hall, 2018.
3. Achyut S. Godbole, Atul Kahate, Operating Systems, McGraw Hill Education, 2016.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	2	-	1	-
CO2	3	3	-	2	-	-	-	-	-	-	2	-	1	-
CO3	3	3	2	2	-	-	-	-	-	-	2	-	1	-
CO4	3	3	2	2	-	-	-	-	-	-	2	-	1	-
CO5	3	2	2	2	-	-	-	-	-	-	2	-	1	-
CO6	3	2	-	-	-	-	-	-	-	-	2	-	1	-
Avg.	3	2.5	2	2	-	-	-	-	-	-	2	-	1	-

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

Course Code	Course Name	Category	L	T	P	C
AD24411	Data Engineering	PCC	3	0	2	4

Course Objectives:

- To basics the techniques and processes of data science
- To learn and use data models
- To develop the ETL pipeline
- To use data wrangling and feature engineering
- To analysis the importance of Data Security

UNIT I INTRODUCTION TO DATA ENGINEERING 9

Data Engineering vs. Data Science - Role of a Data Engineer – DataOps - Data Formats: CSV, JSON, XML, Parquet, Avro - Defining Analytics - Types of data analytics - Descriptive Analytics - Stem and Leaf Plots - Frequency table - Time Series data - Central Tendency Measures of the location of data - Dispersion measures - Correlation analysis.

UNIT II DATA MODELS 10

Relational Databases: MySQL/PostgreSQL – NoSQL Databases: Document Based systems – Key value Stores – Column Based Systems – Graph Databases. Analytics Storage Solutions – Data Warehouses – Data Lake – Data Mart – Star/Snowflake schemas – Slowly Changing Dimensions - OLAP

UNIT III ETL AND DATA PIPELINES 9

ETL vs ELT - Introduction to Data Pipelines - Batch Processing and Stream Processing Data Pipeline Stages - Extraction (API, Web Scraping) - Ingestion (Batch Vs Stream) - Cleaning - Transformation - Feature management - Data Versioning – Dimension Modelling

UNIT IV DATA WRANGLING AND FEATURE ENGINEERING 10

Exploratory Data Analysis, Data Wrangling - Data cleaning - Data Aggregation, Sampling - Statistical descriptions of data - Measuring data similarity & dissimilarity - Handling Numeric Data - Discretization, Binarization - Normalization - Data Smoothening - Dealing with textual Data - Dealing with Images, audio and video data - Managing Categorical Attributes, Feature Engineering - Feature Subset Selection - Feature Reduction – Hypothesis testing – chi square test - t test – z test.

UNIT V ETHICS AND DATA SCIENCE 7

Data Science and Ethics – Bias and Fairness in data – Types of Bias – Testing for Bias – Fixing the Bias – Five C's in Data - Data Privacy and Security – Europe's GDPR - HIPAA - Indian Information Technology (IT) Act - Ethical Considerations in Data Usage - Auditing and Logging

Periods: 45

LIST OF EXPERIMENTS

1. Load, inspect, and convert between CSV, JSON, XML, Parquet, Avro using Pandas or PySpark.

2. Fetch data from an open API (e.g., weather, COVID) and save it locally in multiple formats.
3. Extract data from an API or CSV, transform and clean it (e.g., missing value handling, type casting), and load into PostgreSQL/MongoDB.
4. Given a dataset with missing values and multiple features, perform data normalization and data transformation.
5. Create tables, insert records, perform CRUD operations using SQL and Python
6. Use MongoDB (Document Store) to store and retrieve nested JSON documents.
7. Querying and aggregating with MongoDB queries.
8. Design a simple data warehouse schema for a sales domain using fact and dimension tables. Implement Slowly Changing Dimensions (SCD)
9. Using a dataset with continuous and categorical features, apply feature selection techniques to identify the most relevant features for predicting a continuous target variable
10. Implement batch and streaming ingestion using Pyspark to ingest data into PostgreSQL/MongoDB
11. Mini Project – Build a complete pipeline from ingestion to analytics

Suggested Activities:

- Sketch a data pipeline for a real-world scenario (e.g., Uber ride data)
- To analyse a dataset (e.g., COVID-19 time-series) for descriptive analytics
- Data Format conversions competitions
- Dataset investigation to find out the correlation and causation
- Group discussion for topics in unit 5 - Discuss ethical dilemmas

Course Outcomes:

On completion of the course, the students will be able to
CO1: To basics data engineering roles and pipeline stages
CO2: Design efficient relational and NoSQL data models
CO3: Construct ETL pipelines for batch/streaming workflows
CO4: Transform raw data into optimized analytical features
CO5: Analysis and compliance to data security practices
CO6: Deploy scalable data solutions for real-world analytics

Text Books:

1. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
2. Davy Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
3. Pang-Ning Tan, Anuj Karpatne, Michael Steinbach, Vipin Kumar “Introduction to Data Mining”, Global Edition 2019
4. Mike Loukides, Hilary Mason, and DJ Patil “Ethics and Data Science”, O’Reilly, 2018
5. Joe Reis & Matt Housley "Fundamentals of Data Engineering" O'Reilly Media, 2022

References:

1. "Data Engineering with Python" by Paul Crickard
2. Prabhu S and Venkatesan N, “Data Mining and Warehousing”, New Age International Pvt Ltd Publishers; First Edition, 2006
3. A Survey on Bias and Fairness in Machine Learning
4. Andreas Kretz, “The Data Engineering Cookbook”

Laboratory Requirements:

S.No	Name of the Equipments/Software	Required
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse	30
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30
3	Python 3.9 and above	30
4	Jupyter Notebook, Scipy, statmodels, seaborn, plotly, PySpark	30
5	MySQL, Mongo DB or equivalent	30

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	-	1	2	-
CO2	3	2	2	-	2	-	-	-	-	-	-	1	2	-
CO3	3	2	2	2	2	-	-	-	-	-	-	1	2	-
CO4	3	2	2	2	2	-	-	-	-	-	-	1	2	-
CO5	2	2	-	-	2	2	2	-	-	-	-	1	2	-
CO6	2	2	3	2	2	-	-	-	-	-	-	1	2	-
Avg.	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**-**

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

Course Code	Course Name	Category	L	T	P	C
CS24311	Digital Principles and Computer Organization	ESC	3	0	2	4

Course Objectives:

- To basics the fundamentals of number systems, codes, and combinational logic circuits.
- Analyse and design sequential logic circuits using flip-flops, counters, and state machines.
- Comprehend the basic structure, functional units, and operations of a digital computer.
- Develop knowledge on processor architecture including data path design, control units, and pipelining concepts.
- Explore memory organization, management techniques, and understand input/output interfacing mechanisms.

UNIT I COMBINATIONAL LOGIC 9

Number systems, Conversion of bases, Signed arithmetic, Complement, Parity bits, weighted and non-weighted codes, Logic gates, Combinational Circuits – Karnaugh Map - Design Procedures – Binary Adder – Subtractor – Decimal Adder - 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 – Shift 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) of MIPS: Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of MIPS Instruction – Interaction between Assembly and High Level Language.

UNIT IV DATAPATH & CONTROL DESIGN 9

Instruction Execution – Building a Data Path – Single cycle and Multicycle Implementation - Designing a Control Unit – Pipelining - Pipelined data path – Structural Hazard - 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.

Periods: 45

List of Experiments:

1. Design and implementation of combinational circuits using gates for arbitrary functions.
2. Implementation of 4-bit binary adder/subtractor circuits.
3. Implementation of code converters.
4. Implementation of BCD adder.
5. Implementation of encoder and decoder circuits.
6. Implementation of Multiplexers and Demultiplexers.
7. Implementation of functions using Multiplexers.
8. Implementation of the counters.
9. Implementation of Shift register.
10. Simulator based study of Computer Architecture.

Periods: 30
Total Periods: 75

Course Outcomes:

On completion of the course, the students will be able to

CO1: Perform conversions between number systems, and solve problems related to signed arithmetic and binary codes.

CO2: Design and simplify combinational logic circuits using logic gates and Karnaugh Maps.

CO3: Analyze and design synchronous sequential circuits using flip-flops, shift registers, and counters.

CO4: Explain the functional units of a digital computer and describe instruction execution, addressing modes, and instruction sequencing.

CO5: Develop data path and control unit designs (both hardwired and microprogrammed) and analyze the concept of pipelining with hazards.

CO6: Understand memory hierarchy, cache mapping techniques, virtual memory concepts, and various I/O interfacing standards like DMA, USB, and SATA.

Text Books:

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.

References:

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016.
2. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016.

Laboratory Requirements:

S. No.	Name of the Equipments / Software	Required
1	Digital Trainer Kit	15 Nos.
2	ICs - OR,AND, NOT, NAND, XOR, 4 bit Adder, FFs	As Required
3	Connecting Wires	As Required

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	3	2	-	1	-	-	-
CO2	3	3	2	-	-	-	-	3	2	-	1	-	-	-
CO3	3	3	2	-	-	-	-	3	2	-	1	-	-	-
CO4	3	1	1	-	-	-	-	-	-	-	1	-	-	-
CO5	3	1	1	-	-	-	-	-	-	-	1	-	-	-
CO6	3	-	1	-	-	-	-	-	-	-	1	-	-	-
Avg.	**3**	**1.8**	**1.5**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**1**	**-**	**-**	**-**

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

Course Code	Course Name	Category	L	T	P	C
AD24421	Machine Learning Laboratory	PCC	0	0	3	1.5

Course Objectives:

- To design the data sets and apply suitable algorithms for selecting the appropriate features for analysis.
- To learn to implement supervised machine learning algorithms on standard datasets and evaluate the performance.
- To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance.
- To compare the performance of different ML algorithms and select the suitable one based on the application.

LIST OF EXPERIMENTS

1. Introduction to Python and ML Libraries: Numpy, Pandas, Scikit-learn
2. Implementation of univariate, bivariate and multivariate regression
3. Implementation of Linear Regression and Evaluation Metrics (MSE, R^2)
4. Implementation of Logistic Regression with ROC Curve and AUC Analysis
5. Classification of text/spam dataset using Naïve Bayes
6. Train and evaluate a Support Vector Machine (SVM) with linear and non-linear kernel
7. Implement and visualize a Decision Tree Classifier
8. Implement Random Forest Classifier
9. Implement Ensemble Methods: Bagging and Boosting (AdaBoost, Gradient Boosting, XGBoost)
10. Implement Clustering Algorithm
11. Implement K-Nearest Neighbors (KNN) for classification
12. Apply Gaussian Mixture Model (GMM) and Expectation-Maximization (EM) algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using the k-Means algorithm. Compare the results of these two algorithms.
13. Principal Component Analysis (PCA) for Dimensionality Reduction
14. Design and Evaluation of a Machine Learning Pipeline with Cross-Validation, Performance Metrics, and Statistical comparison of Classifiers
15. Mini Project

Total Periods: 45

On completion of the course, the students will be able to

CO1: Implement and evaluate regression models

CO2: Implement supervised machine learning algorithms on standard datasets and evaluate the performance.

CO3: Construct neural networks for supervised learning tasks

CO4: Apply unsupervised machine learning algorithms on standard datasets and evaluate the performance.

CO5: Assess and compare the performance of different ML algorithms and select the suitable one based on the application.

Laboratory Requirements:

S.No	Name of the Equipments/Software	Required	Available
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17” or higher TFT Monitor, Keyboard and mouse	30	30
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30	30
3	Python3.9 and above, Anaconda Distribution Jupyter Notebook	30	30

MAPPING OF COs WITH POs AND PSOs

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

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

CS24421	**Operating Systems Laboratory**	**PCC**	**L**	**T**	**P**	**C**
			0	**0**	**3**	**1.5**

Course Objectives:

- Provide hands-on experience in understanding operating system concepts.
- Familiarize students with system calls, process management, and scheduling techniques.
- Enable students to implement memory management and file system operations.
- Demonstrate synchronization techniques using semaphores and threads.
- Train students to simulate deadlock prevention, avoidance, and detection strategies.
- Explore disk scheduling and virtualization through real-world tools and C programming.

LIST OF EXPERIMENTS:

1. Execute basic UNIX/Linux shell commands.
2. Develop simple shell scripts for automation tasks.
3. Write C programs to demonstrate process creation and management using fork(), exit(), getpid(), wait(), and close() system calls.
4. Develop C programs to simulate various CPU scheduling algorithms:
    i. First-Come, First-Served (FCFS)
    ii. Shortest Job First (SJF)
    iii. Priority Scheduling
    iv. Round Robin (RR)
5. Implement IPC mechanisms such as pipes, shared memory, and message queues.
6. Write C programs to achieve mutual exclusion using semaphore primitives.
7. Implement Banker's Algorithm in C to prevent deadlock scenarios.
8. Develop a C program to detect deadlocks using deadlock detection algorithm.
9. Write C programs to create and manage multiple threads using POSIX threads (pthreads).
10. Develop C programs to demonstrate:
    i. First Fit
    ii. Best Fit
    iii. Worst Fit memory allocation methods.
11. Write C programs to simulate page replacement policies:
    i. FIFO (First-In-First-Out)
    ii. LRU (Least Recently Used)
    iii. Optimal Page Replacement.

12. Simulate disk scheduling strategies like:
    i. FCFS
    ii. SSTF (Shortest Seek Time First)
    iii. SCAN
    iv. C-SCAN.

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Demonstrate basic UNIX/Linux commands and shell scripting.
CO2: Apply system calls to create, manage, and synchronize processes and threads in C.
CO3: Implement and analyze various CPU scheduling algorithms and IPC techniques.
CO4: Develop programs to simulate deadlock handling and synchronization.
CO5: Simulate memory allocation methods, paging techniques, and page replacement algorithms.
CO6: Implement disk scheduling techniques using C.

References:

1. https://man7.org/linux/man-pages/
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, 10th Edition, Wiley, 2018.
3. Andrew S. Tanenbaum, Modern Operating Systems, 5th Edition, Pearson, 2022.
4. William Stallings, Operating Systems: Internals and Design Principles, 7th Edition, Prentice Hall, 2018.

Laboratory Requirements:

1. INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse
2. Windows 10 or higher operating system / Linux Ubuntu 20 or higher
3. Linux Ubuntu 20 or higher
4. DevC++ / Eclipse CDT / Code Blocks / CodeLite / equivalent open source IDE

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	3	1	1	-	-	1	3	3	3	-	1	-
CO2	3	1	1	2	2	-	-	3	2	1	1	-	1	-
CO3	3	3	2	1	2	-	-	3	3	1	2	-	1	-
CO4	1	2	2	3	2	-	-	3	1	3	1	-	1	-
CO5	2	2	1	1	3	-	-	1	2	2	3	-	1	-
CO6	2	2	2	1	3	-	-	2	2	2	3	-	1	-
Avg.	**2.3**	**1.8**	**1.8**	**1.5**	**2.2**	**-**	**-**	**2.2**	**2.2**	**2.0**	**2.2**	**-**	**1**	**-**

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

Course Code	Course Name	Category	L	T	P	C
AD24422	Project Driven Learning	EEC	0	0	2	1

Course Objectives:

- Apply Design Thinking & Problem-Solving Techniques
- Develop and Implement a Structured Project Plan
- Build Functional Prototypes & Minimum Viable Products (MVPs)
- Evaluate Performance & Optimize Solutions
- Present and Deploy Innovative Solutions

UNIT I Ideation & Problem Identification **6**

- Icebreaker & Team Formation
  - Tools: Miro, MURAL
- Brainstorming Sessions (Design Thinking, Mind Mapping)
  - Tools: Miro, XMind, Lucidchart
- Understanding User Needs & Problem Validation
  - Tools: Google Forms, Typeform
- Conducting Market Research & Competitor Analysis
  - Tools: Google Trends, Statista, Crunchbase

UNIT II Solution Conceptualization & Planning **6**

- Exploring Feasible Solutions (Convergent Thinking)
  - Tools: Miro, FigJam
- Selecting the Tech Stack & Tools
- Creating a Project Timeline (Agile/Scrum Basics)
  - Tools: Jira, Trello
- Sketching Wireframes, Flowcharts, or System Diagrams
  - Tools: Figma, Lucidchart
- Risk Analysis & Contingency Planning
  - Tools: SWOT Analysis Templates, Risk Assessment Matrix

UNIT III Prototyping & Implementation **6**

- Creating a Low-Fidelity Prototype (Paper/Digital Mockups)
  - Tools: Figma
- Building a Minimum Viable Product (MVP)
- Testing & Refining the Prototype Based on Feedback
- Implementing Core Functionalities of the Solution
- Code/Design Review & Iteration

UNIT IV Performance Metrics, Benchmarking & Optimization **6**

- Defining Key Performance Metrics (KPIs) for the Project
  - Tools: Google Analytics
- Setting Industry Benchmarks & Performance Goals
- Conducting Functional & Usability Testing
  - Tools: Selenium

- Analyzing System Performance & Bottleneck Detection
- Optimizing Code, UI/UX, and Resource Utilization

UNIT V Presentation & Deployment 6

- Crafting a Compelling Pitch (Storytelling, Business Model)
    - Tools: Business Model Canvas, Pitch Deck Templates (Canva, Google Slides)
- Creating a Demo
- Pitching & Receiving Feedback from Mentors/Peers
- Deploying/Publishing the Project
    - Tools: GitHub Pages
- Showcasing the Final Product & Reflection

Total Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

- Finalize a well-defined problem statement and identify key stakeholders
- Develop a structured project plan, defining goals, tech stack, and execution roadmap
- Build a functional prototype with key features working
- Establish clear performance benchmarks, conduct thorough testing, and optimize their project for efficiency, usability, and scalability.
- Successfully present and deploy their projects
- Demonstrate end-to-end project development skills**,** integrating problem-solving, technical implementation, optimization, and presentation to create impactful solutions

Learning Links:

1. Miro Basics
2. Lucidchart Tutorials
3. Figma Wireframing Guide
4. Trello Agile Basics
5. GitHub Basics
6. GitHub Pages Deployment

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	2	1	2	2	2	2	-	2	2
CO2	2	2	3	1	2	-	-	2	2	3	2	-	2	2
CO3	3	3	3	2	3	-	-	2	2	2	2	-	2	2
CO4	3	3	3	3	3	-	-	-	-	2	2	-	2	2
CO5	2	2	2	-	2	1	1	3	3	2	2	-	2	2
CO6	3	3	3	2	3	2	1	3	3	3	3	-	2	2
Avg.	2.7	2.5	2.7	2	2.6	1.7	1	2.4	2.4	2.3	2.2	-	2	2

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

Course Code	Course Name	Category	L	T	P	C
FC24301	Soft Skills	HSMC	2	0	0	1

Course Objectives:

- Apply proper etiquette in social, corporate, and online interactions
- Develop effective verbal and nonverbal communication skills, including body language and posture
- Enhance participation in group discussions and structured professional conversations
- Prepare for job interviews with appropriate etiquette, research, and response techniques
- Communicate professionally in written formats such as emails, inquiries, and job offer letters
- Deliver structured and engaging presentations using storytelling and persuasive techniques

UNIT I Etiquette **6**

Definition

- Social
- Corporate/Business - Meeting
- Telephone
- Netiquette

UNIT II Body Language and Nonverbal Communication **6**

- Posture
- Personal grooming
- Facial expression/ gesture/eye contact

UNIT III Group Discussion **6**

- Etiquette - Rules of conduct
- GD flow
- Pestel - Political, economic, social, tech, legal, environmental
- Handling unpredictable situation

UNIT IV Job Interview – Etiquette **6**

- Pre-interview prep and research
- Responding to non technical questions (star model - situation/task/ action plan/ result)
- Speaking your resume
- Writing inquiries and responding to job offer letters

UNIT V Presentation skills **6**

- Setting the tone/ storytelling
- JAM/ Turn your Court

Total Periods: 30

Course Outcomes:

CO1. Demonstrate professionalism in meetings, telephone calls, and digital communication
CO2. Use appropriate body language, facial expressions, and gestures to enhance communication
CO3. Participate effectively in group discussions, debates, and structured dialogues

CO4. Apply job interview strategies, including answering behavioral questions using the STAR model
CO5. Write clear and professional business correspondence, including inquiries and job offers
CO6. Present ideas confidently with a structured approach, engaging tone, and strong delivery

Suggested Activities

1. **Role-Playing Business Meetings** – Students are assigned different corporate roles (CEO, Manager, Employee) and have them conduct a mock meeting with proper etiquette.
2. Group Discussion
3. **PESTEL Case Study** – Students analyze a real-world company using PESTEL factors and present their findings.
4. **Resume Pitching** – Students present their resumes as a story, explaining their achievements in an engaging way.
5. **Turn the Court Debate Organizer** – Students list arguments for and against a topic to prepare for persuasive speaking.

Work Sheets:

1. Business Meeting Etiquette Checklist – A checklist where students identify correct/incorrect meeting behaviors.
2. PESTEL Case Study Template – A table where students analyze a company using Political, Economic, Social, Technological, Environmental, and Legal factors.
3. STAR Method Interview Worksheet – Students write answers to common behavioral questions using the situation, Task, Action, Result format.

References:

1. Pachter, Barbara. The Essentials of Business Etiquette: How to Greet, Eat, and Tweet Your Way to Success. McGraw-Hill, 2013.
2. Pease, Allan, and Barbara Pease. The Definitive Book of Body Language. Bantam, 2004.
3. Gage, Martha. The Power of STAR Method: How to Succeed at Behavioral Job Interviews. Independently published, 2019.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	1	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO3	-	-	-	-	-	-	-	1	1	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO6	-	-	-	-	-	-	-	1	1	-	-	-	-	-
Avg.	-	-	-	-	-	-	-	1	1	-	-	-	-	-

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

Course Code	Course Name	Category	L	T	P	C
HS24321	Communication Skills Building Laboratory	HSMC	0	0	2	1

Course Objectives:

- Develop the ability to construct grammatically correct and contextually appropriate sentences
- Enhance critical thinking skills for analyzing and interpreting texts, media, and experiences
- Strengthen comprehension, summarization, and documentation skills for professional contexts
- Improve verbal and non-verbal communication for effective interaction in diverse professional settings
- Equip learners with teamwork, networking, and interview skills essential for career advancement
- Enable the creation of a professional digital identity through resumes, LinkedIn profiles, and self-presentation techniques

UNIT I The Art of Discourse **6**

- **Listening:** Listen to stand-up comedy, political commentaries, and campaigns for appreciative listening.
- **Reading:** Read and evaluate business and economic news articles; determine tone (neutral, positive, negative) and fact-check.
- **Writing:** Craft commentary and opinion pieces to persuade or provoke discussion.
- **Speaking:** Explain satire comic strips (e.g., Amul advertisements, political cartoons)

UNIT II Professional Communication Essentials 6

- **Listening**: Listen to voicemail, messages, and fill out forms.
- **Reading**: Compare products & services; analyze advertisements.
- **Writing**: Draft meeting agendas and minutes.
- **Speaking**: Engage in open-field group discussions.

UNIT III Documentation and Summation 6

- **Listening:** Listen to documentaries, book summaries, and movie summaries for comprehensive understanding.
  Reading: Read and analyze reports on significant events (e.g., environmental disasters, economic downturns).
- **Writing:** Write survey reports and paraphrase key information.
- **Speaking:** Report news, weather forecasts, and predictions.

UNIT IV Refining Professional Competence 6

- **Listening:** Translate informal language into formal business communication (Contextual translation)
- **Reading:** Read and interpret technical texts and industry-specific jargon.
- **Writing:** Write cover letters and statements of purpose.

- **Speaking:** Role-play professional etiquette in workplace scenarios (e.g., expressing empathy, kindness, courtesy).

UNIT V Developing a Professional Profile 6

- **Listening:** Listen to podcasts, Josh Talks, and professional interviews.
- **Reading**: Analyze professional resumes and LinkedIn profiles.
- **Writing**: Set up a LinkedIn profile and write engaging posts.
- **Speaking**: Conduct mock interviews and deliver an effective elevator pitch.

Total Periods:30

Course Outcomes:

C01: Construct coherent and professional sentences tailored to various workplace scenarios
C02: Analyze and critically interpret professional texts and multimedia content
C03: Document, summarize, and report information effectively across multiple formats
C04: Communicate effectively in professional and social interactions
C05: Demonstrate teamwork, networking, and interview skills relevant to career development
C06: Curate a professional online presence through resume development - LinkedIn, Indeed, .

Suggested Activities:

1. Documentation and Summation
   Assignment: Newsroom Simulation (20 Marks)
   - Students record a 2-minute news report on an environmental/economic issue.
   - Must include paraphrased content from real news reports (cite sources).
   - Submission: Video + written news script.
2. Group Discussion (30 Marks)
3. Refining Professional Competence
   Assignment: Corporate Dilemma Roleplay (20 Marks)
   - Scenario-based role play on professional etiquette (handling client complaints, rejecting proposals kindly, etc.).
   - Each student submits a formal email responding to the scenario professionally.
4. Developing a Professional Profile
   Assignment: LinkedIn Challenge (30 Marks)
   - Students create or optimize their LinkedIn profile and write a compelling post (e.g., career reflections, lessons from a recent project).
   - Submit a screenshot of updated profile + link to post.
   - Optional: Engage with at least three classmates' posts with meaningful comments.

Text Books:

1. English for Engineers and Technologists. Volume I by Orient Blackswan, 2022
2. English for Science & Technology - I by Cambridge University Press, 2023

References:

1. Seely, John. Oxford Guide to Effective Writing and Speaking: How to Communicate Clearly. Oxford University Press, 2013.
2. Cottrell, Stella. Critical Thinking Skills: Developing Effective Analysis and Argument. Bloomsbury Academic, 2017.
3. Bhatnagar, Nitin. Communicative English for Professional Courses. Pearson, 2010.

4. Guffey, Mary Ellen, and Dana Loewy. Essentials of Business Communication. Cengage Learning, 2021.
5. Collins, Patrick. Speak with Power and Confidence: Tested Ideas for Becoming a More Powerful Communicator. Prentice Hall, 2009.
6. Locker, Kitty O., and Stephen Kyo Kaczmarek. Business Communication: Building Critical Skills. McGraw-Hill, 2020.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	1	1	1	-	-	-	-
CO2	-	1	-	1	-	-	-	1	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	1	-	-	-	-	-
CO5	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Avg.	-	1	-	-	-	1	1	1	1	1	-	-	-	-

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

Course Code	Course Name	Category	L	T	P	C
AD24501	Big Data Analytics	PCC	3	0	0	3

Course Objectives:

- To introduce the fundamentals of Big Data concepts, trends, and technologies.
- To analysis the architecture, working, and implementation of Hadoop and MapReduce.
- To explore the ecosystem tools such as HBase, Pig, and Hive for data storage and processing.
- To demonstrate the integration of Big Data analytics with cloud platforms, especially Google Cloud Platform (GCP).
- To provide practical exposure to building and managing data warehouses using BigQuery and Airflow.

UNIT I Understanding Big Data and Introduction to Hadoop 10

Introduction to big data – convergence of key trends – unstructured data – Industry examples of big data – Introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics. Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration.

UNIT II Map Reduce Applications 8

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of MapReduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN –

job scheduling – shuffle and sort – task execution – MapReduce types – input formats – output formats.

UNIT III Big-Data Technology Overview 9

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries. Introduction to Cassandra.

UNIT IV Big Data Capability in Cloud 9

ELT Concept-process multiple files using map reduce-On Demand nature of cloud-introduction to GCP console-GCP cloud shell-GCP services –GCP server less services-service mapping and prioritization- IAM tool - Hands-on practice - Simulate ELT using Python -Classic MapReduce example using Python and Hadoop.- Explore a Free Cloud Console

UNIT V Building a Data warehouse in Big Query 9

Introduction to Google cloud storage and big query-big query console - pre-requisites - developing a data warehouse-cloud composer-working of airflow. - Hands-on practice - Simulate a warehouse using PostgreSQL locally - Upload and query CSV using BigQuery console - Build a basic Airflow DAG for file loading and transformation

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Analysis the concepts, trends, and technologies driving Big Data and its applications.
CO2: Illustrate the architecture and functionality of Hadoop Distributed File System (HDFS)
CO3: Implement and evaluate data processing workflows using the MapReduce framework and related components.
CO4: Apply HBase, Pig, and Hive tools to process, analyze, and query large datasets effectively.
CO5: Integrate Big Data analytics with cloud-based environments using GCP services and tools.
CO6: Design and simulate a cloud-based data warehouse using BigQuery and Airflow for ETL operations.

Suggested Activities:

- Big Data Identification Activity
- Hadoop Ecosystem Poster Challenge
- Discussion on MapReduce Applications - Classic WordCount vs. Real-World Use Cases, Log Analysis for Large Websites
- Industry Case Study Review
- Mini Hackathon

Text Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Wijeya, A. Data Engineering with Google Cloud Platform: A practical guide to operationalizing scalable data analytics systems on GCP. Packt Publishing. 2022

3. Balamurugan Balusamy, Nandhini Abirami R, Seifedine Kadry and Amir H.Gandomi,"Big Data Concepts, Technology and Architecture", Wiley Publication, 2021

References:

1. Tom White,"Hadoop: The Definitive Guide", O'Reilly Publications, 2015.
2. Sadasivam, S. & Gunasekaran, K. 2019, Big Data Analytics, Wiley India Pvt. Ltd., New Delhi.
3. Raj Kamal, Preeti Saxena, Big Data Analytics: Introduction to Hadoop, Spark and Machine, McGraw Hill Education (India) pvt. Ltd. 2019.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO3	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO5	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO6	2	2	2	-	3	-	-	-	-	-	-	-	2	-
Avg.	2	3	3	-	3	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
AD24502	Neural Networks and Deep Learning	PCC	3	0	0	3

Course Objectives:

- To analysis the foundational concepts of neural networks and training techniques for deep learning models.
- To learn the principles and operations of CNNs for effective feature extraction and image-based learning.
- To explore RNN architectures and techniques for modeling sequential and time-dependent data.
- To apply transformer-based models for diverse natural language processing tasks.
- To develop skills to evaluate, tune, and debug deep learning models using metrics and hyperparameter strategies.

UNIT I Deep Network Foundations 9

Introduction to Neural Networks - Biological inspiration - Neuron models - Perceptron and Multi-layer Perceptron (MLP) - Activation functions – Feed Forward Process - Network Architectures - Feedforward and Feedback Networks - Error Functions - Optimization Algorithms - Back Propagation

UNIT II Convolutional Neural Networks 10

Image Classification using MLP - CNN Architecture - Convolution Layers - Pooling - Fully Connected Layers - Image Classification using CNN - Dropout layers - Convolution over color images - Performance and hyper parameter tuning - Evaluation Metrics - Neural Network hyper parameters - Learning and Optimization - Regularization Techniques - Batch Normalization

UNIT III Recurrent Neural Networks 9

RNN Basics – Unfolding gradient Computation - Deep Recurrent Networks - Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM and GRU.

UNIT IV Advanced CNN Architectures, Transfer learning and Object Detection 8

ImageNet - VGG – ResNet – Transfer Learning Approaches - Object Detection Framework - Region based CNN - Single shot detector - YOLO

UNIT V Transformers 9

Transformer Architecture - Self-Attention, Scaled Dot-Product Attention, Multi-Head Attention - Positional encoding and token embedding - Transformer Encoder and Decoder architecture - Feedforward, residual connections, and layer normalization - Encoder Only Model - BERT, Decoder-only models - GPT

Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: To analysis the foundational concepts of neural networks and various training techniques used in deep learning models.

CO2: Apply the principles and operations of Convolutional Neural Networks (CNNs) for feature extraction and image-based learning tasks.

CO3: Implement Recurrent Neural Network (RNN) architectures to model sequential and time-dependent data effectively.

CO4: Compare and assess advanced CNN architectures (VGG, ResNet) and apply transfer learning and object-detection frameworks

CO5: Analyze the components and working principles of the Transformer architecture for attention-based learning.

CO6: Implement deep learning techniques for solving complex real-world tasks

Suggested Activities:

- Build a single-layer perceptron from scratch for binary classification.
- Compare different activation functions and discuss their pros and cons in real-world tasks.
- Identify common issues such as vanishing/exploding gradients and implement solutions.
- Quiz on CNN and RNN types
- Debate pros and cons of transformer models vs RNNs for NLP tasks.
- Study of Encoder Decoder Model - T5
- Discuss real-world implications of evaluation metrics in applications like medical diagnosis or finance.

Text Books:

1. Elgendy, Mohamed. Deep Learning for Vision Systems. Shelter Island, NY: Manning Publications, 2020.

2. Saitoh, Koki. Deep Learning from the Basics: Python and Deep Learning: Theory and Implementation. Packt Publishing, 2021.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning", MIT Press, 2016.
4. Natural Language Processing with Transformers" by Lewis Tunstall, Leandro von Werra, and Thomas Wolf (O'Reilly, 2022)

References:

1. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, ``A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018.
2. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 2018.
3. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
4. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited, 2011

MAPPING OF COs WITH POs AND PSOs

COs	**POs**											**PSOs**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	3	-	-	-	-	-	-	3	2	1
CO2	2	3	3	2	3	-	-	-	-	-	-	2	3	1
CO3	2	3	3	2	3	-	-	-	-	-	-	2	3	1
CO4	2	3	3	3	3	-	-	-	-	-	-	2	3	1
CO5	2	3	3	3	3	-	-	-	-	-	-	2	3	1
CO6	2	3	3	3	3	-	-	-	-	-	-	2	3	1
Avg.	2	3	3	2	3	-	-	-	-	-	-	2	3	1

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

Course Code	**Course Name**	**Category**	**L**	**T**	**P**	**C**
GE24501	Project Management and Operations Management	PCC	2	0	2	3

Course Objectives:

- To analysis the fundamental concepts, roles, and lifecycle of project management
- To equip learners with planning, scheduling, and control techniques
- To introduce software project management methodologies and modern development frameworks
- To provide knowledge of operations management principles
- To familiarize students with quality management practices and sustainable operational strategies

UNIT I Fundamentals of Project Management **6**

Understanding Project Management – Project Management Role – Classification of Projects – Product Vs Project Management – Project Lifecycle – Project Risk Management – Case Studies: LP Manning Corporation and Project Firecracker

UNIT II Project Planning, Scheduling and control **6**

Project planning process and Work Breakdown Structure (WBS) – Project scheduling techniques: Gantt chart, PERT, CPM – Resource allocation – Project budgeting and cost estimation – Project Management Information Systems (PMIS) and software tools (MS Project, Primavera)

UNIT III Software Project Management and process models **6**

Software Process Models : Waterfall Model, Prototyping Model, RAD Model, Incremental Model, Spiral Model, Agile Fundamentals - Scrum Framework

UNIT IV Operations Management and inventory control **6**

Production systems, Classification of Production systems, Operations system, Operations Management - Definition, Objectives, Strategic role of operations, Strategic Planning, Inventory control or management - Inventory, Objectives of inventory control, benefits, techniques (EOQ, JIT, ABC analysis)

UNIT V Quality management and Sustainable Operations **6**

Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Supply chain management – Lean operations and Six Sigma overview - Quality management concepts – TQM, ISO standards, Kaizen, 5S

Periods: 30 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: To comprehend the fundamental concepts of project management, including project lifecycle and risk management

CO2: Apply project planning and scheduling techniques such as WBS, Gantt charts, PERT, and CPM

CO3: Analyze and compare various software process models including Waterfall, Spiral, Agile, and Scrum frameworks.

CO4: Apply operations management principles and inventory control techniques such as EOQ, JIT, and ABC analysis in practical scenarios.

CO5: Evaluate quality management practices using tools such as TQM, Six Sigma, Kaizen, and ISO standards

CO6: Design and develop integrated solutions by combining project management, operations strategies, and quality frameworks

Suggested Activities

- Interactive lectures and discussions
- Case studies from engineering and industrial projects

- Hands-on workshops on PERT/CPM using software tools
- Group projects on planning and evaluating an engineering project
- Industry expert talks on project execution and operations excellence

Text Books:

1. Kerzner, H. (2018). Project Management: A Systems Approach to Planning, Scheduling and Controlling. Wiley.
2. Chandra, Prasanna. (2017). Projects: Planning, Analysis, Selection, Financing, Implementation and Review. McGraw Hill Education.
3. Anil Kumar, S. & Suresh, N. (2018). Operations Management. New Age International Publishers.
4. Robert Hughes and Mike Cotterell (2009). Software Project Management. McGraw-Hill Higher Education.

References:

1. Dale H. Besterfiled, Carol B.Michna, Glen H. Bester field, MaryB.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. Gray, C. F., & Larson, E. W. (2020). Project Management: The Managerial Process. McGraw Hill Education.
3. Jack R. Meredith & Samuel J. Mantel. (2019). Project Management: A Managerial Approach. Wiley India.
4. Bhavesh. M Patel, Sandhya Rai, J.S Chandan, Dr. A. Nag, Project Management, Vikas Publishing House, New Delhi, 2020.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	2			
CO2	3	3	2	2	-	-	-	-	-	3	2			
CO3	3	3	2	2	-	-	-	-	-	3	2			
CO4	3	3	2	2	-	-	-	-	-	3	2			
CO5	3	3	2	2	-	-	-	-	-	3	2			
CO6	3	3	3	2	-	-	-	-	-	3	2			
Avg.	3	3	2	2	-	-	-	-	-	3	2			

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

Course Code	Course Name	Category	L	T	P	C
AD24512	Data Visualization and Story Telling	PCC	3	0	2	4

Course Objectives:

- To develop the ability to analyze and interpret data using visual techniques to uncover patterns and insights.

- To equip learners with skills to create and customize diverse visualizations using Python libraries for effective data communication.
- To design interactive dashboards and connect data sources using modern business intelligence platforms.
- To explain how to craft compelling data narratives and apply visualization ethics in real-world contexts.
- To introduce design thinking principles for building user-centered, accessible, and aesthetically impactful data stories.

UNIT I Exploratory Data Analysis and Visualization using Python 9

Fundamentals of Exploratory Data Analysis - Significance of EDA – EDA using Python – Types of data visualizations – Python Libraries for Data Visualization - Basic Plotting with Matplotlib - Visualization for Descriptive Statistics – Visualizing central tendency and dispersion - Box plots and whiskerplots – Correlation and Relationship Analysis – Scatterplot matrix – Correlation heatmaps.

UNIT II Visualization using PowerBI 9

Features of Power BI - Getting Started with Data – Data Modelling - Report Design :Adding Visualization, Style Manipulations, Setting Colours and Background, Exploring charts -Introduction to DAX Measures and Columns - Editing Interactions - Filters: Types of Filters Visual Level, Page and Report Level, Include and Exclude, Using Slicer as a Filter-Adding Reports and Data Sets in Workspace – Dashboards

UNIT III Visualization using Tableau 9

Introduction to Tableau – Overview of Tableau - Tableau Interface - Connecting to Data - Data Preparation - Data cleaning and transformation within Tableau - Basic Visualizations in Tableau -Bar charts, line charts, and pie charts - Tables and cross-tabs-Formatting and styling visualizations-Filters and Parameters-Adding filters to visualization-Calculated Fields and Analytics - Advanced Visualizations in Tableau -Heatmaps, tree maps and bubble charts- Creating maps - Dashboards and Stories

UNIT IV Storytelling with Data and Real-World Applications 9

Importance of the context – Choosing an effective visual – Clutter is your enemy – Focus your audience's attention – Think like a designer - Dissecting Model – Lessons in Story Telling

UNIT V Introduction to Design Thinking in Data Storytelling 9

Introduction to Design Thinking – Stages of Design Thinking – Human Centric Design in AI and Analytics - The intersection of Data, Design, and Storytelling - Understanding the Audience

Periods: 45

Course Outcomes:

On completion of the course, the students will be able to
CO1: To apply core concepts of exploratory data analysis to uncover patterns and insights.
CO2: Create and customize effective data visualizations using Python libraries and plotting techniques.

CO3: Build interactive dashboards with BI tools, integrating data sources and applying design principles.
CO4: Craft compelling data stories using narrative structures and ethical visualization practices.
CO5: Apply design thinking to create user-centered, accessible, and aesthetically engaging data experiences.
CO6: Communicate analytical findings through dashboards and visual storytelling for real-world decision-making.

Practical Exercises:

1. Descriptive feature identification for predicting a target feature by visualizing relationships.
2. Data preparation for Exploration using normalization, binning and sampling methods.
3. Perform exploratory data analysis (EDA) on with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
4. Working with Numpy arrays, Pandas data frames, Basic plots using Matplotlib.
5. Perform Time Series Analysis and apply the various visualization techniques
6. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc.
7. Data Visualization Using PowerBi - Learning the Power BI Interface, connecting to various data sources (Excel, CSV, SQL databases), Creating basic visualizations: bar charts, line charts, pie charts, Creating Calculated Columns and Measures Building Dashboards.
8. Data Visualization Using Tableau - Introduction to Tableau and its interface, connecting to various data sources (Excel, CSV, SQL databases), Creating basic visualizations: bar charts, line charts, pie charts, Creating calculated fields
9. Building dashboards and stories in Tableau
10. Mini Project

30 Periods
Total Periods: 75

Suggested Activities:

- EDA Mini Challenge
- Correlation and Relationship Analysis
- Compare Matplotlib vs Seaborn Activity
- Creation of a Basic Business Dashboard
- Storyboarding Activity

Text Books:

1. Jake Vander Plas, “Python Data Science Handbook: Essential Tools for Working with Data”, Oreilly, 1st Edition, 2016.
2. Daniel G. Murray, "Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software", John Wiley & Sons, Inc., Second Edition, 2016.
3. Brett Powell, "Power BI Cookbook: Creating Business Intelligence Solutions of Analytical Data Models, Reports, and Dashboards", Packt Publishing Ltd, First Edition, 2017
4. Knaflic, Cole Nussbaumer. *Storytelling with Data: A Data Visualization Guide for Business Professionals.* Hoboken, NJ: Wiley, 2015.

References:

1. Joshua N. Milligan, “Learning Tableau", Packt Publishing Ltd, Third Edition, 2019.
2. Errin O’Connor “Microsoft Power BI Dashboards Step by Step”, Pearson Education, 2019.
3. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020.
4. Liedtka J and Ogilvie T, Design Thinking for Strategic Innovation, Columbia Business School Publishing, 2011.
5. https://www.datacamp.com/courses/introduction–to–data–visualization–with–python
6. https://machinelearningmastery.com/data–visualization–methods–in–python/
7. https://www.kaggle.com/benhamner/python–data–visualizations
8. https://infocepts.ai/pdf/books/InfoCepts_Data_Storytelling_Book.pdf

Total Periods: 60

Laboratory Requirements:

S.No	Name of the Equipments/Software	Required	Available
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17” or higher TFT Monitor, Keyboard and mouse	30	30
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30	30
3	Python 3.9 or above, Power BI Desktop, Tableau Desktop (Free Tier)	30	30

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	-	3	-	-	-	-	-	2	-	1	-
CO2	2	2	2	-	3	-	-	-	-	-	2	-	2	-
CO3	2	2	2	-	3	-	-	-	-	-	2	-	2	-
CO4	2	2	2	-	2	2	-	-	-	-	2	-	1	-
CO5	-	1	2	-	2	3	-	-	2	-	3	-	1	-
CO6	-	2	-	-	2	2	-	-	2	-	3	-	1	
Avg.	2.25	2	2	-	2.5	2.33	-	-	2	-	2.33	-	1.33	-

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

Course Code	Course Name	Category	L	T	P	C
CS24512	Computer Networks	PCC	3	0	2	4

Course Objectives:

- To basics the concept of layering in networks
- To analysis the basics of how data flows from one node to another
- To know the functions of each layer of TCP/IP protocol suite
- To familiarize the protocols of each layer of TCP/IP protocol suite
- To develop the performance of data transmission

UNIT I Introduction and Physical Layer 9

Data Communication – Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched networks

UNIT II Data Link Layer and Media Access 8

Data Link Layer – Framing – Error control – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Ethernet Basics – CSMA/CD – Wireless LAN (802.11)

UNIT III Network Layer and Routing 12

Network Layer Services - Switching: Packet Switching - Internet protocol - IPV4: Packet Format – Address Spacing – Classful Addressing – Classless Addressing – Subnetting – IPV6, ARP, RARP, ICMP – Routing and protocols: Unicast routing – Distance Vector Routing – RIP – Link State Routing – OSPF – Multicasting basics

UNIT IV Transport Layer 9

Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control – Congestion Control – Congestion avoidance – SCTP

UNIT V Application Layer 7

Introduction to Application Layer: Providing Services – Application Layer Paradigms – Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS

Periods: 45

LIST OF EXPERIMENTS:

1. Learn to use commands like ping, netstat, ipconfig, nslookup, tracert and getmac.
2. Simulation of Cyclic Redundancy Check.
3. Simulation of a) ARP protocol b) RARP protocol.
4. Simulation of a) Distance Vector Routing Algorithm b) Link State Routing algorithm.
5. Study of Network simulator (NS).
6. Simulation of Congestion Control Algorithms using NS.
7. Use a tool like Wireshark to capture packets and examine the packets. Capture ping and tracer PDUs and various protocol PDUs.
8. Applications using TCP sockets like: a) Echo client and echo server b) Chat
9. Write a HTTP web client program to download a web page using TCP sockets.
10. Simulation of DNS using UDP sockets.

30 PERIODS
TOTAL PERIODS: 75

Course Outcomes:

On completion of the course, the students will be able to

CO1:To know the basic layers of computer networks and understand the physical layer functionalities

CO2: To develop the data link layer functionalities and analyze the protocols used in the Data Link Layer.
CO3:To design the process of subnetting and analyze the various Internet protocols and routing algorithms
CO4: Demonstrate the functions of the transport layer and analyze the transport layer protocols.
CO5:To familiarize the application layer services and analyze the working of various application layer protocols.
CO6: Design, configure and implement network topology for a given use.

Suggested activities:

1. Designing a network topology based on the Use Case.
2. Configuration of VLAN in managed switches.
3. Study of router functionality and configuration.
4. Study of Firewall functionality and Unified Threat Management

Text Books:

1. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022

References:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An OpenSource Approach", McGraw Hill, 2012.

Laboratory Requirements:

S.No	Name of the Equipments/Software	Required	Available
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse	30	30
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30	30
3	Java JDK 21/ Python, Equivalent Compiler Network Simulator like NS2 / Wireshark 4.0 and above	30	30

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1		1	-	-	-	-	-	2	2	1	1
CO2	3	3	1	1	2	-	-	-	-	-	2	2	1	1
CO3	3	3	1	2	2	-	-	-	-	-	3	2	2	2
CO4	3	3	1	2	2	-	-	-	-	-	2	2	2	2
CO5	3	3	1	1	1	-	-	-	2	-	2	2	2	1
CO6	2	2	3	3	3	-	-	2	2	2	2	3	3	2
Avg.	**2.8**	**2.7**	**1.3**	**1.5**	**1.8**	**-**	**-**	**0.3**	**0.7**	**0.3**	**2.2**	**2.2**	**1.8**	**1.5**

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

Course Code	Course Name	Category	L	T	P	C
AD24521	Big Data Analytics Lab	PCC	0	0	3	1.5

Course Objectives:

1. Provide hands-on experience in installing, configuring, and managing Hadoop
2. Develop the ability to implement and execute MapReduce programs for large-scale data processing.
3. Demonstrate data management operations using HDFS and NoSQL databases such as HBase.
4. To enable integration of heterogeneous data sources
5. To familiarize students with cloud-based big data environments
6. To empower students to automate big data workflows

List of Experiments:

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
3. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Loading data into HDFS and Perform various HDFS commands
6. Installation of Hive along with practice examples.
7. Installation of HBase, Installing thrift along with Practice examples
8. Practice importing and exporting data from various databases
9. "Pig" installation & Develop Pig Scripts and call UDF's to accomplish functionalities to meet the problem objectives & Embedding PIG Latin in Python
10. Run simple Linux commands, manage GCP storage, and perform Python execution within Cloud Shell.
11. Load CSV data into a local PostgreSQL database and apply transformation logic.
12. Create custom roles, assign permissions, and restrict access for specific users using IAM (Identity and Access Management)
13. Building a Basic Airflow DAG for File Loading and Transformation
14. Deploy an AI/ML model using BigQuery ML for predictive analytics.

Periods: 45 Periods

Course Outcomes:

On completion of the course, the students will be able to

CO1. Install, configure, and run Hadoop and HDFS and Perform map-reduce analytics using Hadoop.
CO2. Perform data management operations in HDFS
CO3. Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics
CO4. Integrate external data sources by importing and exporting datasets between Hadoop and

CO5. relational databases to enable end-to-end data flow across systems.
CO6. Utilize cloud-based tools and environments
CO7. Design and automate big data workflows using Apache Airflow and deploy AI/ML models using BigQuery ML for predictive analytics and decision-making.

References:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Wijaya, A. Data Engineering with Google Cloud Platform: A practical guide to operationalizing scalable data analytics systems on GCP. Packt Publishing, 2022.

Laboratory Requirements:

S.No	Name of the Equipments/Software	Required	Available
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse	30	30
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30	30
3	Java JDK 21, Python 3.10, Apcahe Hadoop 3.0 or above, Apache Hive, Apache Pig, Apache Spark, Google Cloud Free Tier	30	30

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO3	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO4	1	2	2	-	3	-	-	-	-	-	-	-	2	-
CO5	2	2	2	-	3	-	-	-	-	-	-	-	2	-
CO6	2	2	2	-	3	-	-	-	-	-	-	-	2	-
Avg.	2	3	3	-	3	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
AD24522	Deep Learning Lab	PCC	0	0	3	1.5

Course Objectives:

- To provide hands-on experience in designing and implementing deep learning models using PyTorch.
- To familiarize with neural network architectures including Perceptron, CNN, RNN, LSTM, and GANs.
- To apply deep learning models to real-world domains such as image, audio, and text processing.
- To develop skills in transfer learning, model optimization, and hyperparameter tuning.

- Cultivate the ability to evaluate, compare, and interpret deep learning model performance for various applications.

LIST OF EXPERIMENTS

1. Implement and execute simple deep learning programs using PyTorch.
2. Design and implement a Perceptron model for basic binary classification tasks.
3. Develop a Feedforward Neural Network and train it using the Backpropagation algorithm.
4. Construct a Convolutional Neural Network (CNN) model for image analysis and classification.
5. Explore and fine-tune pretrained deep learning models for transfer learning applications.
6. Implement and compare the performance of three popular CNN architectures: VGG, ResNet and GoogLeNet for classification.
7. Implement Recurrent Neural Networks (RNN), including LSTM and GRU architectures, for sequence modelling.
8. Build a text generation model using Long Short-Term Memory (LSTM) networks. Train the model on a text corpus to generate coherent sequences of text and evaluate the generated text for fluency and coherence.
9. Perform Transfer Learning using advanced transformer-based models such as BERT and GPT.
10. Perform Hyperparameter Tuning and Model Optimization in Deep Learning
11. Design and execute a comprehensive deep learning project on a real-world problem

Periods: 45

On completion of the course, the students will be able to

CO1. Implement and execute basic deep learning programs using PyTorch.

CO2. Design, train and evaluate Feedforward Neural Networks and Convolutional Neural Networks (CNNs) for various classification tasks.

CO3. Apply deep learning techniques to image and text datasets, including sequence modeling using LSTM and Recurrent Neural Networks.

CO4. Utilize pre-trained and transformer-based models for transfer learning and fine-tuning.

CO5. Perform hyper parameter tuning and evaluate deep learning models for performance optimization.

CO6. Integrate and compare multiple deep learning architectures for a real-world problem.

References:

1. Elgendy, Mohamed. Deep Learning for Vision Systems. Shelter Island, NY: Manning Publications, 2020.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”', MIT Press, 2016.

Laboratory Requirements:

S.No	Name of the Equipments/Software	Required	Available
1	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17” or higher TFT Monitor, Keyboard and mouse	30	30
2	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30	30
3	Python3.9 and above, Anaconda Distribution	30	30

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	-	-	-	-	-	-	3	2	1
CO2	2	3	3	2	3	-	-	-	-	-	-	2	3	1
CO3	2	3	3	2	3	-	-	-	-	-	-	2	3	1
CO4	2	3	3	3	3	-	-	-	-	-	-	2	3	1
CO5	2	3	3	3	3	-	-	-	-	-	-	2	3	1
CO6	2	3	3	3	3	-	-	-	-	-	-	2	3	1
Avg.	2	3	3	2	3	-	-	-	-	-	-	2	3	1

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

Course Code	Course Name	Category	L	T	P	C
BS24502	Logical Reasoning and Aptitude Training	BSC	2	0	0	1

Course Objectives:

- To develop foundational knowledge and skills in averages, percentages.
- To develop foundational knowledge and skills in problems on ages, ratios and proportions, time and work.
- To enable students to apply quantitative reasoning techniques to solve practical problems involving boats & streams, pipes & cisterns, trains.
- To enhance logical reasoning skills from series, venn diagrams, tables and graphs.
- To enhance logical reasoning skills and critical thinking.

UNIT I QUANTITATIVE APTITUDE I 6

- **Averages:** Properties of Averages- Weighted Averages - Problems on Averages - Averages of Averages
- **Percentage:** Percentage Increase and Decrease - Finding Percentages - Percentage Change - Successive Percentage Changes - Percentage Comparisons
- **Permutations and Combinations:** Selection - Ordering - Arrangements

UNIT II QUANTITATIVE APTITUDE II 6

- **Problems on Ages:** Formulating Equations Based on Age Statements - Solving Single-variable Age Problems - Solving Multi-variable Age Problems - Age Differences - Sum of Ages - Average Age - Age Ratios - Age Problems Involving Future and Past Scenarios
- **Ratios & Proportions:** Comparing Ratios - Proportions - Compound Ratios - Ratio and Proportion in Real-life Applications
- **Time & Work:** Work and Time Relationship - Work Efficiency - Combined Work - Work Rate - Fractional Work - Work and Wages - Real-life Applications

UNIT III QUANTITATIVE APTITUDE III 6

- **Boats & Streams:** Speed of Boat in Still Water - Speed of Stream or Current - Upstream and Downstream Concepts - Relative Speed - Calculating Efficiency
- **Pipes & Cisterns:** Inlet and Outlet Pipes - Individual Rates of Pipes - Combined Efficiency - Problems Involving Leakage or Partials - Alternative Filling Scenarios - Pipes with Different Capacities - Applications in Real-life Scenarios
- **Problems on Trains:** Relative Speed of Trains - Crossing and Overtaking Problems - Meetings and Passing - Time and Distance Problems - Platform and Bridge Problems - Average Speed of Trains.

UNIT IV LOGICAL REASONING I 6

- **Series:** Alphabet and Number Series - Odd Man Out Series – Puzzles and Patterns - Blood Relations - - Directional Sense Test.
- **Venn Diagrams:** Using Venn Diagrams for Logical Reasoning - Diagrammatic Representation of Data - Real-life Applications
- **Data-Interpretation and Data-Sufficiency:** Introduction to Data Interpretation - Types of Charts and Graphs - Calculations and Approximations - Percentage Calculations - Comparison and Analysis – Problem Solving Techniques

UNIT V LOGICAL REASONING II 6

- **Non-verbal reasoning:** Pattern Recognition - Analogy and Classification - Series Completion - Spatial Orientation and Visualization - Cube and Dice Problems - Mirror and Water Image Problems - Analytical Reasoning with Diagrams
- **Syllogisms:** Types of Syllogisms - Categorical Syllogisms - Venn Diagram Representation - Rules of Inference - Types of Validity - Formal vs Informal Fallacies - Conditional Syllogistic Reasoning
- **Critical Thinking:** Understanding Arguments - Argument Structure - Logical Fallacies - Evidence and Reasoning - Counter arguments and Rebuttal - Assumptions and Implications - Creative Thinking - Contextual Understanding - Practice and Application

Total Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

- Apply different techniques to solve problems including averages and percentages.
- Solve quantitative problems including ages, ratios and proportions, time and work.
- Solve quantitative problems, including boats & streams, pipes & cisterns and trains.
- Apply logical reasoning and draw conclusions from series, venn diagrams, tables and graphs.
- Apply logical reasoning, analyse information and draw conclusions.

Suggested Activities

- Mock test
- Skill Rack Practices
- Case Study Analysis**.**

Text Books:

1. Dr R S Aggarwal, “Quantitative Aptitude for Competitive Examinations”, S Chand and Company Ltd., 2025.
2. Dr R S Aggarwal, “A Modern Approach to Logical Reasoning”, S Chand and Company Ltd., 2022.
3. S. Sridhar, “Design and Analysis of Alogorithms”2nd Edition, Oxford University Press 2024.
4. Nishit K Sinha, “Quantitative Aptitude for the CAT” , 6th Edition, Pearson Publication 2024.
5. Abhijit Guha, “Quantitative Aptitude for all Competitive Examination”, 7th Edison, Mc Graw Hill Education 2020.
6. FACE, “ Aptipedia: Aptitude Encyclopaedia” 2nd Edition, Wiley India Pvt. Ltd., 2017.

References:

1. Arun Sharma, “Quantitative Aptitude for the CAT” 10th edition, Mc Graw-Hill Publishing, 2022.
2. Praveen R V, “Quantitative Aptitude and Reasoning”, 3rd edition, PHI Learning Pvt. Ltd., 2016.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	1	-	-	-	-	-	1	**-**	**-**	**-**
CO2	3	3	1	-	-	-	-	-	1	-	2	**-**	**-**	**-**
CO3	3	3	1	-	-	-	-	-	1	-	2	**-**	**-**	**-**
CO4	2	3	-	2	2	-	-	-	1	-	1	**-**	**-**	**-**
CO5	1	3	-	-	2	1	-	1	2	2	1	**-**	**-**	**-**
Avg.	**2.4**	**2.8**	**1**	**2**	**1.6**	**1**		**1**	**1.25**	**2**	**1.4**	**-**	**-**	**-**

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

Course Code	Course Name	Category	L	T	P	C
FC24501	Universal Human Values and Service Learning	HSMC	1	0	1	2

Course Objectives:

- To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

UNIT I **Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution** **3**

The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution

UNIT II **Right Understanding (Knowing)- Knower, Known & the Process** **3**

The domain of right understanding starting from understanding the human being (the knower, the experiencer and the doer) and extending up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human beings in existence (human conduct).

UNIT III **Understanding Human Being** **3**

Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self.

UNIT IV **Understanding Nature and Existence** **3**

A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, selfawareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

UNIT V **Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living** **3**

Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with Allencompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence

Outreach Activities **15**

- **Introduction to Service Learning (SL)** - Concept and meaning of Service Learning - History and Evolution of Service Learning - Dynamics of Service Learning - Understanding the idea of learning through service.
- **Understanding the process of Urbanization**- Process of Urbanization - Characteristics and issues of Urban Poor - Urban Social Problems - Slums: Types, Living Conditions, Challenges.
- **Cura personalis** - Identifying groups in the community such as women-children-youth-elders and persons with disabilities-Equipping with the skills to address issues such as Education, health, sanitation, Environment & livelihood issues.

- **Community Program Planning**: Identifying an issue - Need analysis - brainstorming solutions to the issues - content creation - tool selection - venue arrangements - resource mobilization - budgeting - implementation of the planned activity - documentation and reflection guided by the principle of Magis.

Total Periods: 30

Course Outcomes:

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

1. Evaluate the significance of value inputs in formal education and start applying them in their life and profession
2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
3. Analyse the value of harmonious relationship based on trust and respect in their life and profession
4. Examine the role of a human being in ensuring harmony in society and nature.
5. Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.
6. Recognize the socio-economic conditions of the urban poor and the importance of urbanization.
7. Analyse the socio-economic conditions in the slums and compare it to the larger state and national level realities.
8. Identify the community needs
9. Implement a simple community outreach activity and prepare documentation and present reflections based on the field experience.

Suggested Activities

- Classroom discussions
- Self-assessment
- Peer assessment
- Socially relevant project
- Group Activities

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.
2. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.

6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press
10. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	3	-	-	-	3	2	1
CO2	-	-	-	-	-	-	3	3	-	-	-	2	3	1
CO3	-	-	-	-	-	-	3	3	3	3	-	2	3	1
CO4	-	-	-	-	-	-	3	3	-	3	-	2	3	1
CO5	-	-	-	-	-	-	3	3	-	-	-	2	3	1
CO6	-	-	-	-	-	-	-	3	-	-	-	2	3	1
Avg.	-	-	-	-	-	-	3	3	3	3	-	2	3	1

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

Course Code	Course Name	Category	L	T	P	C
GE24502	ENTREPRENEURSHIP AND INTERNATIONAL BUSINESS MARKET	HSMC	2	0	0	2

Course Objectives:

- Introduce the fundamental concepts of entrepreneurship, entrepreneurial traits, creativity and innovation.
- Develop the ability to generate, evaluate and transform innovative ideas into feasible business plans.
- Explain the legal forms of business organization and the importance of intellectual property rights for entrepreneurs.
- Impart knowledge on the nature of international entrepreneurship and strategies for entering and operating in global markets.
- Explain the principles of international entrepreneurship and the dynamics of international trade and foreign exchange markets.

UNIT I Fundamentals of Entrepreneurship 6

Concept and importance of entrepreneurship - Characteristics and types of entrepreneurs - Entrepreneurship vs. Intrapreneurship - Creativity and Entrepreneurship - Innovation - Types of Innovation - Entrepreneurial innovation. Entrepreneurial ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors; Sources of finance – bootstrapping, venture capital, angel investors, government grants, crowdfunding; Stages of entrepreneurial process.

UNIT II Idea to Business Plan 6

Sources of new ideas - Techniques for generating ideas - Steps involved in assessing the business potential of an idea - Preparing a Business Plan - Pitching a Business Plan - Steps in Setting up a Small Business Enterprise.

UNIT III Legal Aspects of Business 6

Forms of Business Entity - Requirements for incorporation of a private or a public limited company - Introduction to Intellectual Property Rights: Patents, Trademarks, Copyright, Geographical Indication (GI), International Patents - IPRs and their importance - Importance of IP for start-ups. Patents - Types of Patents - Criteria for Patentability - Patent Process - Patent Infringement.

UNIT IV International Entrepreneurship 6

Nature of International Entrepreneurship - International Vs Domestic Entrepreneurship - Foreign Market Selection - Entrepreneurial Entry Strategies - Barriers to International Trade.

UNIT V International Trade and Foreign Exchange Markets 6

Interventionist and Free Trade Theories - Foreign Exchange - Aspects of Foreign Exchange Market - Major Foreign Exchange Markets - Foreign Exchange Trading Process.

Periods: 30 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Analyze entrepreneurial traits and apply creativity and innovation in entrepreneurial contexts.
CO2: Create viable business plans by generating, evaluating and developing entrepreneurial ideas.
CO3: Apply knowledge of business structures and protect innovations using intellectual property rights.
CO4: Analyze international business environments and formulate strategies for entering and sustaining in global markets.
CO5: Interpret trade theories, explain foreign exchange market operations and evaluate their impact on international business decisions.
CO6: Understand entrepreneurship concepts and apply them in domestic and international business contexts

Suggested Activities

- Business Ideation using Design Thinking/ Brainstorming innovative product/service ideas using mind-mapping or SCAMPER technique.

- Develop a mini business plan and pitch the plan/ Review and critique of a real-world business plan (available from start-up incubators).
- Patent infringement case study/ Role-play on registering a company and selecting appropriate legal structure.
- Study of an Indian company's international expansion/ Market research exercise: Identify potential foreign markets for a product/service.
- Analysis of real-world trade agreements and their impact on a business (e.g., India–US trade relations)/ Study of a company affected by currency fluctuations in international operations.

Text Books:

1. Arya Kumar (2012). *Entrepreneurship: Creating and leading an entrepreneurial organization*. Pearson Education, Inc.
2. Khanka, S. S. (2026). *Entrepreneurial development*. S. Chand & Company Ltd.
3. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2020). Entrepreneurship. McGraw Hill Education.
4. Daniels, J. D., Radebaugh, L. H., & Sullivan, D. P. (2021). International Business: Environments and Operations. Pearson Education.
5. Kuratko, D. F. (2019). Entrepreneurship: Theory, Process and Practice. Cengage Learning.

References:

1. Rajeev Roy, Entrepreneurship, 3rd Edition Oxford

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	1	1	-	-	-	1	-	1	1	1	-	-	-
CO2	-	1	1	-	-	-	-	-	1	2	1	-	-	-
CO3	-	1		-	-	1	3	-	1	-	1	-	-	-
CO4	-	1	1	-	-	1	-	-	1	2	1	-	-	-
CO5	-	1		-	-	1	-	-	1	2	1	-	-	-
CO6	-	1	1	-	-	1	1	-	1	2	1	-	-	-
Avg.	-	1	1	-	-	1	1.67	-	1	1.8	1	-	-	-

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

Course Code	Course Name	Category	L	T	P	C
CS24611	Distributed and Cloud Computing	PCC	3	0	2	4

Course Objectives:

- To demonstrate the principles, architecture and models of distributed systems.
- To explore fault tolerance, synchronization and consensus mechanisms.
- To learn distributed storage and computing frameworks like Hadoop and Spark.

- To introduce cloud computing fundamentals, virtualization and service models.
- To develop understanding of orchestration and resource management in the cloud.
- To gain knowledge of cloud security principles, standards and risk management strategies.

UNIT I Fundamentals Of Distributed Systems 12

Distributed system goals - Transparency, scalability, and fault tolerance - Synchronization: logical clocks, vector clocks, causal ordering - Mutual exclusion algorithms - Leader election - Consistency
and replication models – Global states and distributed snapshot algorithms .
Case Study: Google File System (GFS).

UNIT II Distributed File Systems, Principles and Computing Frameworks 9

Distributed file systems - Design principles - Fault tolerance and data replication - Hadoop Distributed File System (HDFS) - Apache Spark - Distributed consensus algorithms: Paxos and Raft - Fault recovery.
Case Study: Apache Kafka.

UNIT III Cloud Computing Fundamentals 6

Evolution of Cloud Computing - Essential characteristics - Cloud architecture and reference model - Service models and Deployment models - Virtualization: Concepts, hypervisors, VMs and containers.

UNIT IV Cloud Architecture and Orchestration 9

Containerization concepts - Docker architecture, images, containers, volumes and networks - Kubernetes architecture: pods, replica sets, deployments, services - Cluster scheduling and scaling - Resource allocation and management - Load balancing and high availability - Cloud service providers (AWS, Azure, GCP).
Case Study1: Hosting a web application on cloud.
Case Study2: Deploy a web application using Docker

UNIT V Cloud Security 9

Cloud security fundamentals - Shared responsibility model - Identity and Access Management (IAM) - Authentication and authorization (RBAC, ABAC) - Data protection and encryption (at rest & in transit) - Key Management Services – Security in virtualization and containers - Network security (firewalls, security groups, VPNs, zero-trust) - Compliance and governance (Overview of GDPR and HIPAA)

45 PERIODS

LIST OF EXPERIMENTS:

1. Simulate message passing between distributed processes and demonstrate Lamport's logical clocks for event ordering.
2. Implement Ricart–Agrawala algorithm to achieve distributed mutual exclusion among multiple processes.
3. Install and configure Hadoop 3.x in a single-node mode. Execute basic HDFS file operations (copy, delete, read).
4. Write and run simple MapReduce applications such as Word Count.
5. Install and configure Apache Spark on the same cluster. Implement a Spark program for data aggregation
6. Create and configure multiple VMs with different OS flavours (Linux/Windows) using VirtualBox or a cloud free tier (AWS, Azure or GCP).
7. Demonstrate file transfer between two VMs using SSH or shared folders.
8. Containerize a sample web application using Docker, create an image, and deploy it using Kubernetes (Minikube)
9. Configure Identity and Access Management (IAM), roles and encryption mechanisms in a cloud platform.
10. Design and deploy a small-scale cloud application integrating storage, containerization and security

30 PERIODS
TOTAL PERIODS: 75

Course Outcomes:

On completion of the course, the students will be able to
CO1: Explain the principles and architecture of distributed systems.
CO2: Analyze distributed file systems and computing frameworks.
CO3: Describe the fundamental concepts and architecture of cloud computing.
CO4: Deploy and manage containerized applications using orchestration tools.
CO5: Apply cloud security and compliance strategies for secure deployments.
CO6: Design and implement cloud-based application ensuring performance and security.

Suggested Activities:
- Weekly hands-on laboratory exercises using Docker, Kubernetes, and cloud platforms.
- Mini-project on deploying and managing a scalable cloud-based application.
- Research paper review on distributed systems and cloud technologies.
- Industry expert lectures on cloud-native architectures and DevOps practices.
- Team-based project involving distributed application development and deployment.
- Hackathon or cloud deployment challenge using AWS, Azure, or GCP.

Text Books:

1. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", Elsevier, 2013.

2. Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, "Mastering Cloud Computing: Foundations and Applications Programming", McGraw Hill Education, 2019.
3. Dan C. Marinescu, "Cloud Computing: Theory and Practice", 3rd Edition, Elsevier, 2022.

References:

1. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, "Distributed Systems: Concepts and Design", 6th Edition, Pearson Education, 2021.
2. Kelsey Hightower, Brendan Burns, and Joe Beda, "Kubernetes Up and Running: Dive into the Future of Infrastructure", 3rd Edition, O'Reilly Media, 2022.
3. Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, "Cloud Computing: Concepts, Technology and Architecture", 2nd Edition, Pearson Education, 2023.
4. Murthy G. M. and G. P. S. Varma, "Cloud Security: Concepts, Applications and Practices", Routledge, 2023.

Laboratory Requirements

1. Virtualization Tools: Oracle VirtualBox v7.0 / VMware Workstation Player.
2. Programming Tools: Java JDK 21 or above, Python 3.10 or above.
3. Distributed Frameworks: Apache Hadoop v3.3 and Apache Spark v3.4 or above.
4. Containerization & Orchestration: Docker v25 and Minikube v1.32 or above.
5. Cloud Platforms: AWS Educate / Azure for Students / Google Cloud Free Tier.
6. Development Environment: Eclipse / IntelliJ IDEA Community Edition / Visual Studio Code.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	–	–	–	–	–	2	3	2	–
CO2	3	3	3	2	2	–	–	–	–	–	2	3	3	2
CO3	3	2	2	2	3	–	–	–	1	–	3	2	3	2
CO4	2	3	3	2	3	–	–	1	1	2	3	2	3	2
CO5	2	3	3	2	3	2	2	–	–	–	3	2	3	–
CO6	3	3	3	3	3	2	1	2	2	3	3	3	3	2
Avg.	2.7	2.7	2.7	2.2	2.5	2.0	1.5	1.5	1.3	2.5	2.7	2.5	2.8	2.0

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

Course Code	Course Name	Category	L	T	P	C
GE24503	FINANCIAL LITERACY	HSMC	2	0	0	2

Course Objectives:

- Develop financial awareness among engineering students.
- Enable students to make informed decisions regarding personal finance, savings and investments.

- Equip learners with the skills to manage budgets, taxes, credit and debt efficiently.
- Provide knowledge on digital financial systems, fintech applications and entrepreneurship finance.
- Foster responsible financial behaviour and ethical decision-making.

UNIT I Introduction to Financial Literacy and Money Management 6

Meaning, need and importance of financial literacy - Basic financial concepts: income, expenses, assets, liabilities, cash flow - Financial goals and planning process - Budgeting for Skilled Money Management - Time value of money and inflation

UNIT II Banking and Digital Financial Systems 6

Process of Opening Bank Accounts - Types of bank accounts and their operation - Cheques, demand drafts, ATM, debit and credit cards - Digital banking: UPI, Internet banking, mobile banking, NEFT, RTGS, IMPS - Digital payment security and cyber safety - Role of RBI, NPCI and SEBI

UNIT III Saving and Investment Options 6

Difference between saving and investment - Risk and return concepts - Types of investment avenues: bank deposits, mutual funds, stocks, bonds, PPF, NPS, insurance, gold bonds, real estate - Government Schemes for Various Savings & Investment Options - Introduction to capital markets - Systematic Investment plan and portfolio diversification

UNIT IV Credit, Loans and Taxation 6

Concept of credit - Types of loans: education loan, vehicle loan, home loan, personal loan, Gold Loan - Understanding credit cards and managing debt - Credit score and its importance - Basics of taxation: income tax structure in India, PAN, TDS, filing IT returns - Tax Exemptions and Deductions

UNIT V Financial Planning, Entrepreneurship and Ethical Finance 6

Components of comprehensive financial planning - Retirement planning and insurance planning - Financial aspects of entrepreneurship and start-ups - Costing, pricing and break-even analysis for small businesses - Sustainable and ethical financial practices

Periods: 30 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the fundamentals of personal and business finance.
CO2: Prepare personal budgets and financial plans.
CO3: Evaluate different saving and investment options.
CO4: Use digital tools and platforms for financial transactions and management.
CO5: Apply basic financial principles in entrepreneurial or career settings.
CO6: Effectively manage personal finances using financial literacy and planning skills.

Suggested Activities

- Hands-on sessions on budgeting and investment planning using Excel or Google Sheets/ Create a Daily Spending Diary/ Conduct a Money Management SWOT Analysis
- Mock Account Opening Activity/ Digital Payment Demonstration: Hands-on demo of UPI, NEFT, IMPS and online payment apps (without real transactions)
- Analysis of the Government Schemes/ Create a mock investment portfolio/ Review on FinTech innovations and investment apps
- Demonstrate mock IT return filing using a sample Form 16 and income data/ Compare education, housing and vehicle loans from 2–3 banks, highlighting interest rates, EMIs and eligibility.
- Create a personal financial plan including budgeting, insurance, investments and retirement goals/ Mini Start-Up Simulation: Groups design a simple business idea and calculate costing, pricing and break-even point using realistic figures.

Text Books:

1. Shalu Garg, "Personal Financial Planning", Sultan Chand & Sons, Educational Publishers New Delhi, First Edition: 2024.
2. Jack R. Kapoor, Les R. Dlabay, Robert J. Hughes, Melissa M. Hart, "Personal Finance", 14th edition, McGraw Hill LLC, 2023.
3. Financial Education Booklet, Securities and Exchange Board of India (SEBI), Mumbai, November 2020.
4. Banking Theory and Practice, Mahesh Kumar Sarva, Excel Books Private Limited, New Delhi.

References:

5. "Principles and Practices of Banking" – Indian Institute of Banking & Finance (IIBF)
6. Financial Education Handbook For New Entrants at Workplace, National Centre for Financial Education (NCFE), First Edition September 2024.
7. Tulsi Bharatbhai Raval, "Financial Planning", Study Guide Educational Publication, December 2021.
8. National Finance Olympiad, "Personal Finance Handbook", Pockvue Solutions Pvt. Ltd., Ed. 1, 2024 - 2025

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	1	-	2	-	3	3			
CO2	-	3	-	-	2	1	-	-	2	3	3			
CO3	-	3	-	-	3	1	2	-	2	3	3			
CO4	-	-	-	-	3	1	2	2	2	3	3			
CO5	-	-	-	-	2	1	2	2	2	3	3			
CO6	-	2	-	-	-	1	2	3	2	3	3			
Avg.	**-**	**2.75**	**-**	**-**	**2.5**	**1**	**2**	**2.25**	**2**	**3**	**3**			

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

PROFESSIONAL ELECTIVE COURSES VERTICALS

Course Code	Course Name	Category	L	T	P	C
	Cloud Application Development	PEC	2	0	2	3

Course Objectives:

- Provide a strong foundation in the core concepts, service models (IaaS, PaaS, SaaS), and architectural principles of modern cloud-native application development.
- Develop practical, hands-on proficiency in using key services on Amazon Web Services (AWS) and Microsoft Azure for computing, storage, database, and application integration.
- Impart the skills necessary to design, develop, and deploy a secure, scalable, and cost-effective full-stack application on a major cloud platform.
- Provide an understanding of modern development practices, including containerization with Docker, serverless computing, and automated CI/CD pipelines.
- Cultivate the ability to analyze and evaluate trade-offs between different cloud services and architectures, enabling informed decision-making for real-world projects.

UNIT I Local Development To Cloud Native 6

Introduction - Cloud for Developers - The Serverless & Container Mindset. Tools Setup: Git, VS Code, Docker, Cloud CLIs. IAM for Developers: Setting up secure credentials for your apps. Deploying functions to AWS Lambda and Azure Functions.

UNIT II Building The Backend: Apis & Data 6

Serverless APIs: Creating RESTful endpoints with API Gateway (AWS) and API Management (Azure). Databases for Apps: Using DynamoDB (AWS) and Cosmos DB (Azure) for NoSQL. Using RDS (AWS) and Azure SQL Database for SQL. Connecting functions to databases.

UNIT III Frontend, Authentication & Asynchronous Processing 6

Static Web Hosting: Deploying a React/Angular/vanilla JS frontend to S3 + CloudFront (AWS) and Blob Storage + CDN (Azure). Authentication: Integrating Cognito (AWS) and Azure Active Directory B2C. Asynchronous Tasks: Using SQS (AWS) and Service Bus (Azure) for decoupling services.

UNIT IV Containers & Ci/Cd 6

Containerization Deep Dive: Dockerfiles, multi-stage builds. Serverless Containers: Deploying with AWS Fargate and Azure Container Instances (ACI). Automated Deployment: Building a CI/CD pipeline from GitHub to the cloud using GitHub Actions.

UNIT V Integration & Monitoring 6

Connecting the Dots: Building a complete data processing pipeline (file upload -> trigger function -> process data -> store in DB). Observability: Adding logging and monitoring with CloudWatch (AWS) and Azure Monitor. Cost Control for Developers: Understanding and optimizing your application's cloud bill. Building the Capstone Project.

Periods: 30

LIST OF EXPERIMENTS:

1. Foundations - Set up accounts, install CLIs, configure IAM roles for development.
2. Serverless Hello World - Write and deploy a "Hello World" function in Python/Node.js on Lambda & Azure Functions.
3. Serverless API - Create a CRUD API for a "To-Do" list using API Gateway + Lambda and Azure API Management + Azure Functions.
4. NoSQL Data Layer - Integrate the API from Lab 3 with DynamoDB and Cosmos DB.
5. Frontend & Auth - Deploy a static frontend, integrate it with the API, and add a simple login using Cognito & Azure AD B2C.
6. Async Messages - Modify the "To-Do" app to process new items asynchronously via SQS and Service Bus.
7. Containerize an App - Dockerize an existing monolithic application.
8. Deploy Containers - Push the Docker image to ECR & Azure Container Registry and deploy it using Fargate & ACI.
9. CI/CD Pipeline - Automate the deployment of the containerized app using GitHub Actions.
10. Capstone Project
    Students (in groups of 2-3) must choose ONE of the following application types, implement it, and deploy it on one of the two cloud platforms. The project must integrate at least four distinct cloud services.
    Project Choices:
    a. Serverless Image Processing Portal: A web app where users can upload images. Upon upload, a serverless function automatically generates a thumbnail and stores both images. The frontend displays the gallery of processed images.
    *Suggested Services: S3/Blob Storage, Lambda/Azure Functions, DynamoDB/Cosmos DB, SNS/Event Grid.
    b. Real-Time Polling/Voting Application: A web app that allows users to create polls and vote in real-time. The frontend should update results without requiring a page refresh.
    *Suggested Services: API Gateway/APIM, Lambda/Azure Functions, DynamoDB/Cosmos DB, WebSockets (API Gateway WebSocket/ Azure Web PubSub).
    c. Document Processing Pipeline: An application that accepts document uploads (e.g., resumes), extracts text and key metadata, and stores the results in a searchable database.
    *Suggested Services: S3/Blob Storage, Lambda/Azure Functions, Textract/Azure Form Recognizer, RDS/Azure SQL, SQS/Service Bus.

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Analyze the core services of AWS and Azure to select appropriate cloud-native solutions for given application requirements.
CO2: Design and develop serverless backends and APIs by leveraging cloud functions, databases, and integration services.
CO3: Implement secure and scalable cloud-based data storage and retrieval solutions using managed SQL and NoSQL database services.
CO4: Containerize a monolithic application using Docker and deploy it using serverless container orchestration services.
CO5: Build and deploy a full-stack cloud application by integrating multiple services and configuring automated CI/CD pipelines.
CO6: Evaluate the architectural, cost, and security trade-offs of implementation choices on AWS and Azure platforms.

Suggested Activities:

- Hands-on Activities
- Mini Project
- Case Studies

Text Books:

1. Cloud Native Development Patterns and Best Practices, John Gilbert, Packt Publishing, 1st Edition, 2018.
2. Serverless Architectures on AWS: With examples using AWS Lambda, Peter Sbarski, Yan Cui, Manning Publications, 2nd Edition, 2022.
3. The Docker Book: Containerization is the New Virtualization, James Turnbull, James Turnbull, 2024.

References:

1. Architecting Cloud Native .NET Applications for Azure, Microsoft (Rob Vettor, et al.), Microsoft Press / O'Reilly Media, 1st Edition, 2024
2. AWS Certified Solutions Architect Study Guide: Associate SAA-C03 Exam, Ben Piper, David Clinton, Sybex,4th Edition, 2022.
3. Learn Azure in a Month of Lunches, Iain Foulds, Manning Publications, 1st Edition, 2020.

MAPPING OF COs WITH POs AND PSOs

COs	PO											PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	3	-	3	-	-	-	-	-	-	3	3	-
CO3	3	2	3	-	3	-	-	-	-	-	-	3	2	-
CO4	2	-	2	-	3	-	-	-	-	-	-	2	2	-
CO5	3	3	3	2	3	2	-	2	2	2	2	3	3	-
CO6	-	3	3	-	-	3	-	-	-	2	3	2	3	-
Avg.	2.8	2.6	2.7	2.0	3.0	2.5	-	2.0	2.0	2.0	2.5	2.6	2.7	-

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

Course Code Course Name Category L T P C

PCS2410 App Development PEC 2 0 2 3

Course Objectives:

- To learn development of native applications with basic GUI Components
- To develop cross-platform applications with event handling
- To develop applications with location and data storage capabilities
- To develop web applications with database access

UNIT I Fundamentals of Mobile App Development and Introduction To Modern App Development **6**

Evolution of Mobile and Web Applications - App Architecture: Client-Server Model, Frontend, Backend, API, and Database Integration- Native vs Cross-Platform vs Progressive Web Apps (PWA) vs Hybrid Applications- Responsive Web Design Principles- Overview of Development Tools (Android Studio, VS Code, Expo, Flutter SDK).

UNIT II Native App Development **6**

Introduction to Native App Development -Kotlin and Java for Android Studio- Android App Components & UI Design- Data Storage and Device Features- Introduction to iOS App Development-Swift and Xcode IDE.

UNIT III Cross-Platform App Development Using Flutter and React Native **6**

Introduction to Cross-Platform App Development- Introduction to Flutter- Flutter UI Components and Layout- State Management in Flutter, Introduction to React Native - React Native Components and UI- State and Props in React Native.

UNIT IV Hybrid And Progressive Web App Development With Api Integration **6**

Introduction to Hybrid App Development (Web view and Native app Wrapper)- Building Hybrid Apps (Ionic or Cordova)- Progressive Web Apps (PWA)- API and Backend Integration (REST APIs and HTTP methods), basics of JSON.

UNIT V Non-Functional Characteristics and Performance Evaluation Of App Frameworks **6**

Introduction to Non-Functional Characteristics- Build and Runtime Performance- Debugging and Testing Capabilities- Maintainability, Scalability & Ease of Development- UI/UX Consistency, Reusability & Time to Market.

Periods: 30

LIST OF EXPERIMENTS:

1. Design a web application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expenses.
2. Develop an GUI application that uses Layout Managers and event Listeners.

3. Develop a library application using Kotlin/Java that makes use of SQLite for displaying books available, books lend and books reserved.
4. Using react native, build a cross-platform application for a BMI calculator.
5. Develop a cross-platform application using Flutter to currency using live exchange rates from https://freecurrencyapi.com/.
6. Design and develop a cross-platform application for day-to-day task (to-do) management with data persistence even after app closing.
7. Design and develop an 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.
8. Develop a hybrid mobile application using Apache Cordova that fetches the user's current location and displays nearby restaurants, hospitals, and ATMs using a public places API (OpenStreetMap, Foursquare Places API)
9. Build a progressive web application for an e-commerce website.

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understanding of app ecosystems, architectures, platforms, and essential tools
CO2: Develop simple Android applications using Kotlin/Java and insight of iOS app development tools
CO3: Develop cross-platform applications with location and data storage capabilities.
CO4: Build basic multi-screen apps with responsive UI
CO5: Build basic hybrid/PWA apps, and integrate them with APIs
CO6: Evaluate app quality through non-functional parameters

Suggested Activities:

- Build Online Banking web application to retrieve account information of customers and process transactions process transaction utilizing APIs.
- Build apps for specific platforms (iOS with Swift/Objective-C, Android with Java/Kotlin) to leverage device features (Accelerometer, Vibrator, Light sensor) and provide optimal performance and user experience.
- Develop web applications to demonstrate a native app-like experience through modern web capabilities, including offline functionality, push notifications, and home screen installation, accessible via a web browser.
- Design and develop a cross-platform mobile application that integrates a public API (such as weather or news) to fetch and display real-time data.
- Develop a lightweight mobile application that measures and compares performance metrics (build size, load time) across two frameworks like Flutter and React Native.

Text Books:

1. Dawn Griffiths, "Head First Android Development", O'Reilly,1st Edition, 2015
2. Raymond K. Camden, "Apache Cordova in Action", Manning, 2015.
3. Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, "Full Stack React Native: Create Beautiful Mobile Apps with JavaScript and React Native", Full Stack Publishing, 2019.

4. Thomas Bailey, Alessandro Biessek – Flutter for Beginners: Cross-platform mobile development from Hello World to app release with Flutter 3.10+ and Dart 3.x, 2023.

References:

1. John Horton, Android Programming for Beginners, Packt Publishing, 2nd Edition, 2018
2. Shaun Lewis and Mike Dunn, "Native Mobile Development", 2019.
3. Pawan Lingras, Matt Triff and Rucha Lingras, "Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach", 2016.
4. John M Wargo, "Apache Cordova 4 Programming", 2015.
5. Daniel Ward, "React Native Cookbook", Packt Publishing, 2nd Edition, 2019.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	-	-	1	1	2	1	-	-	-
CO2	2	1	3	2	2	-	-	3	2	2	3	-	-	-
CO3	2	2	2	1	2	-	-	1	1	1	1	-	-	-
CO4	1	3	1	1	3	-	-	1	1	3	2	-	-	-
CO5	1	1	3	1	3	-	-	1	1	2	1	-	-	-
CO6	1	1	3	1	3	2	1	1	1	2	1	-	-	-
Avg.	1.5	1.7	2.2	1.3	2.7	2.0	1.0	1.3	1.2	2.0	1.5	-	-	-

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

Course Code	Course Name	Category	L	T	P	C
PCS2411	Full Stack Web Application and Development	PEC	2	0	2	3

Course Objectives:

- Learn the fundamentals of TypeScript and client-side web application development.
- Design and develop single-page applications using Angular.
- Build RESTful APIs using Node.js and Express.js.
- Implement data storage and retrieval using MongoDB.
- Integrate front-end and back-end to develop a complete MEAN stack application.
- Deploy and test full stack web applications.

UNIT I Fundamentals & Typescript Basics 6

Introduction to Web Application Development – Client-Side vs. Server-Side – Single Page Applications (SPA) – Introduction to TypeScript – Variables, Data Types, Functions – Classes and Interfaces.

UNIT II Angular Framework 6

Introduction to Angular – Components and Templates – Data Binding – Directives – Services and Dependency Injection – Angular Forms (Template Driven and Reactive) – Routing and Navigation.

UNIT III Node.Js Basics 6

Introduction to Node.js – Installation and NPM Packages – Modules and Events – Asynchronous Programming and Callbacks –Simple Server Creation using Node.js.

UNIT IV Express.Js Framework 6

Introduction to Express.js – Creating and Configuring Express Apps – Routing – Middleware – Handling Requests and Responses – Building Simple REST APIs.

UNIT V Mongodb 6

Introduction to NoSQL Databases – MongoDB Basics – Documents, Collections and Databases – Data Types and CRUD Operations – Querying and Filtering Documents.

Periods: 30

LIST OF EXPERIMENTS:

1. Develop and execute basic TypeScript programs using variables, functions, and classes.
2. Design and implement Angular components with data binding and event handling.
3. Build a simple user input form in Angular using Template-Driven Forms and validate inputs using basic form validators.
4. Configure and implement routing and navigation between multiple pages in Angular.
5. Access and display data from external REST APIs using Angular HttpClient.
6. Develop a basic Node.js server demonstrating modules, event handling, and asynchronous callbacks using setTimeout or file operations.
7. Build RESTful API endpoints using Express.js with route handling and middleware.
8. Perform CRUD operations on documents using MongoDB.
9. Connect an Express.js application with MongoDB using Mongoose and perform create and read operations.
10. Develop a simple MEAN stack application integrating Angular, Node.js, Express.js, and MongoDB with basic CRUD functionality.

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Use TypeScript to build modular and reusable client-side applications.
CO2: Design responsive single-page web applications using Angular.
CO3: Build RESTful APIs and handle server-side operations using Node.js.
CO4: Develop and manage web server routes and middleware using Express.js.
CO5: Implement CRUD operations and manage data using MongoDB.
CO6: Integrate front-end and back-end components to create a full stack web application.

Suggested Activities:

- Hands-on Activities
- Mini Project

Text Books:

1. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, Apress, 2018.
2. Kirupa Chinnathambi, Learning React: A Hands-On Guide to Building Web Applications Using React and Redux, Addison-Wesley, 2018

References:

1. Adam Freeman, "Essential TypeScript", Apress, 2019
2. Mark Clow, "Angular Projects", Apress, 2018
3. Alex R. Young, Marc Harter, "Node.js in Practice", Manning Publication, 2014
4. Azat Mardan, "Pro Express.js", Apress, 2015
5. Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, "MongoDB in Action", Manning Publications, 2nd Edition, 2016

Laboratory Requirements:

1. Node.js (LTS version), npm, and TypeScript Compiler
2. Angular CLI and Angular Framework
3. Express.js and Nodemon (for server-side development and auto-reload)
4. MongoDB Community Server and MongoDB Compass GUI
5. Visual Studio Code (IDE) and Git (Version Control System)

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	3	-	-	-	1	-	1	3	2	-
CO2	3	2	3	-	3	1	-	2	2	-	1	3	2	-
CO3	3	2	3	1	3	-	-	-	1	1	-	3	2	-
CO4	3	2	3	1	3	-	-	-	1	1	-	3	2	-
CO5	3	2	3	1	3	-	-	-	1	1	-	3	3	1
CO6	3	3	3	1	3	2	-	3	2	2	1	3	3	1
Avg.	**3.0**	**2.2**	**2.8**	**1.0**	**3.0**	**1.5**	**-**	**2.5**	**1.3**	**1.3**	**1.0**	**3.0**	**2.3**	**1.0**

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

Course Code	Course Name	Category	L	T	P	C
PCS2412	UI and UX Design	PEC	2	0	2	3

Course Objectives:

- To provide a sound knowledge in UI and UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI and UX
- Creating a wireframe and prototype

UNIT I Foundations of Design 6

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking – Brainstorming and Game storming - Observational Empathy.

UNIT II Foundations of UI Design 6

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviours and Principles – Branding -Style Guides.

UNIT III Foundations of UX Design 6

Introduction to User Experience - Why You Should Care about User Experience – Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.

UNIT IV Wireframing, Prototyping and Testing 6

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing – Creating Wireflows -Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns- Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings -Prototype Iteration.

UNIT V Research, Designing, Ideating, & Information Architecture 6

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods – Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams – Flow Mapping - Information Architecture.

Periods:30

LIST OF EXPERIMENTS:

1. Identifying and Writing Problem Statements
2. Hands on Design Thinking Process for a new product
3. Brainstorming feature for proposed product
4. Exploring various open-source collaborative interface Platform
5. Exploring various UI Interaction Patterns
6. Developing an interface with proper UI Style Guides
7. Developing Wire flow diagram for application using open-source software
8. Designing a Responsive layout for a societal application
9. Defining the Look and Feel of the new Project
10. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
11. Identify a customer problem to solve and conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping
12. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Build UI for user Applications
CO2: Evaluate UX design of any product or application
CO3: Demonstrate UX Skills in product development
CO4: Implement Sketching principles
CO5: Create Wireframe and Prototype
CO6: Apply design thinking principles to Build UI for applications

Suggested Activities

- Pitching design ideas and solution
- Brainstorming and ideation
- Visual design exercises with animation and transition
- Creating interactive prototype using any open-source software

TEXT BOOK:

1. Joel Marsh, "UX for Beginners", O'Reilly, 2022.
2. Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services", O'Reilly 2021.

References:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition, O'Reilly 2020.
2. Steve Schoger, Adam Wathan "Refactoring UI", 2018.
3. Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile", Third Edition, 2015.
4. https://www.nngroup.com/articles/
5. https://www.interaction-design.org/literature

MAPPING OF COs WITH POs AND PSOs

COs	**POs**											**PSOs**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	3	1	-	-	3	3	2	1	-	-	-
CO2	2	3	1	3	2	-	-	1	2	2	2	-	-	-
CO3	1	3	3	2	2	-	-	2	3	1	2	-	-	-
CO4	1	2	3	3	1	-	-	3	2	1	3	-	-	-
CO5	1	2	3	2	1	-	-	2	1	1	1	-	-	-
CO6	1	2	3	2	1	1	1	2	1	1	1	-	-	-
Avg.	**1.5**	**2.2**	**2.3**	**2.5**	**1.3**	**1.0**	**1.0**	**2.2**	**2.0**	**1.3**	**1.7**	-	-	-

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

Course Code	Course Name	Category	L	T	P	C
PCS2413	Software Testing and Automation	PEC	2	0	2	3

Course Objectives:

- To understand the basics of software testing
- To learn how to do the testing and planning effectively
- To build test cases and execute them
- To focus on wide aspects of testing and understanding multiple facets of testing
- To get an insight about test automation and the tools used for test automation

UNIT I Foundations of Software Testing **6**

Why do we test Software? Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT II Test Planning **6**

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III Test Design and Execution **6**

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV Advanced Testing Concepts **6**

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT V Test Automation and Tools **6**

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

Periods: 30

LIST OF EXPERIMENTS:

1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Test the e-commerce application and report the defects in it.
4. Develop the test plan and design the test cases for an inventory control system.
5. Execute the test cases against a client server or desktop application and identify the defects.
6. Test the performance of the e-commerce application.
7. Automate the testing of e-commerce applications using Selenium.
8. Integrate TestNG with the above test automation.
9. Mini Project:
   i) Build a data-driven framework using Selenium and TestNG
   ii) Build Page object Model using Selenium and TestNG
   iii) Build BDD framework with Selenium, TestNG and Cucumber

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the basic concepts of software testing and the need for software testing
CO2: Design Test planning and different activities involved in test planning
CO3: Design effective test cases that can uncover critical defects in the application
CO4: Carry out advanced types of testing
CO5: Automate the software testing using Selenium and TestNG
CO6: Analyze software testing standards, documentation practices, and metrics to ensure quality and continuous improvement in software development.

Suggested Activities:

- Hands-on
- In-Class Activities
- Mini Project

Text Books:

1. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" – Second Edition, 2018

References:

1. Glenford J. Myers, Corey Sandler, Tom Badgett, “The Art of Software Testing”, John Wiley & Sons, Inc., 2012
2. Ron Patton, “Software Testing”, Sams Publishing, 2006
3. Paul C. Jorgensen, “Software Testing: A Craftsman’s Approach”, Taylor & Francis Group, 2014
4. Carl Cocchiaro, “Selenium Framework Design in Data-Driven Testing”, Packt Publishing, 2018
5. Elfriede Dustin, Thom Garrett, Bernie Gauf, “Implementing Automated Software Testing”, Pearson Education, Inc. – 2009
6. Satya Avasarala, “Selenium WebDriver Practical Guide”, Packt Publishing, 2014

7. Varun Menon, “TestNG Beginner's Guide”, Packt Publishing, 2013

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	-	-	1	1	3	2			
CO2	2	3	1	1	1	-	-	2	2	1	2			
CO3	2	2	1	3	1	-	-	1	3	1	2			
CO4	2	1	3	2	1	-	-	1	1	1	2			
CO5	2	2	1	3	1	-	-	1	3	2	1			
CO6	1	1	3	2	3	3	-	1	3	2	2			
Avg.	2.0	2.0	1.8	2.0	1.5	3.0	-	1.2	2.2	1.7	1.8			

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

Course Code	Course Name	Category	L	T	P	C
PCS2414	Web Application Security	PEC	2	0	2	3

Course Objectives:

- 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 get an insight about Hacking techniques and Tools

UNIT I Fundamentals of Web Application Security 6

The history of Software Security – Recognizing Web Application Security Threats, Web Application Security: Authentication – Authorization, Secure Socket layer, Transport layer Security, Session Management – Input Validation.

UNIT II Secure Development and Deployment 5

The Penetrate-and-Patch-Approach – The Holistic Approach –The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM), The Building Security In Maturity Model (BSIMM).

UNIT III Secure API Development 6

API Styles – API Security – Token Based Authentication, Session Cookies: Session Fixation Attack, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys, OAuth2, Securing Microservice APIs in Kubernetes: Service Mesh for TLS, Locking Down Network Connections.

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: SQL Injection, Code Injection, Command Injection, Prepared Statements, Cross-Site Scripting (XSS): Stored XSS, Reflected XSS, DOM-Based XSS, Cross-Site Request Forgery: Query Parameter Tampering, Alternate GET Payloads, CSRF against POST Endpoints, Security Misconfiguration, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite.

Periods: 30

LIST OF EXPERIMENTS:

1. Install wireshark and explore the various protocols
    a. Analyze the difference between HTTP vs HTTPS
    b. Analyze the various security mechanisms embedded with different protocols.
2. Input Validation
3. Identify the vulnerabilities using OWASP ZAP tool
4. Create simple REST API using python for the following operation
    a. GET
    b. PUT
    c. POST
    d. DELETE
5. Simulate a phishing attack

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understanding the basic concepts of web application security and the need for it.
CO2: Be acquainted with the process for secure development and deployment of web applications.
CO3: Acquire the skill to design and develop Secure Web Applications that use Secure APIs.
CO4: Be able to get the importance of carrying out vulnerability assessment and penetration testing.
CO5: Acquire the skill to think like a hacker, use Social Engineering and other methods.
CO6: Acquire the skill to use hackers' tool sets.

Suggested activities:

- Case study on a tool (Comodo, OpenVAS, Nexpose, Nikto)

Text Books:

1. Andrew Hoffman, “Web Application Security: Exploitation and Countermeasures for Modern Web Applications”, First Edition, O’Reilly Media Inc., 2020.
2. Bryan Sullivan, Vincent Liu, “Web Application Security: A Beginners Guide”, The McGraw-Hill Companies, 2012.
3. Neil Madden, “API Security in Action”, Manning Publications Co., NY, USA, 2020.

References:

1. Michael Cross, “Developer’s Guide to Web Application Security”, Syngress Publishing, Inc., 2007.
2. Ravi Das and Greg Johnson, “Testing and Securing Web Applications”, Taylor & Francis Group, LLC., 2021.
3. Prabath Siriwardena, “Advanced API Security”, Apress Media LLC, USA., 2020.
4. Malcom McDonald, “Web Security for Developers”, No Starch Press, Inc., 2020.
5. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams “Grey Hat Hacking: The Ethical Hacker’s Handbook”, The McGraw-Hill Companies, Third Edition, 2011.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	2	1	3	-	-	-	-	-	1			
CO2	2	1	3	3	3	-	-	-	3	3	-			
CO3	3	3	1	3	3	-	-	-	3	-	1			
CO4	1	2	1	1	3	-	-	-	2	-	-			
CO5	1	2	2	2	3	-	-	-	2	-	1			
CO6	1	2	2	2	3	-	-	-	2	-	1			
Avg.	1.5	2	1.8	2	3	-	-	-	2.4	3	1			

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

Course Code	Course Name	Category	L	T	P	C
PCS2415	DevOps	PEC	2	0	2	3

Course Objectives:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT I Introduction To Devops **6**

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II Compile and Build Using Maven & Gradle **6**

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle.

UNIT III Continuous Integration Using Jenkins 6

Install & Configure Jenkins, Jenkins Architecture Overview, Creating and Running a Simple Jenkins Job, Essential Plugins (Git and Maven Plugin), Configuring Jenkins with Git and Maven - Introduction to SonarQube - Integrating Jenkins with SonarQube for a Basic Code Quality Scan.

UNIT IV Configuration Management Using Ansible 6

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

UNIT V Building Devops Pipelines Using Azure 6

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

Periods: 30

LIST OF EXPERIMENTS:

1. Problem Identification and Software Requirement Specification (SRS) Development.
2. Web Application Development using MVC Architecture and Spring Boot Framework
3. Install Git version control system and configure with GitHub
4. Installation and build using Maven
5. Installation and build using Gradle
6. Create a Maven build pipeline in Azure
7. Run regression test using Maven build pipeline in Azure
8. Installation and Configuration of Jenkins and creating a workspace
9. Install Jenkins in cloud and create CI/CD pipeline and deploy in cloud
10. Install and configure Ansible
11. Create an Ansible playbook for a simple web application infrastructure

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand different actions performed through Version control tools like Git.
CO2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle
CO3: Ability to Install, configure, and manage Jenkins with Java, Git, and Maven for CI/CD automation

CO4: Perform integration and use key Jenkins plugins to enhance job execution and reporting
CO5: Ability to do configuration management using Ansible
CO6: Understand to leverage Cloud-based DevOps tools using Azure DevOps

Suggested Activities:

- Hand-on activities
- Case Studies
- In-Class activities
- Project

Text Books:

1. Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2. Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014

References:

1. Mitesh Soni, "Hands-On Azure Devops: Cicd Implementation for Mobile, Hybrid, And Web Applications Using Azure Devops and Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback", 2020.
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
4. Mariot Tsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
5. https://www.jenkins.io/user-handbook.pdf
6. https://maven.apache.org/guides/getting-started/

Laboratory Requirements:

1. Java JDK 21 or above, Maven v3.9 or above, Gradle v8 or above.
2. Jenkins (latest LTS version).
3. SonarQube Server (Community Edition) and SonarScanner CLI.
4. Azure DevOps Organization (Student / Free Tier) with Pipeline Access.
5. Ansible v2.15 or above with YAML support.
6. Visual Studio Code and Git Version Control System

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-			
CO2	3	3	3	2	3	-	-	-	-	-	-			
CO3	3	3	3	2	3	-	-	-	-	-	-			
CO4	3	3	3	2	3	-	-	-	-	-	-			
CO5	3	3	3	2	3	-	-	-	-	-	-			
CO6	3	3	3	2	3	-	-	-	-	-	-			
Avg.	3.0	3.0	3.0	2.0	3.0	-	-	-	-	-	-			

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

Course Code	Course Name	Category	L	T	P	C
PCS2416	Principles of Programming Languages	PEC	3	0	0	3

Course Objectives:

- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in programming languages
- To develop programs in non-procedural programming paradigms

UNIT I Syntax and Semantics 9

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom-up parsing

UNIT II Data, Data Types, and Basic Statements 9

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements

UNIT III Subprograms and Implementations 9

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping

UNIT IV Object-Orientation, Concurrency, and Event Handling 9

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling

UNIT V Functional and Logic Programming Languages 9

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Describe syntax and semantics of programming languages
CO2: Explain data, data types, and basic statements of programming languages
CO3: Design and implement subprogram constructs
CO4: Apply object-oriented, concurrency, and event handling programming constructs
CO5: Develop programs in Scheme, ML, and Prolog
CO6: Understand and adopt new programming languages

Suggested Activities:

- Hands-on / In-class Activities
- Mini Project

Textbooks:

1. Robert W. Sebesta, "Concepts of Programming Languages", Twelfth Edition (Global Edition), Pearson, 2022.
2. Michael L. Scott, "Programming Language Pragmatics", Fourth Edition, Elsevier, 2018.
3. R. Kent Dybvig, "The Scheme programming language", Fourth Edition, Prentice Hall, 2011.

References:

1. Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Pearson, 1997.
2. W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	2	1	-	-	-	-	-	3			
CO2	3	3	3	2	2	-	-	-	-	-	3			
CO3	3	3	3	2	2	-	-	-	-	-	3			
CO4	3	3	3	3	2	2	-	-	-	-	-			
CO5	3	3	3	3	2	2	-	-	-	-	-			
CO6	3	3	3	3	3	2.5	2	1	3	1	3			
Avg.	2.8	2.8	3.0	2.5	2.0	2.2	2.0	1.0	3.0	1.0	3.0			

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

Course Code	Course Name	Category	L	T	P	C
PAD2401	AI Engineering	PEC	3	0	0	3

Course Objectives:

- To introduce the fundamentals and significance of AI Engineering and differentiate it from ML and Full Stack Engineering.
- To understand the working of foundation models, their training data, architectures, and fine-tuning strategies.
- To explore various evaluation methodologies, metrics, and challenges in assessing AI and language models.

- To gain knowledge on inference optimization, performance metrics, and AI accelerator technologies.
- To understand AI system architecture, feedback mechanisms, and user interaction design in AI applications.
- To develop practical skills in building, fine-tuning, deploying, and optimizing AI-driven systems through hands-on exercises.

UNIT I Introduction to Building AI Applications 9

The rise of AI Engineering - Foundation Model Use Cases - Planning AI Applications - The AI Engineering Stack - AI Engineering Vs ML Engineering - AI Engineering Vs Full Stack Engineering

UNIT II Understanding Foundational Models 9

Training Data - Multilingual Models - Domain Specific Models - Modelling - Model Architecture - Model Size - Post Training - Supervised Fine tuning - Preference Fine tuning - Sampling Fundamentals - Sampling Strategies - Test Time Compute - Structured Outputs - Probabilistic Nature of AI

UNIT III Evaluation Methodology 9

Challenges of Evaluating Foundational Models - Understanding Language Modelling Metrics - Exact Evaluation - AI as a Judge - Evaluation Criteria - Model Selection - Designing Evaluation Pipeline, Fine Tuning - Motivation - Memory Bottlenecks – Fine tuning Techniques - Parameter Efficient Fine tuning - Model Merging and Multi task Fine tuning

UNIT IV Inference Optimization 9

Understanding Inference Optimization - Inference Overview - Inference Performance Metrics - AI Accelerators - Inference Optimization - Model Optimization - Inference Service Optimization.

UNIT V AI Engineering Architecture and User Feedback 9

AI Engineering Architecture and User Feedback - Monitoring and Observability - AI Pipeline Orchestration - User Feedback - Extracting Conversational Feedback - Feedback Design - Limitations

Periods: 45 Periods

Course Outcomes:

On completion of the course, the students will be able to

CO1. To understand the scope of AI Engineering, including the differences between AI, ML, and Full Stack Engineering, and identify suitable use cases for foundation models.
CO2. To analyze the architecture, training methods, and optimization strategies of foundation models, including supervised fine-tuning, preference fine-tuning, and sampling strategies.
CO3. To evaluate the performance of foundation models using appropriate language modeling metrics, exact evaluation techniques, and model selection criteria.
CO4. To apply parameter-efficient fine-tuning, model merging, and multi-task fine-tuning techniques to improve model performance for specific tasks.

CO5. To optimize inference performance of AI models by selecting appropriate AI accelerators, optimizing models, and designing efficient inference services.

CO6. Design AI engineering architectures with effective monitoring, observability, pipeline orchestration, and incorporate user feedback for continuous improvement.

Suggested Activities

- AI vs ML vs Full Stack Engineering – Concept Mapping
- Use Case Identification Workshop
- Mini Case Study Discussion
- LLM System Architecture Design Project

Text Books:

1. Huyen, Chip. AI Engineering. O'Reilly Media, 2024.

References:

1. P. Iusztin and M. Labonne, LLM Engineer's Handbook: Master the Art of Engineering Large Language Models from Concept to Production. Birmingham, UK: Packt Publishing, Nov. 2024.
2. Z. "Leo" Liu, Artificial Intelligence for Engineers: Basics and Implementations. Cham, Switzerland: Springer Nature Switzerland AG, Jan. 2025.
3. N. L. Sree Thatavarthi and P. K. Kanuri, AI for Engineers: Concepts, Algorithms and Use Cases. Iterative International Publishers, Jul. 2025.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	3	-	-	-	-	-	-	-	-	2	-
CO2	2	2	3	3	-	-	-	-	-	-	-	-	2	-
CO3	2	2	3	3	-	-	-	-	-	-	-	-	2	-
CO4	2	2	3	3	-	-	-	-	-	-	-	-	2	-
CO5	2	2	3	3	-	-	-	-	-	-	-	-	2	-
CO6	2	2	3	3	-	-	-	-	-	-	-	-	2	-
Avg.	2	3	3	3	-	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
PCS2402	Recommender Systems	PEC	2	0	2	3

Course Objectives:

- To understand the foundations and taxonomy of recommender systems.
- To explore the role of machine learning and data mining techniques in recommender systems.
- To study various recommendation approaches such as content-based, collaborative filtering, and hybrid methods.
- To design and implement a recommender system.
- To understand evaluation metrics and attack-resilient recommendation models.

UNIT I Introduction to Recommender Systems 6

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

UNIT II Content-Based Recommendation Systems 6

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

UNIT III Collaborative Filtering Methods 6

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection)

UNIT IV Attack-Resistant Recommender Systems 6

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

UNIT V Evaluating Recommender Systems 6

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures

Periods: 30

LIST OF EXPERIMENTS:

1. Implement Data similarity measures using Python
2. Implement dimension reduction techniques for recommender systems
3. Implement user profile learning
4. Implement content-based recommendation systems
5. Implement collaborative filter techniques
6. Create an attack for tampering with recommender systems
7. Implement accuracy metrics like Receiver Operated Characteristic curves

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the basic concepts of recommender systems.
CO2: Implement machine-learning and data-mining algorithms in recommender systems data sets.
CO3: Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
CO4: Design and implement a simple recommender system.
CO5: Learn about advanced topics of recommender systems.

CO6: Learn about advanced topics of recommender systems applications.

Suggested Activities

- Practical learning – Implement Data similarity measures.
- External Learning – Singular Value Decomposition (SVD) applications
- Assignment on content-based recommendation systems
- Assignment of learning user profiles
- Assignment of security aspects of recommender systems
- Group Discussion on attacks and their mitigation
- Study of the impact of group attacks
- Group Discussion on goals of evaluation design
- Study of accuracy metrics

Text Books:

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach, Markus Zanker, Alexander Felfernig, Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press, 2011.

References:

1. Francesco Ricci, Lior Rokach, Bracha Shapira, Recommender Systems Handbook, 1st Edition, Springer, 2011.
2. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, 3rd Edition, Cambridge University Press, 2020.

MAPPING OF COs WITH POs AND PSOs

	POs											PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	-	-	-	-	2	-	2	1	-	3
CO2	2	3	3	3	2	-	-	-	2	-	3	2	-	2
CO3	3	3	3	3	2	-	-	-	3	-	3	2	-	3
CO4	2	3	3	3	2	-	-	-	3	-	2	3	-	2
CO5	3	3	3	3	3	-	-	-	3	-	3	3	-	3
CO6	3	3	3	3	3	-	-	-	3	-	3	3	-	3
Avg.	**2.7**	**2.8**	**2.8**	**2.8**	**2.4**	-	-	-	**2.7**	-	**2.7**	**2.3**	-	**2.7**

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

Course Code	**Course Name**	**Category**	**L**	**T**	**P**	**C**
PCS2441	**Soft Computing**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
- To provide the mathematical background for carrying out the optimization associated with neural network learning.
- To learn various evolutionary Algorithms.

- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
- To introduce case studies utilizing the above and illustrate the Intelligent behavior of programs based on soft computing.

UNIT I INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC 6

Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems.

UNIT II NEURAL NETWORKS 6

Supervised Learning Neural Networks – Perceptron - Backpropagation -Multilayer Perceptron – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks.

UNIT III META HEURISTIC ALGORITHMS 6

Chromosome Encoding Schemes -Population initialization and selection methods – Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function – Optimization Algorithms: Particle Swarm Optimization and Ant Colony Optimization.

UNIT IV NEURO FUZZY MODELLING 6

ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modelling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum – Analysis of Adaptive Learning Capability.

UNIT V APPLICATIONS 6

Modeling a two-input sine function - Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction.

Total Periods: 30

PRACTICAL EXERCISES:

1. Implementation of fuzzy control/ inference system
2. Programming exercise on classification with a discrete perceptron
3. Implementation of XOR with backpropagation algorithm
4. Implementation of self-organizing maps for a specific application
5. Programming exercises on maximizing a function using Genetic algorithm
6. Implementation of two input sine function
7. Implementation of three input non-linear function
8. Implementation of Particle Swarm Optimization for Benchmark Function Minimization

Total Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Apply the fundamental concepts of fuzzy to solve real-world problems

CO2: Analyse fuzzy logic operations and reasoning mechanisms to design effective decision-making systems

CO3: Apply supervised and unsupervised neural network models for pattern recognition.

CO4: Analyse the working of genetic algorithms to optimize engineering problems.

CO5: Apply neuro-fuzzy modelling techniques to develop adaptive and intelligent systems

CO6: Apply soft computing techniques in real world applications

Suggested Activities:

- Design a simple fuzzy inference system
- ANFIS Modeling Activity
- Case Study Discussion
- Mini Project
- Research Paper Writing

Text Books:

1. Sajang, J.-S. R., Sun, C.-T., & Mizutani, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall,1997
2. Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python With Case Studies and Applications from the Industry, Apress, 2020

References:

1. Roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
3. Samir Roy, Udit Chakraborthy, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
4. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019. 5. R.Eberhart, P.Simpson and R.Dobbins, “Computational Intelligence - PC Tools”, AP Professional, Boston, 1996

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	-	-	-	-	-	1	2	2	1
CO2	2	3	2	1	2	-	-	-	1	-	1	2	2	1
CO3	3	2	2	2	3	-	-	-	-	-	1	3	3	3
CO4	2	3	2	2	2	-	-	-	-	-	1	2	3	2
CO5	3	2	2	2	3	-	-	-	-	-	2	3	3	3
CO6	3	2	2	2	3	1	1	-	1	-	2	3	3	2
Avg.	**2.67**	**2.3**	**1.8**	**1.8**	**2.5**	**1**	**1**	**-**	**1**	**-**	**1.3**	**2.5**	**2.67**	**2**

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

Course Code	Course Name	Category	L	T	P	C
PCS2403	Text and Speech Analysis	PEC	2	0	2	3

Course Objectives:

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesize

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**

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

UNIT V Automatic Speech Recognition **6**

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Periods: 30

LIST OF EXPERIMENTS:

1. Create Regular expressions in Python for detecting word patterns and tokenizing text
2. Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams
3. Accessing Text Corpora using NLTK in Python
4. Write a function that finds the 50 most frequently occurring words of a text that are not stop words.
5. Implement the Word2Vec model
6. Use a transformer for implementing classification
7. Design a chatbot with a simple dialog system
8. Convert text to speech and find accuracy
9. Design a speech recognition system and find the error rate

Periods: 30

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Explain NLP foundations, text preprocessing, and text representation techniques.

CO2: Apply embeddings and deep learning models for text classification and summarization.

CO3: Analyze and build question-answering and dialogue systems.

CO4: Demonstrate text-to-speech synthesis concepts and deep learning–based TTS models.

CO5: Apply acoustic modelling and feature extraction techniques for ASR systems.

CO6: Integrate deep learning methods to develop end-to-end text and speech applications.

Suggested Activities:

- Flipped classroom
- Quiz
- Development of simple chatbots
- Mini Project

Text Books:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.

References:

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

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	1	-	-	1	-	2	2	3	3
CO2	3	3	2	2	3	1	-	-	1	-	2	2	3	3
CO3	2	3	3	2	3	1	-	1	2	1	2	2	3	3
CO4	3	2	2	2	3	1	-	-	1	-	2	2	3	3
CO5	3	2	1	2	3	1	-	-	1	-	2	2	3	3
CO6	3	3	3	2	3	1	-	1	2	2	3	3	3	3
Avg.	**2.8**	**2.5**	**2.0**	**1.8**	**3.0**	**1.0**	**-**	**1.0**	**1.3**	**1.5**	**2.2**	**2.2**	**3.0**	**3.0**

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

Course Code	Course Name	Category	L	T	P	C
PCS2406	Image and Video Analytics	PEC	2	0	2	3

Course Objectives:

- To understand the basic concepts and principles of image and video analytics.
- To learn preprocessing techniques for enhancing image quality and feature extraction.

- To explore object detection and classification using traditional and deep learning approaches.
- To study various face and gesture recognition techniques using neural network models.
- To gain insights into video analytics and its applications in intelligent surveillance systems.
- To provide hands-on experience with real-time image and video datasets for analytical model development.

UNIT I Introduction 6

Computer Vision – Image representation and image analysis tasks – Image representations – digitization – properties – colour images – Data structures for Image Analysis – Levels of image data representation – Traditional and Hierarchical image data structures.

UNIT II Image Pre-Processing 6

Local pre-processing – Image smoothing – Edge detectors – Zero-crossings of the second derivative – Scale in image processing – Canny edge detection – Parametric edge models – Edges in multispectral images – Local pre-processing in frequency domain – Line detection by local pre-processing operators – Image restoration.

UNIT III Object Detection Using Machine Learning 6

Object detection – Object detection methods – Deep-Learning frameworks for object detection – Bounding box approach – Intersection over Union (IoU) – Deep Learning architectures: R-CNN, Faster R-CNN, YOLO – Salient features – Loss functions – YOLO architectures.

UNIT IV Face Recognition and Gesture Recognition 6

Face Recognition – Introduction – Applications – Process of Face Recognition – DeepFace solution by Facebook – FaceNet for Face Recognition – Implementation using FaceNet – Gesture Recognition techniques using CNN and RNN.

UNIT V Video Analytics 6

Video Processing – Use-cases of video analytics – Vanishing gradient and exploding gradient problem – ResNet architecture – ResNet and skip connections – Inception Network – GoogleNet architecture – Improvements in Inception v2 – Video analytics using ResNet and Inception v3 – Applications in surveillance and smart cities.

Periods: 30

LIST OF EXPERIMENTS:

1. Write a program that computes the T-pyramid of an image.
2. Write a program that derives the quad tree representation of an image using the homogeneity criterion of equal intensity
3. Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale (c) Skewing (d) Affine transform calculated from three pairs of corresponding points (e) Bilinear transform calculated from four pairs of corresponding points.
4. Develop a program to implement Object Detection and Recognition

5. Develop a program for motion analysis using moving edges, and apply it to your image sequences.
6. Develop a program for Facial Detection and Recognition
7. Write a program for event detection in video surveillance system

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the fundamentals of image and video analytics.
CO2: Apply preprocessing and enhancement techniques for image analysis.
CO3: Implement object detection models using machine learning and deep learning frameworks.
CO4: Analyze and perform face and gesture recognition using deep learning.
CO5: Develop and evaluate video analytics models for real-world applications.
CO6: Design and execute mini-projects using real-time image and video data.

Suggested Activities:
- Hands-on
- Mini Project
- Case Study
- Implementation Demo

Text Books:
1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013.
2. Vaibhav Verdhan,(2021, "Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras", Apress 2021(UNIT-III,IV and V)

References:
1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited, 2011.
2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012.
3. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
4. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	1	-	2	2	2	3
CO2	3	2	1	1	3	-	-	-	1	-	2	3	2	3
CO3	3	3	3	2	3	-	-	-	1	-	2	3	3	3
CO4	3	2	2	3	3	-	2	-	1	-	2	3	3	3
CO5	3	2	3	3	3	1	1	-	1	-	3	3	3	3
CO6	3	2	3	2	3	1	1	3	2	3	3	3	3	3
Avg.	3.0	2.2	2.2	2.0	2.8	0.3	0.7	0.5	1.2	0.5	2.3	2.8	2.7	3.0

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

Course Code	Course Name	Category	L	T	P	C
PCS2407	Computer Vision	PEC	2	0	2	3

Course Objectives:

- 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.

UNIT I Introduction to Image Formation and Processing 6

Computer Vision – Geometric primitives and transformations – Photometric image formation – The digital camera – Point operators – Linear filtering – More neighbourhood operators – Fourier transforms – Pyramids and wavelets – Geometric transformations – Global optimization.

UNIT II Feature Detection, Matching and Segmentation 6

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 & Moton Estimation 6

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 6

Shape from X – Active range finding – Surface representations – Point-based representations – Volumetric representations – Model-based reconstruction – Recovering texture maps and albedos.

UNIT V Image-Based Rendering and Recognition 6

View interpolation – Layered depth images – Light fields and Lumi graphs – Environment mattes – Video-based rendering – Object detection – Face recognition – Instance recognition – Category recognition – Context and scene understanding – Recognition databases and test sets.

Periods: 30

LIST OF EXPERIMENTS:

1. OpenCV Installation and working with Python
2. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
3. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
4. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection

5. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment
6. Image segmentation using Graphcut / Grabcut
7. Camera Calibration with circular grid
8. Pose Estimation
9. 3D Reconstruction – Creating Depth map from stereo images
10. Object Detection and Tracking using Kalman Filter, Camshift

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand basic knowledge, theories, and methods in image processing and computer vision.

CO2: Implement basic and some advanced image processing techniques in OpenCV.

CO3: Apply 2D image alignment and feature extraction techniques.

CO4: Perform image segmentation and motion estimation using computer vision algorithms.

CO5: Apply 3D image reconstruction techniques.

CO6: Design and develop innovative image processing and computer vision applications.

Suggested Activities:

- Hands-on / Lab Activities
- Mini Project
- Case studies
- Assessment Activities

Text Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer Texts in Computer Science, Second Edition, 2022.
2. D. A. Forsyth & J. Ponce, Computer Vision: A Modern Approach, Pearson Education, Second Edition, 2015.

References:

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

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	0	0	0	1	0	2	2	2	3
CO2	3	2	2	2	3	0	0	0	1	0	2	3	2	3
CO3	3	3	3	2	3	0	0	0	1	0	2	3	3	3
CO4	3	3	2	3	3	1	0	0	1	0	3	3	3	3
CO5	3	2	2	3	3	0	0	0	1	0	3	3	3	3
CO6	3	2	3	2	3	2	1	3	2	3	3	3	3	3
Avg.	**3.0**	**2.3**	**2.2**	**2.2**	**2.8**	**0.5**	**0.2**	**0.5**	**1.2**	**0.5**	**2.5**	**2.8**	**2.7**	**3.0**

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

Course Code	Course Name	Category	L	T	P	C
PAD2402	MLOps	PEC	2	0	2	3

Course Objectives:

- Understand the fundamentals of Machine Learning and its types
- Gain proficiency in ML development workflows
- Design and implement ML pipelines
- Deploy and scale ML models in production environments
- Evaluate, monitor, and maintain ML models
- Apply MLOps practices to build robust, scalable ML solutions

UNIT I Fundamentals of MLOps Workflow 6

ML Solution Development Process – Types of ML Models – Learning Models, Hybrid Models, Statistical Models, HITL Models - Traditional software development challenges - Trends of ML adoption in software development - Understanding MLOps - Concepts and workflow of MLOps – Structuring MLOPs – Implementation RoadMap

UNIT II Machine Learning Pipelines 6

Basics of ML pipelines - Data ingestion and feature engineering - Machine learning training and hyperparameter optimization - Model testing and defining metrics - Model packaging - Registering models and production artifacts

UNIT III Model Evaluation and Packaging 6

Model evaluation and interpretability metrics - Production testing methods - Why package ML models? - Packaging ML models - Serialized files - Packetizing or containerizing - Microservice generation and deployment

UNIT IV Deploying Machine Learning Models at Scale 6

Understanding the types of ML inference in production – Deployment Targets - Continuous integration, delivery, and deployment in MLOps - Setting up a CI/CD pipeline and the test environment – Pipeline Execution – Introduction to APIs and MicroServices - The need for microservices for ML - REST API-based microservices - Developing a microservice using Docker - Tesing

UNIT V Monitoring ML Models in Production 6

Understanding the key principles of monitoring an ML system - Monitoring in the MLOps workflow - Understanding the Explainable Monitoring Framework - Enabling continuous monitoring for the service - Serving, monitoring, and maintaining models in production - Different modes of serving ML models - Serving the model as a batch service - Serving the model to a human user - Serving the model to a machine.

Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1: To understand machine learning models and development process
CO2: To design and implement machine learning pipelines
CO3: To evaluate and interpret ML models
CO4: To deploy Machine Learning Models at Scale
CO5: To Monitor and Maintain ML Models in Production
CO6: To Integrate MLOps Practices for Robust ML Solutions

Practical Exercises:

1. Build a basic ML pipeline: Include data ingestion, preprocessing, and feature engineering
2. Train a model with hyperparameter tuning and record performance metrics.
3. Save and register the trained model using a model registry (e.g., MLflow or TensorBoard).
4. Package a trained model as a serialized file and containerize it using Docker
5. Generate a microservice wrapper for the packaged model.
6. Implement a REST API-based microservice for the trained ML model using Flask or FastAPI.
7. Deploy the ML model using Docker and test it with sample input data.
8. Set up a simple CI/CD pipeline for the ML service using GitHub Actions or Jenkins

Periods: 30
Total Periods: 60

Text Books:

1. Emmanuel Raj, Engineering MLOps Rapidly build, test and manage production-ready machine learning life cycles at scale, Packt Publications, 2021.
2. Jeff Nickoloff and Stephen Kuenzli, Docker in Action, Third Edition, Manning, 2019.
3. Kelsey Hightower, Brendan Burns, and Joe Beda, Kubernetes Up & Running: Dive into the Future of Infrastructure", OReilly 2017.

References:

1. Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann, Introducing MLOps: How to Scale Machine Learning in the Enterprise: O'Reilly Media: 2020

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	2	2	-	-	-	-	2	-	-	3	-
CO2	2	3	3	3	3	-	-	-	-	2	-	-	3	-
CO3	2	3	3	3	3	2	-	-	3	3	-	-	3	-
CO4	2	3	3	3	3	2	-	-	3	3	-	-	3	-
CO5	2	3	3	3	3	3	3	2	3	3	2	-	3	-
CO6	2	3	3	3	3	2	3	2	3	3	2	-	3	-
Avg.	2	3	2	2	2	-	-	-	-	2	-	-	3	-

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

Course Code	Course Name	Category	L	T	P	C
PAD2403	ML Design Patterns	PEC	3	0	0	3

Course Objectives:

- Explain the need for and benefits of using design patterns in machine learning projects.
- Learn effective data and problem representation patterns for optimizing model performance.
- Describe training design patterns for improving model accuracy, robustness, and scalability.
- Discuss deployment and serving patterns for reliable and efficient ML inference.
- Study reproducibility design patterns to ensure consistency, traceability, and maintainability in ML workflows.

UNIT I Introduction and Data Representation Design Patterns 9

The Need for Machine Learning Design Patterns - What Are Design Patterns? - Common challenges in Machine Learning - - Patterns within ML Projects - ML Life Cycle – Data Representation Design patterns - Simple Data Representations - Design Patterns Hashed Feature - Embeddings - Feature Cross - Multimodal Input

UNIT II Problem Representation Design Patterns 9

Problem Representation Design Patterns - Reframing - Multilabel - Ensembles - Cascade - Neutral Class - Rebalancing

UNIT III Model Training Design Patterns 9

Typical Training Loop - Useful Overfitting - Checkpoints - Transfer Learning - Distribution Strategy - Hyper parameter Tuning

UNIT IV Design Patterns for Resilient Serving 9

Stateless Serving Function - Batch Serving – Continuous Model Evaluation – Two Phase Predictions – Keyed Predictions – Bias and Variance Tradeoff

UNIT V Reproducibility Design Patterns 9

Reproducibility Design Patterns - Transform - Bridged Schema - Windowed Interference - Workflow pipeline - Feature Store - Model Versioning

Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the principles and need for design patterns in machine learning.
CO2: Apply data and problem representation design patterns in ML pipelines.
CO3: Implement model training design patterns for optimizing learning processes.
CO4: Utilize serving design patterns to ensure resilient and scalable ML deployment.
CO5: Apply reproducibility design patterns for ensuring consistency and transparency in ML projects.
CO6: Integrate various ML design patterns to build efficient, production-ready ML systems.

Suggested Activities:

- Case Study
- Implementation Demo

Text Books:

1. V. Lakshmanan, S. Robinson, and M. Munn, Machine Learning Design Patterns: Solutions to Common Challenges in Data Preparation, Model Building, and MLOps. Sebastopol, CA, USA: O'Reilly Media, 2020, ISBN 978-1-0981-1578-4

References

1. Chip Huyen, Designing Machine Learning Systems: An End-to-End Approach to ML Solution Architecture.
2. Emmanuel Ameisen, Building Machine Learning Powered Applications: Going from Idea to Product. (O'Reilly Media, 2020)

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO2	2	3	3	2	2	-	-	-	-	-	-	-	2	-
CO3	2	3	3	3	3	-	-	-	-	-	-	-	2	-
CO4	2	2	3	3	3	-	-	-	-	-	-	-	2	-
CO5	1	2	2	3	3	-	-	-	-	-	-	-	2	-
CO6	3	3	3	3	3	-	-	-	-	-	-	-	3	-
Avg.	2.17	2.5	2.5	2.8	2.8	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
PAD2404	Explainable AI	PEC	2	0	2	3

Course Objectives:

- To understand the need and fundamentals of Explainable AI.
- To apply different computation interpretable techniques to ML models.
- To study various XAI techniques.
- To apply explainability methods for unstructured data.
- To learn recent trends and applications in responsible AI.

UNIT I Introduction to Explainable AI (XAI) 6

Definition and need for explainability – Overview and types of explanations – Known issues in explainability – Fundamentals and objectives of XAI – Categorization and taxonomy of XAI methods (model-specific vs model-agnostic, global vs local) – Limitations and challenges of XAI.

UNIT II XAI Methods for Machine Learning Models 6

Explainability in Linear Models: Regression & Classification. Explainability in Non-linear Models: Decision Trees, Rule-Based Models. Ensemble Models: Random Forest.

UNIT III XAI for Deep Learning and Time series 6

Deep Neural Networks: Saliency Maps, Grad-CAM - Deep SHAP - Time Series Prediction & Interpretability - Counterfactual & Contrastive Explanations

UNIT IV XAI for NLP and Vision Applications 6

Text Classification Explanation: LIME. N-gram based Explanation Techniques (core concepts only). Importance-based Interpretation for NLP Models. Vision Explainability: Grad-CAM for CNN models. Applications in Image Classification.

UNIT V Responsible AI 6

Building trustworthy and transparent AI systems – Ethical and regulatory aspects of XAI – Fairness, accountability, and transparency in AI – Medical diagnosis, Making AI decisions trustworthy for physicians and patients, Sales predictions on the house sale, Recent trends.

Periods: 30

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the fundamentals, needs and challenges of Explainable AI.
CO2: Apply interpretability methods for different machine learning models.
CO3: Apply XAI techniques.
CO4: Implement AI explainability for unstructured data.
CO5: Evaluate fairness, accountability and transparency in AI systems.
CO6: Explore recent trends and application in explainable AI.

Practical Exercises:

1. Prediction of linear regression model.
2. Installation of LIME and explaining the prediction of linear regression.
3. Implement SHAP to interpret model predictions and visualize feature contributions.
4. Generate Counterfactual Explanations (DiCE) for classification models and analyse decision boundaries.
5. Apply Grad-CAM for visual explanations in image classification.
6. Perform explainability analysis on text data using LIME.

Periods: 30
Total Periods: 60

Suggested Activities:

- Case study Discussion
- Flipped classroom: Model-specific vs Model-agnostic Explainability
- Interpretability Demonstration
- Think-Pair-Share: Comparing XAI Techniques
- Ethical XAI Debate
- Research showcase: Recent trends in XAI

Text Books:

1. Pradeepta Mishra, “Practical Explainable AI Using Python”, Apress, 2022.

2. Christoph Molnar, “Interpretable Machine Learning: A Guide for Making Black Box Models Explainable”, 2022.

References:

1. Uday Kamath, John Liu, “Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning”, 2021.
2. Denis Rothman, “Hands-On Explainable AI (XAI) with Python: Interpret, Visualize, Explain, and Integrate Reliable AI for Fair, Secure, and Trustworthy AI Apps”, Packt Publishing Ltd, 2020.
3. Patrick Hall, Navdeep Gill, “Machine Learning Interpretability”, O'Reilly Media, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	2	2	-	-	-	2	2	1	1
CO2	2	3	2	2	3	-	-	-	-	-	2	2	2	1
CO3	2	3	3	2	3	-	-	1	-	-	2	2	3	1
CO4	2	3	3	3	3	-	-	-	-	-	2	2	3	1
CO5	-	2	2	-	2	3	3	2	-	1	2	2	2	2
CO6	1	2	2	1	2	2	2	-	-	-	3	2	2	2
Avg.	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**		**1**	**2**	**2**	**2.16**	**1.33**

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

Course Code	Course Name	Category	L	T	P	C
PAD2405	Generative AI	PEC	2	0	2	3

Course Objectives:

- To understand the fundamentals of Generative AI and Transformer based architectures.
- To explore text and image generations using large language models and generative models.
- To study Retrieval Augmented Generation systems and their components.
- To understand the principles and techniques of Prompt Engineering.
- To apply advanced prompting and fine-tuning for GenAI applications.

UNIT I Introduction to Generative Modelling 6

Introduction to Gen AI - Discriminative vs Generative modelling - Understanding generative models - Taxonomy of generative models – Basic generative model – Discriminative model – Latent Space – Evaluating Generative models – Bias. Generative Model framework – Core Probability Theory – Taxonomy.

UNIT II Text Generation using GenAI 6

Introduction to Text Generation - Text Generation Techniques- Greedy, Beam, Top-k, Top-p, Fine-tuning LLMs for text generation – Text Summarization Pipelines – Measuring the quality of the generated text

UNIT III Image Generation using GenAI 6

Introduction to Image Generation, Implementing GANs for Image Generation Training and Fine-Tuning GANs, Generating Images with VAEs, Image and Video Generation Applications.

UNIT IV Introduction to RAG 6

Introduction to RAG - Workflow of RAG Systems - Information retrieval - lexical vs semantic search - Dense retrieval using transformer based encoders - Vector Databases - Chunking strategies - relevance scoring, Generator and Integration Strategies - Generative model integration - Context injection and prompt construction - Fusion methods - Applications, Evaluation, and Tools

UNIT V Prompting Techniques 6

Prompt Engineering – Definition and Importance, Role of prompts in guiding AI behaviour. Types of Prompts Zero-shot, few-shot and chain of thought programming, Instruction-based prompts Vs open-ended prompts. Best practices of Prompt Design – clarity, specificity and context, iterative refinements of prompts, Handling ambiguous or complex queries

Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1: Explain the architecture and working of transformers and LLMs.
CO2: Apply generative techniques for text and image generations using GenAI models.
CO3: Implement Retrieval Augmented Generation systems using transformer encoders and vector databases.
CO4: Demonstrate principles of prompt engineering and design prompts for diverse AI tasks.
CO5: Apply advanced prompting techniques for reasoning and task chaining.
CO6: Evaluate and fine-tune generative AI models for diverse applications.

Practical Exercises:

1. Implement a Transformer architecture and visualize self-attention mechanisms.
2. Use a pre-trained LLM for text generation with different decoding strategies.
3. Fine-tune a decoder-only LLM for a custom text generation task.
4. Implement image generation using GAN and VAE models on a small dataset.
5. Build a basic RAG pipeline integrating a vector database and a retrieval model.
6. Implement semantic search and context injection for document based question answering.
7. Create an Agentic AI system using Agentic Frameworks, integrating tools and memory.
8. Experiment with different agent types and analyze responses.
9. Apply prompt engineering techniques for specific tasks.
10. Mini project: Fine-tune a GenAI model for a real world application.

Periods: 30
Total Periods: 60

Suggested Activities:

1. Visualizing Attention
2. Flipped Classroom: Evolution of LLMs
3. Creative text generation challenge.
4. Hands on showcase: Generative Art

5. Prompt design competition

Text Books:

1. David Foster, “Generative Deep Learning”, O’Reily Books, 2024.
2. Anjanava Biswas, Wrick Talukdar, “Building Agentic AI Systems - Create intelligent, autonomous AI agents that can reason, plan and adapt”, Packt Publishing, 2025.

References:

1. Altaf Rehmani, “Generative AI for Everyone”, BlueRose One, 2024.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	3	-	-	-	-	-	2	1	2	-
CO2	2	3	3	2	3	-	-	-	-	-	2	1	2	-
CO3	2	3	3	2	3	-	-	1	-	-	3	1	2	-
CO4	2	3	3	2	3	1	-	2	-	1	3	1	2	-
CO5	1	2	2	-	3	-	1	1	-	-	3	1	2	-
CO6	2	3	3	2	3	2	-	-	-	1	3	1	2	-
Avg.	**2**	**2.67**	**2.67**	**2**	**3**	**1.5**	**1**	**1.33**	**-**	**1**	**2.67**	**1**	**2**	**-**

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

Course Code	Course Name	Category	L	T	P	C
PAD2405	Bio-Inspired Optimization Techniques	PEC	3	0	0	3

Course Objectives:

- To understand fundamental topics in bio-inspired optimization techniques
- To Learn the collective systems such as ACO, PSO, and BCO
- To develop skills in biologically inspired algorithm design with an emphasis on solving real world problems
- To understand the most appropriate types of algorithms for different data analysis problems and to introduce some of the most appropriate implementation strategies.
- To implement the Bio-inspired technique with other traditional algorithms.

UNIT I Introduction 9

Optimization Techniques: Introduction to Optimization Problems – Single and Muti- objective Optimization – Classical Techniques – Overview of various Optimization methods – Evolutionary Computing: Genetic Algorithm and Genetic Programming: Basic concept – encoding – representation – fitness function – Reproduction – differences between GA and Traditional optimization methods – Applications – Bio- inspired Computing (BIC): Motivation – Overview of BIC – usage of BIC – merits and demerits of BIC.

UNIT II Swarm Intelligence 9

Introduction – Biological foundations of Swarm Intelligence – Swarm Intelligence in Optimization – Ant Colonies: Ant Foraging Behavior – Towards Artificial Ants – Ant Colony Optimization (ACO) – S ACO – Ant Colony Optimization Metaheuristic: Combinatorial Optimization – ACO Metaheuristic – Problem solving using ACO – Other Metaheuristics – Simulated annealing – Tabu Search – Local search methods – Scope of ACO algorithms.

UNIT III Natural to Artificial Systems 9

Biological Nervous Systems – artificial neural networks – architecture – Learning Paradigms – unsupervised learning – supervised learning – reinforcement learning – evolution of neural networks – hybrid neural systems – Biological Inspirations in problem solving – Behaviour of Social Insects: Foraging –Division of Labor – Task Allocation – Cemetery Organization and Brood Sorting – Nest Building – Cooperative transport.

UNIT IV Swarm Robotics 9

Foraging for food – Clustering of objects – Collective Prey retrieval – Scope of Swarm Robotics – Social Adaptation of Knowledge: Particle Swarm – Particle Swarm Optimization (PSO) – Particle Swarms for Dynamic Optimization Problems – Artificial Bee Colony (ABC) Optimization biologically inspired algorithms in engineering.

UNIT V Case Studies 9

Other Swarm Intelligence algorithms: Fish Swarm – Bacteria foraging – Intelligent Water Drop Algorithms – Applications of biologically inspired algorithms in engineering. Case Studies: ACO and PSO for NP-hard problems – Routing problems – Assignment problems – Scheduling problems – Subset problems – Machine Learning Problems – Travelling Salesman problem.

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the fundamental principles of evolutionary computing and bio inspired computing methods

CO2: Analyze swarm intelligence techniques and other metaheuristics for various optimization scenarios.

CO3: Compare biological systems and artificial neural learning paradigms to design hybrid and biologically inspired problem-solving models.

CO4: Implement swarm robotics and bio-inspired algorithms for real-time tasks such as foraging, clustering, and collective decision making.

CO5: Evaluate and apply bio-inspired optimization algorithms to engineering case studies including routing, scheduling, assignment, and NP-hard problems.

CO6: Design and develop innovative optimization solutions by integrating multiple bio-inspired algorithms to address complex real-world engineering problems.

Suggested Activities:

- Flipped classroom - GA vs Traditional Optimization
- Simulation of Art Foraging Behaviour
- Implementation of Ant Colony Optimization

- Implementation of Artificial Bee Colony Optimization
- Comparative study of Swarm Algorithms
- Case Study/Seminar Paper Presentation

Text Books:

1. A. E. Elben and J. E. Smith, “Introduction to Evolutionary Computing”, Springer, 2010.
2. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
3. Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007

References:

1. Eric Bonabeau, Marco Dorigo, Guy Theraulaz, “Swarm Intelligence: From Natural to Artificial Systems”, Oxford University press, 2000.
2. Christian Blum, Daniel Merkle (Eds.), “Swarm Intelligence: Introduction and Applications”, Springer Verlag, 2008.
3. Leandro N De Castro, Fernando J Von Zuben, Inspired Computing”, Idea Group Inc., 2005. “Recent Developments in Biologically
4. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
5. C. Ebelhart et al., “Swarm Intelligence”, Morgan Kaufmann, 2001.

MAPPING OF COs WITH POs AND PSOs

Cos	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	-	2	2	-
CO2	2	3	2	2	3	-	-	-	-	-	-	2	3	-
CO3	3	2	3	3	3	-	-	-	-	-	-	2	3	-
CO4	2	2	3	2	2	-	-	-	-	-	-	1	3	-
CO5	2	3	3	3	3	-	-	-	-	-	-	1	3	-
CO6	3	3	3	2	3	-	-	-	-	-	-	1	3	-
Avg.	2.5	2.5	2.5	2.16	2.67	-	-	-	-	-	-	1.5	2.83	-

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

Course Code	Course Name	Category	L	T	P	C
PAD2407	Responsible AI	PEC	3	0	0	3

Course Objectives:

- To understand AI basics, misconceptions, responsible AI principles, and challenges in implementation.
- To understand and analyse biases in AI, fairness metrics, and mitigation techniques.
- To understand explainability, challenges, methods, and evaluation for interpretable machine learning models.
- To understand AI safety, security, privacy, and resilience, including model and data protection.
- To explore ethical issues and implications of AI in various real-world applications.

UNIT I **Introduction to Responsible AI** **9**

Overview of AI – Common misconception of AI – Introduction to Responsible AI – Characteristics of Responsible AI – Key principles of responsible AI - Challenges in implementing responsible AI - ELSI Framework and AI - Safety and Alignment – Fairness and Privacy.

UNIT II **Fairness And Bias** **9**

Human Bias - Types of biases - Effects of biases on different demographics - Bias vs Fairness - Sources of Biases - Exploratory data analysis - Bias Mitigation Techniques - Pre-processing techniques - In processing techniques - Post-processing techniques - Bias detection tools - Overview of fairness in AI - Demographic parity - Equalized odds - Simpson's paradox and the risks of multiple testing - Group fairness and Individual fairness - Counterfactual fairness - Fairness metrics - Bias and disparity mitigation with Fairlearn.

UNIT III **Explainability & Interpretability** **9**

Importance of Explainability and Interpretability – Challenges - Interpretability through simplification and visualization - Intrinsic interpretable methods - Post Hoc interpretability – Interpretability Evaluation methods - Explainability through causality - Model agnostic Interpretation - LIME (Local Interpretable Model-agnostic Explanations) - SHAP (SHapley Additive exPlanations).

UNIT IV **Safety, Security, And Privacy** **9**

Overview of safety – security – privacy - resilience - Taxonomy of AI safety and Security - Adversarial attacks and mitigation - Model and data security - The ML life cycle - Adopting an ML life cycle MLOps and ModelOps - Model drift - Data drift - Concept drift - Privacy-preserving AI techniques- Differential privacy - Federated learning.

UNIT V **Case Studies** **9**

COMPAS Algorithm - Google Photos Tagging Controversy - ProPublica's Analysis of Recidivism Predictions - Amazon's AI Recruiting Tool - Facial Recognition Technology Misidentification - AI in Healthcare: Predictive Analytics in Patient Care - Tesla Autopilot and Ethical Implications of Autonomous Vehicles

Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: State the aspects of Responsible AI, such as fairness, bias, privacy etc.
CO2: Enforce fairness in models and mitigate bias in data.
CO3: Understand the importance of explainability and interpretability in AI systems.
CO4: Implement strategies to manage safety, security and privacy in AI systems.
CO5: Evaluate the societal impact of AI applications.
CO6: Integrate Responsible AI principles into the design, development, and deployment of AI-based solutions

Suggested Activities:

- Flip Classroom on Key Principles and challenges in Responsible AI

- Case study
- Hands-On Lab - Bias Detection and Fairness Metrics using Fairlearn
- Group Project on Fairness in AI
- Ethical Evaluation of Autonomous systems
- Mini Project on MLOps-based secure AI model lifecycle

Text Books:

1. Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way", 2019.
2. Adnan Masood, Heather Dawe, "Responsible AI in the Enterprise", 2023.
3. Beena Ammanath, "Trustworthy AI", O' Reilly, 2022. 4. Christoph Molnar "Interpretable Machine Learning", 1st edition, 2019.

References:

1. I. Almeida, "Responsible AI in the Age of Generative Models: Governance, Ethics and Risk Management", 2024.
2. Silja Voeneky, Philipp Kellmeyer et. al, "The Cambridge Handbook of Responsible Artificial Intelligence", Cambridge University Press, 2022.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3	-	-	-	-	3	-	-	3
CO2	1	-	-	-	-	3	-	-	-	-	3	-	-	3
CO3	2	1	-	-	-	2	-	-	-	-	3	-	-	3
CO4	1	1	2	2	-	3	-	-	-	-	3	-	-	3
CO5	1	2	2	2	-	3	-	-	-	-	3	-	-	2
CO6	2	1	2	1	-	3	-	-	-	-	3	-	-	3
Avg.	1.5	1.25	2	1.67	-	2.83	-	-	-	-	3	-	-	3

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

Course Code	Course Name	Category	L	T	P	C
PAD2408	Image Generation	PEC	2	0	2	3

Course Objectives:

- To understand the taxonomy and fundamentals of generative models.
- To explore the architecture and training of Generative Adversarial Networks.
- To analyze advanced GAN variants.
- To study the concepts and working principles of diffusion-based generative models.
- To compare GANs and diffusion models for quality, efficiency, and diversity.

UNIT I Introduction to Generative Modelling 6

Overview of discriminative vs generative models - Taxonomy of generative models - Basic generative model – Discriminative model – Latent Space – Evaluating Generative models – Bias. Generative Model framework – Core Probability Theory

UNIT II Variational Autoencoder 6

Introduction – Autoencoders – Working with clothing item images – Variational Autoencoders – Exploring latent space with facial image dataset.

UNIT III Generative Adversial Networks 6

Deep Convolutional GAN (DCGAN) – Conditional GAN (cGAN) – Pix2Pix - CycleGAN - GAN-based applications: super-resolution (SRGAN), Inpainting, Face synthesis

UNIT IV Diffusion Model 6

Motivation and transition from GANs to diffusion-based models – Forward Diffusion Process- Parameterization Trick – Diffusion Schedules – Reverse Diffusion Process - U-Net architecture for diffusion models - Sampling and training algorithms in diffusion model

UNIT V Advanced Diffusion and Emerging Trends 6

Latent Diffusion Models (LDM) – Stable Diffusion, DALL·E, and Imagen – text-to-image generation - Integration of CLIP for guided diffusion - Fine-tuning and domain adaptation in diffusion models - Responsible generative AI – bias, safety, and regulation

Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1: Explain the fundamentals, taxonomy, and applications of generative models.
CO2: Implement and analyze basic GAN architectures and training challenges.
CO3: Apply advanced GAN variants for tasks like image synthesis.
CO4: Understand and implement diffusion-based generative models.
CO5: Analyze and apply advanced diffusion-based generative models
CO6: Evaluate ethical and responsible aspects of generative AI systems.

Practical Exercises:

1. Implement a simple Variational Autoencoder (VAE) for image generation.
2. Build and train a Vanilla GAN on MNIST or CIFAR-10 dataset.
3. Visualize mode collapse and experiment with techniques to stabilize GAN training.
4. Implement DCGAN for realistic image generation using convolutional layers.
5. Apply a Conditional GAN (Pix2Pix) for image-to-image translation tasks.
6. Implement a simple Diffusion Model from scratch using PyTorch.
7. Experiment with a pre-trained Stable Diffusion model for text-to-image generation.
8. Train a simple Denoising Diffusion Probabilistic Model (DDPM) for image generation.
9. Explore Stable Diffusion or Latent Diffusion Models (LDM) for text-to-image generation.
10. Conduct a mini-project on ethical evaluation and bias detection in generative models.

Periods: 30
Total Periods: 60

Suggested Activities:

1. Quiz
2. Case study - Generative AI in the real world
3. Experiment Latent Space Interpolation
4. Build and Train a basic GAN
5. GAN failure analysis
6. Comparative study - GANs vs Diffusion Models
7. Ethical and Responsible AI discussion

Text Books:

1. David Foster (2022), *Generative Deep Learning*, 2nd Edition, O'Reilly Media.
2. Ian Goodfellow, Yoshua Bengio & Aaron Courville (2016), *Deep Learning*, MIT Press.
3. Jakub Langr & Vladimir Bok (2019), *GANs in Action*, Manning Publications.
4. Ho, J. et al. (2020), "Denoising Diffusion Probabilistic Models," *NeurIPS*.

References:

1. Karras, T. et al. "Analyzing and Improving the Image Quality of StyleGAN," *CVPR*. 2020
2. Dhariwal, P. & Nichol, A. "Diffusion Models Beat GANs on Image Synthesis," *NeurIPS*. 2021
3. Rombach, R. et al. "High-Resolution Image Synthesis with Latent Diffusion Models," *CVPR*. 2022

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	-	2	-
CO2	2	3	3	2	3	-	-	-	-	-	-	1	2	-
CO3	2	2	3	3	3	-	-	-	-	-	-	1	2	-
CO4	2	2	2	3	3	-	-	-	-	-	-	1	2	-
CO5	2	3	2	2	3	-	-	-	-	-	-	1	2	-
CO6	1	1	1	1	-	-	-	-	-	-	-	-	-	2
Avg.	2	2.16	2	2	2.6	-	-	-	-	-	-	1	2	2

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

Course Code	Course Name	Category	L	T	P	C
PAD2409	Game Theory	PEC	2	0	2	3

Course Objectives:

- To introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets.
- To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in 41 modeIIing applications.
- To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.

- To introduce contemporary topics in the intersection of game theory, computer science, and economics.
- To apply game theory in searching, auctioning and trading.

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 7

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 5

Aggregating Preferences – Social Choice – Formal Model – Voting – Existence of social functions – Ranking systems - Protocols for Strategic Agents: Mechanism Design – Mechanism design with unrestricted preferences.

Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.
CO2: Understand the use of Nash Equilibrium for other problems.
CO3: Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.
CO4: Identify some applications that need aspects of Bayesian Games.
CO5: Analyze and compute solution concepts in non-cooperative games
CO6: Apply mechanism design and social choice principles to develop fair and optimal decision-making systems in multi-agent environments.

Practical Exercises

1. Prisoner's dilemma
2. Pure Strategy Nash Equilibrium
3. Extensive Form – Graphs and Trees, Game Trees
4. Strategic Form – Elimination of dominant strategy
5. Minimax theorem, minimax strategies
6. Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium
7. imperfect-information games - Mixed Strategy Nash Equilibrium - Finding mixed-strategy Nash equilibria for zero sum games, mixed versus behavioral strategies.
8. Repeated Games
9. Bayesian Nash equilibrium
10. Mechanism Design and Social Choice Implementation using Python/Matlab

Periods: 30
Total Periods: 60

Suggested Activities:

- Case Study
- Model and Simulate a multi-agent negotiation
- Debate
- Mini Project
- Research review
- Problem-solving workshop
- Group Activity

Text Books:

1. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.
2. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
3. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2007.
4. A.Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.

References:

1. YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008.
2. Zhu Han, DusitNiyato, WalidSaad, TamerBasar and Are Hjorungnes, "Game Theory in Wireless and Communication Networks", Cambridge University Press, 2012.
3. Y.Narahari, "Game Theory and Mechanism Design", IISC Press, World Scientific.
4. William Spaniel, "Game Theory 101: The Complete Textbook", CreateSpace Independent Publishing, 2011.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	-	-	2	1	-
CO2	3	3	2	1	1	-	-	-	-	-	-	2	1	-
CO3	2	3	3	2	2	-	-	-	-	-	-	1	1	-
CO4	2	3	2	3	2	-	-	-	-	-	-	2	1	-
CO5	1	2	3	3	3	-	-	-	-	-	-	1	1	-
CO6	1	2	3	2	2	-	-	-	-	-	-	1	1	-
Avg.	**2**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**	**1**	**-**

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

Course Code	Course Name	Category	L	T	P	C
PAD2410	Agentic AI	PEC	2	0	2	3

Course Objectives:

- Understand the principles, characteristics, and architecture of agentic systems.
- Learn the core components of intelligent agents including reasoning, learning, and decision-making.
- Explore the Coordinator–Worker–Delegator (CWD) approach and its role in generative AI systems.
- Study planning and tool-usage mechanisms for autonomous agent behavior.
- Examine ethical, safety, and trust considerations in deploying agentic AI systems.

UNIT I Introduction to Agentic AI 6

Principles of Agentic Systems - Technical requirements - self-governance, agency, and autonomy - Reviewing intelligent agents and characteristics - architecture of agentic systems – Deliberative, reactive and Hybrid - Multi-agent systems

UNIT II Components, Reflection and Introspection in Intelligent Agents 6

Essential Components of Intelligent Agents : Technical requirements - Knowledge representation - Reasoning - Learning mechanisms - Decision-making and planning - Enhancing agent capabilities with generative AI - Reflection and Introspection : Importance of reflection - Introspection in intelligent agents - Implementing reflective capabilities

UNIT III Coordinator, Worker and Delegator Approach 6

Understanding the CWD model - Key principles - Designing agents with role assignments - Communication and collaboration between agents - Implementing the CWD approach in generative AI systems - Effective Agentic System Design Techniques : Focused system prompts and instructions for agents - State spaces and environment modelling - Agent memory architecture and context management - Sequential and parallel processing in agentic workflows

UNIT IV Tool Usage and Planning in Agents 6

Concepts of Tools in agents : Tools and function calling - Defining tools for agents - Types of tools - Significance of tools - Planning Algorithms for agents: LLM based planning and HTN, Integrating tool use and planning

UNIT V Trust, Safety and Ethics 6

Importance of trust in AI - Techniques for establishing trust - Implementing transparency and explainability - Handling uncertainty and biases - potential risks and challenges - Ensuring safe and responsible AI - ethical guidelines and frameworks - Addressing privacy and security concerns

Periods: 30

Course Outcomes:

On completion of the course, the students will be able to

CO1. Understand the principles, architecture, and characteristics of agentic and multi-agent systems.

CO2. Develop intelligent service assistant agents by implementing knowledge representation.

CO3. Design and simulate role-based agent systems using the Coordinator–Worker–Delegator (CWD) model.

CO4. Implement tool-enabled agents such as LLM-based planning and HTN for real-world autonomous tasks.

CO5. Evaluate the effectiveness of agentic AI applications in real-world scenarios through practical implementation.

CO6. Understand the trust and responsible autonomous behaviour.

Practical Exercises

1. Design an Intelligent Service Assistant Algorithm with Autonomy

2. Developing Utility Functions for Autonomous Agents

3. Simulate the agent with reflection and introspection

4. Enabling tool use and planning in AI agents

5. Designing agents with Coordinator, Worker, and Delegator

6. Effective Agentic System Design Techniques

7. Incorporating Explainability and Transparency in Agent Design

Periods: 30

Total Periods: 60

Text Books:

1. Anjanava Biswas, Wrick Talukdar, "Building Agentic AI Systems - Create intelligent, autonomous AI agents that can reason, plan and adapt", Packt Publishing, 2025.

References:

1. Pascal Bornet, Jochen Wirtz, Thomas H Davenport, David De Cremer, Brain Evergreen, Phil Fersht, Rakesh Gohel and Shail Khiyara, "Agentic Artificial Intelligence Harnessing AI Agents to Reinvent Business, Work and Life", 2025.
2. Mariana Sanchez Caparros, "Artificial intelligence agents and agentic workflows: The new frontier of automation", 1st ed. – Autonomous City of Buenos Aires: La Ley, 2025.
3. David L. Poole, Alan K. Mackworth , "Artificial Intelligence: Foundations of Computational Agents", Second Edition, Cambridge University Press, 2017.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	3	-	-	-	-	-	-	1	-
CO2	3	3	3	2	2	3	-	-	2	-	-	-	3	-
CO3	3	3	3	3	3	2	-	-	2	-	-	-	2	-
CO4	3	3	3	3	3	2	-	-	2	-	-	-	3	-
CO5	2	2	3	2	2	3	-	-	2	-	-	-	3	-
CO6	3	3	3	3	3	3	-	-	-	-	-	-	-	3
Avg.	**2.83**	**2.67**	**2.83**	**2.6**	**2.6**	**2.67**	**-**	**-**	**2**	**-**	**-**	**-**	**2.4**	**3**

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

Course Code	Course Name	Category	L	T	P	C
PCS2446	COGNITIVE SCIENCE	PEC	2	0	2	3

Course Objectives:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition.

UNIT I Philosophy, Psychology And Neuroscience 6

Philosophy: Mental-physucal Relation – From Materialism to Mental Science – Logic and the Science of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing – Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

UNIT II Computational Intelligence 7

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Learning – Language – Vision.

UNIT III Probabilistic Programming Language 6

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probabilities types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations – Enumeration.

UNIT IV Inference Models of Cognition 6

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

UNIT V Learning Models of Cognition 5

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Learning (Deep) Continuous Functions – Mixture Models.

Periods: 30

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the underlying theory behind cognition.
CO2: Understand computational intelligence frameworks
CO3: Apply probabilistic programming concepts using WebPPL
CO4: Analyze inference models of cognition by constructing and evaluating generative models
CO5: Examine learning models of cognition
CO6: Develop applications using cognitive learning model.

Practical Exercises:

1. Demonstrate perception and decision making process using a simple computational model.
2. Implement a logical reasoning system using predicate logic.
3. Build a simple knowledge-based system to simulate human-like inference.
4. Demonstration of Mathematical functions using WebPPL.
5. Implementation of reasoning algorithms.
6. Developing an Application system using generative model.
7. Developing an Application using conditional inference learning model.
8. Application development using hierarchical model.
9. Application development using Mixture model.
10. Mini Project

Periods: 30
Total Periods: 60

Suggested Activities:

1. Concept Map on Cognitive Processes
2. Case Study
3. Comparative Review of Cognitive Architecture
4. Debate - Can Machines Truly Think?

Text Books:

1. Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016.
2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015.
3. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”,The MIT Press, 1999.
4. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020.

References:

1. Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	1	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	2	-	-
CO4	2	3	3	2	-	-	-	-	-	-	-	1	-	-
CO5	2	3	-	2	-	-	-	-	-	-	-	1	-	-
CO6	2	2	3	-	-	-	-	-	-	-	-	-	-	-
Avg	**2.33**	**2.83**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.25**	**-**	**-**

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

Course Code	Course Name	Category	L	T	P	C
PAD2411	AI Infrastructure and System Design	PEC	3	0	0	3

Course Objectives:

- To introduce the fundamentals of machine learning systems, including lifecycle stages and hardware/software constraints.
- To develop knowledge of data engineering techniques for building scalable and efficient ML data pipelines.
- To provide understanding of training infrastructure, model selection, and distributed learning approaches.
- To enable learners to design and implement effective model deployment and serving strategies.
- To impart skills in monitoring, maintaining, and ensuring ethical compliance in ML systems.
- To equip learners with the ability to build complete end-to-end ML systems for real-world applications.

UNIT I Foundations and System Requirements 9

Understanding the "Big Picture" and the hardware/software constraints. Introduction to ML Systems: The difference between ML in research vs. production; challenges of ML systems (Scale, Latency, Data Drift). System Requirements: Reliability, Scalability, Maintainability, and Adaptability. Iterative Process: The ML life cycle from data collection to monitoring. Hardware Basics: Compute (CPU vs. GPU vs. TPU) and the impact of hardware constraints on system design.

UNIT II Data Engineering Infrastructure 9

Data Models: Structured vs. Unstructured data; Row-major vs. Column-major storage. Data Processing: Batch processing vs. Stream processing; The role of Message Brokers (Kafka) and ETL pipelines. Feature Engineering: Managing features at scale; The concept of a Feature Store for consistency between training and serving. Data Labeling: Hand-labeling vs. Programmatic labeling (Weak Supervision).

UNIT III Training Infrastructure and Distributed Systems 9

Model Selection: Training from scratch vs. Fine-tuning vs. Distillation. Distributed Training: Data Parallelism: Splitting data across workers. Model Parallelism: Splitting model layers across workers. Resource Orchestration: Basics of using Containers (Docker) and Scheduling (Kubernetes) for training jobs. Experiment Tracking: Infrastructure for versioning models and logging hyperparameters.

UNIT IV Model Deployment and Serving Infrastructure 9

Serving Patterns: Online prediction (Synchronous) vs. Batch prediction (Asynchronous). Inference Optimization: Model Compression, Quantization (e.g., FP32 to INT8), and Pruning. Deployment Strategies: Canary releases, Blue-Green deployment, and A/B testing. Edge vs. Cloud: Designing for mobile/IoT vs. high-performance cloud servers.

UNIT V Monitoring, Continual Learning, and Ethics 9

Monitoring and Observability: Detecting Data Drift and Concept Drift; System metrics (latency/throughput) vs. ML metrics (accuracy/F1). Continual Learning: Infrastructure for automated retraining and model updates. Testing in Production: Shadow deployments and "Bandit" testing. Infrastructure Ethics: Data privacy (GDPR/CCPA constraints) and architectural fairness.

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the end-to-end machine learning system lifecycle along with hardware constraints
CO2: Apply data engineering concepts to design scalable ML data pipelines
CO3: Apply training infrastructure concepts, including model selection techniques and distributed training methods
CO4: Design and deploy efficient ML serving systems by selecting appropriate serving patterns
CO5: Evaluate and maintain ML systems by monitoring performance and drift, ensuring ethical compliance in terms of data privacy and fairness.
CO6: Design, develop, deploy, and maintain end-to-end machine learning systems by integrating data engineering, distributed training, scalable serving, monitoring, and ethical practices under real-world constraints.

Suggested Activities
1. Case study analysis on real-world ML systems in production environments focusing on scalability, latency, and system reliability.
2. Group discussion and presentation on edge AI, cloud infrastructure, and optimization techniques such as quantization and pruning.
3. Mini project on distributed model training using containers and orchestration platforms such as Docker and Kubernetes.

Text Books:

1. Huyen, C. Designing machine learning systems: An iterative process for production-ready applications, O'Reilly Media, 2022
2. Duy V. Nguyen. Platform Engineering for Artificial Intelligence: Designing scalable infrastructure, data pipelines and model lifecycle management for generative AI and agentic protocols, BPB publication, 2026

References:

1. Scott Anderson Infrastructure for AI Network Design and Architecture, *BPB publication, 2025*
2. Ajit Singh Cloud 3.0 and AI Infrastructure: Design, Build, and Scale, Atlantic Publishers and Distributors (P) Ltd 2026

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	-	-	-	-	-	-	-	3	-
CO2	2	3	2	2	3	-	-	-	-	-	-	-	2	-
CO3	3	3	2	2	3	-	-	-	-	-	-	-	2	-
CO4	2	2	3	2	3	-	-	-	-	-	-	-	2	-
CO5	2	3	2	3	2	-	-	-	-	-	-	-	2	-
CO6	3	3	3	3	3	-	-	-	-	-	-	-	2	-
Avg.	3	3	2	2	3	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
PAD2412	AI FOR INDUSTRIAL APPLICATIONS	PEC	3	0	0	3

Course Objectives:

- Explore how Industrial AI is applied in various sectors.
- Learn about Digital Twins, their characteristics, and how they impact predictive maintenance and data-driven decision-making.
- Explore the role of AI in decision-making, software systems, and software engineering processes.
- Study distributed computing, cloud computing, data storage solutions, and information security.
- Examine AI applications across various industries

UNIT I INDUSTRIAL AI 9

Industrial AI- Industrial AI in action- Applying industrial AI- The IMS architecture for industrial AI Visible and Invisible issues- Building the future with AI- Killer Applications of Industrial AI.

UNIT II DATA ANALYTICS IN INDUSTRY 4.0 9

Digital Twins(DT)- History of DT- Characteristics- Evolution- Data twin - physical world, digital world - Classifications- Level of integration- Characteristics- Modelling digital twins- Smart manufacturing and Applications- Uses of Digital Twin Technology- Digital twins maintenance - predictive maintenance- Planning the digital twin- Digital twin during operation phase- Hybrid analysis and Fleet data- Digital implementation- Digital twin impacts on industry 4.0.- Industry 4.0. Data Analytics - Data driven and model driven approaches-Types - descriptive analytics, diagnostics analytics, maintenance predictive analytics, prescriptive analytics- Data-Driven Decision making- Data quality- Data augmentation- Information logistics- Data driven challenges.

UNIT III AI AND SOFTWARE ENGINEERING 9

Fundamentals in AI – Decision Making- Decision Support Systems- Business Intelligence- Database and Knowledge Base in Decision Support Systems- Inference Mechanisms in AI- Knowledge Interpretation- Data, Information Knowledge and Wisdom- AI and Software Engineering- Systems thinking and Systems Engineering- Software Engineering – Overview- System Software- Evolution-

Paradigm- Architecture Models- Software Systems and Software Engineering Processes, Component based software engineering- Software maintenance overview- Applications of AI in classical software engineering

UNIT IV DATA STORAGE AND COMPUTING MODELS 9

Distributed Computing, Cloud Computing, Fog and Edge Computing, Data Storage and Information Management, Data Fusion and Integration, Data Quality, Communication, Cognitive Computing, Distributed Ledger, Information Security, Cybersecurity, Block chain Security.

UNIT V CASE STUDIES 9

AI factory for Railway- AI Factory, Mining, Augmented Reality and Virtual Reality, Cybersecurity, AI Transformation Roadmap, AI in Healthcare, Education, Banking, Retail and E-commerce, Gaming and Entertainment, Chatbots. Case Study on AI-enabled DART Factories.

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the concepts, principles, and applications of industrial AI in various domains.
CO2: To analyze and apply digital twin technology for smart manufacturing and other industry specific applications.
CO3: Analyze and discuss the impacts and challenges of AI in industry 4.0 and other specific domains.
CO4: To exploit AI algorithms and methodologies in software engineering projects.
CO5: Design and implement various computing models, data storage and management systems and their implications for distributed systems.
CO6: To evaluate and analyze real-world case studies to understand the practical implementation of AI in different industries.

Suggested Activities

1. Case study analysis on Industrial AI applications and smart factories.
2. Mini project on AI-based industrial monitoring or decision support systems.
3. Seminar presentation on emerging Industry 4.0 technologies such as DART factories, AGVs, autonomous systems, and unmanned vehicles.

Text Books:

1. AI Factory Theories, Applications and case Studies, Ramin Karim, Diego Galar and Uday Kumar, CRC Press, 2023

References:

1. Artificial Intelligence and Industry 4.0, Ella Hassanien, Jyotir Moy Chatterjee and Vishal Jain, Academic press, 2022, Taylor and Francis, CRC Press.
2. Artificial Intelligence in Industrial Applications, Stevan Lawrence Fernandes Tarun K. Sharma, Springer, 2022.

3. Artificial Intelligence and the Fourth Industrial Revolution, Utpal Chakraborty, Amit banerjee, Jayanta Kumar Saha, Niloy Sarkar, Chinmay Chakraborty, 2022

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	3	-
CO2	2	3	2	2	3	-	-	-	-	-	-	-	2	-
CO3	2	3	-	2	2	-	-	-	-	-	-	-	3	-
CO4	2	3	3	2	3	-	-	-	-	-	-	-	2	-
CO5	3	3	2	2	3	-	-	-	-	-	-	-	2	-
CO6	2	3	2	3	2	-	-	-	-	-	-	-	2	-
Avg.	2	3	2	2	2	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	PEC	L	T	P	C
PCS2404	Healthcare Analytics		2	0	2	3

Course Objectives:

- To impart the fundamental concepts of healthcare data analytics.
- To provide knowledge about healthcare data sources and their management.
- To familiarize students with advanced data analytics for healthcare.
- To introduce the principles of IoT-based healthcare data analytics.
- To develop the ability to apply analytics in practical healthcare systems.
- To equip students with hands-on skills in healthcare data analysis and visualization tools.

UNIT I INTRODUCTION 6

Introduction to Healthcare Data Analytics – Healthcare Data Sources and Basic Analytics – Electronic Health Records (EHR): Components, Standards, and Coding Systems – Biomedical Image Analysis: Imaging Modalities, Object Detection, Image Segmentation, Image Registration, Feature Extraction – Sensor Data Mining in Medical Informatics: Scope, Challenges, and Applications.

UNIT II HEALTHCARE DATA SOURCES 6

Biomedical Signal Analysis: Types of Biomedical Signals – ECG Signal Analysis – Denoising of Signals – Multivariate Biomedical Signal Analysis – Cross-Correlation Analysis – Connectivity Analysis – Genomic Data for Personalized Medicine: Data Generation Methods, Standards, and Computational Genomics Studies.

UNIT III ADVANCED DATA ANALYTICS FOR HEALTHCARE 6

Statistical Prediction Models – Clinical Prediction and Survival Models: Evaluation and Validation – Temporal Data Mining for Healthcare: Association and Pattern Mining – Sensor Data Analytics – Temporal Modeling Methods – Visual Analytics for Healthcare: Medical Data Visualization and Visual Analytics Applications.

UNIT IV HEALTH IOT DATA ANALYTICS 6

Internet of Things (IoT) in Healthcare – IoT Healthcare Architecture – Characteristics of IoT Health Data – Data Analytics using IoT – Computational Intelligence and Machine Learning in IoT for Healthcare Applications – Challenges and Future Scope.

UNIT V APPLICATIONS AND PRACTICAL SYSTEMS FOR HEALTHCARE 6

Data Analytics for Pervasive Health: Supporting Infrastructure and Technologies – Basic and Advanced Analytic Techniques – Applications in Healthcare – Fraud Detection in Healthcare – Data Analytics for Pharmaceutical Discoveries – Clinical Decision Support Systems.

Periods: 30

LIST OF EXPERIMENTS:

1. Exploring Healthcare Datasets – Loading and Cleaning EHR Data.
2. Preprocessing and Normalizing Biomedical Signal Data (e.g., ECG).
3. Image Preprocessing and Segmentation in Biomedical Imaging.
4. Exploratory Data Analysis (EDA) on Genomic Data.
5. Predictive Modeling for Patient Readmission using Statistical Methods.
6. IoT Health Sensor Data Acquisition and Analysis.
7. Machine Learning Model for Disease Prediction (Classification).
8. Visual Analytics of Healthcare Data using Python/R.
9. Designing a Healthcare Dashboard using Tableau or Power BI.
10. Mini Project: Case Study on Real Healthcare Dataset Integration and Insights.

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Describe the basics of healthcare data analytics.
CO2: Explain the major sources of healthcare data.
CO3: Apply advanced data analytics techniques for healthcare data.
CO4: Implement IoT-based analytics models in healthcare contexts.
CO5: Develop and evaluate practical data-driven systems for healthcare applications.
CO6: Demonstrate visualization and predictive analysis using healthcare datasets.

Suggested Activities:

- Hands-on
- Mini Project
- Case Study
- Implementation Demo

Text Books:

1. Chandan K. Reddy and Charu C. Aggarwal, Healthcare Data Analytics, 1st Edition, CRC Press, 2020.
2. Sanjay Kumar Singh et al., IoT-Based Data Analytics for the Healthcare Industry: Techniques and Applications, Elsevier, Academic Press, 2020.
3. Nilanjan Dey et al., Healthcare Data Analytics and Management, 1st Edition, Elsevier, Academic Press, 2018.

References:

1. Prasant Kumar Pattnaik, Suneeta Mohanty, Satarupa Mohanty, Smart Healthcare Analytics in IoT Enabled Environment, Springer, 2020.
2. Sanket Shah, Healthcare Analytics: A Comprehensive Guide, Kindle Edition, 2020.
3. Amira Ashour & Simon Fong, Medical Data Analytics for Healthcare Applications, Springer, 2019.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	0	1	2	0	0	1	0	2	2	1	2
CO2	3	2	1	0	1	2	1	0	1	0	2	2	1	2
CO3	2	3	2	3	3	1	1	0	1	0	3	2	2	3
CO4	2	2	3	3	3	2	1	0	1	0	2	2	3	3
CO5	2	2	3	3	3	2	2	2	2	2	3	3	3	3
CO6	2	3	1	3	3	1	1	0	2	0	2	3	2	3
Avg.	2.3	2.3	1.8	2.0	2.3	1.7	1.0	0.3	1.3	0.3	2.3	2.3	2.0	2.7

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

Course Code	Course Name	PEC	L	T	P	C
PCS2405	Business Analytics		2	0	2	3

Course Objectives:

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

UNIT I INTRODUCTION TO BUSINESS ANALYTICS 6

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

UNIT II BUSINESS INTELLIGENCE 6

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

UNIT III BUSINESS FORECASTING 6

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

UNIT IV HR & SUPPLY CHAIN ANALYTICS 6

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain - Applying HR Analytics to make a prediction of the demand for hourly employees for a year

UNIT V MARKETING & SALES ANALYTICS 6

Marketing Strategy, Marketing Mix, Customer Behaviour – Selling Process – Sales Planning – Analytics applications in Marketing and Sales - Predictive analytics for customers' behaviour in marketing and sales.

Periods: 30

LIST OF EXPERIMENTS:

Use MS-Excel and Power-BI to perform the following experiments using a Business data set, and make presentations.
Students may be encouraged to bring their own real-time socially relevant data set.

I Cycle – MS Excel

1. Explore the features of Ms-Excel.
2. i. Get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND)
   ii. Perform data import/export operations for different file formats.
3. Perform statistical operations - Mean, Median, Mode and Standard deviation, Variance,
4. Skewness, Kurtosis
5. Perform Z-test, T-test & ANOVA
6. Perform data pre-processing operations i) Handling Missing data ii) Normalization
7. Perform dimensionality reduction operation using PCA, KPCA & SVD
8. Perform bivariate and multivariate analysis on the dataset.
9. Apply and explore various plotting functions on the data set.

II Cycle – Power BI Desktop

1. Explore the features of Power BI Desktop
2. Prepare & Load data
3. Develop the data model
4. Perform DAX calculations
5. Design a report
6. Create a dashboard and perform data analysis
7. Presentation of a case study

Periods: 30

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Explain the real-world business problems and model with analytical solutions.
CO2: Identify the business processes for extracting Business Intelligence
CO3: Apply predictive analytics for business fore-casting
CO4: Apply analytics for supply chain and logistics management
CO5: Use analytics for marketing and sales.
CO6: Use MS Excel and Power BI to analyze business data and present insights effectively.

Suggested Activities:

- Data Exploration & Visualization
- Case Studies
- Mini-Projects
- Industry Dataset Analysis
- SQL for Business Data Handling
- Customer & Market Analytics Activities

Text Books:

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.

References:

1. Decision Support and Business Intelligence Systems, 11th Edition, Pearson Education.
2. Business Analytics: Methods, Models, and Decisions, 3rd Edition, Pearson Education.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	-	1	2	1	3	2	1
CO2	3	3	3	2	3	-	-	-	1	2	2	3	1	2
CO3	2	2	3	3	2	-	-	-	3	1	3	3	1	2
CO4	2	1	1	2	2	-	-	-	3	3	2	1	3	1
CO5	2	3	2	3	2	-	-	-	3	3	3	3	1	1
CO6	2	2	2	3	3	-	-	-	2	3	3	3	3	2
Avg.	2.2	2.2	2.3	2.3	2.2	-	-	-	2.2	2.3	2.3	2.7	1.8	1.5

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

Course Code	Course Name	Category	L	T	P	C
PAD2413	AI IN ROBOTICS	PEC	3	0	0	3

Course Objectives:

- To acquire essential skills in using Robot anatomy for various operations.
- To develop the ability to make use of sensors, actuators, and kinematics of Robots.
- To learn concepts of probabilistic reasoning and temporal models.
- To learn the methods of various planning strategy and algorithms.
- To understand the role of Artificial intelligence in Robotics.

UNIT I INTRODUCTION 9

Historical Perspective of Robots – Classification by Co-ordinate system - Major Components of a Robot – Links and Joints - Translational and Rotational Transformations – Co-ordinate reference Framer – Homogeneous Transformations – Forward solution – Inverse solution.

UNIT II SENSORS AND ACTUATORS 9

Robot Grippers – Mechanical, Vacuum, Magnetic Grippers – Drives, Robot Sensors– Internal and External Sensors – Non Optical and Optical position sensors – Encoders – Velocity, Acceleration, force, Torque, Proximity touch and slip sensors. Robot Vision - Control of Actuators in Robots – Closed Loop control – effect of friction and gravity – Robot Joint Control – Adaptive control stepper Motors – Brushless DC Motors – Direct drive actuators, Hydraulic and pneumatic and Actuators – Servo Amplifiers

UNIT III UNCERTAIN KNOWLEDGE AND REASONING 9

Uncertainty – Review of Probability - Probabilistic Reasoning – Filtering and Prediction - Bayesian Networks – Inference in Bayesian Networks – Temporal Models – Hidden Markov Models – Kalman Filters.

UNIT IV PLANNING 9

Planning with Forward and Backward State Space Search – Partial Order Planning – Total Order Planning - Planning Graphs – Planning with Propositional Logic – Planning and acting in Real World – Path Planning Algorithms – A* - D* - RRT – RRT*.

UNIT V AI IN ROBOTICS 9

Introduction to Genetic algorithm - Artificial Neural Network (ANN) - Robotic assembly sequence planning - Generation using AND/OR Graph and GA, Robotic Perception – Localization – Mapping - Configuring Space - Application of ANN in industrial and mobile robots.

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Analyze using Translational Transformation
CO2: Identify appropriate AI planning methods and algorithms to design a robot.
CO3: Implement AI algorithms for uncertainty and reasoning.
CO4: Integrate sensors and actuators in Robot system.
CO5: Apply AI techniques such as Genetic Algorithms and Artificial Neural Networks for solving robotic perception and task planning problems.
CO6: Apply appropriate AI methods to design a robot.

Suggested Activities

1. Implement path planning and navigation algorithms such as A*, D*, or RRT for autonomous robot movement in simulated environments.
2. Analyze real-world applications of AI-enabled robots in industries such as healthcare, manufacturing, autonomous vehicles, and smart factories through presentations and case studies.
3. Hands-on experiments using robotic sensors, grippers, stepper motors, and servo motors to understand robot perception and control.

Text Books:

1. Murphy, Robin R, “Introduction to AI Robotics”, MIT Press, Second Edition, 2019.
2. Russell, S.J. and Norvig, P., “Artificial intelligence – A modern approach”, Prentice Hall, 2016.

References:

1. Sebastian Thrun, Wolfram Burgard, & Dieter Fox, “Probabilistic Robotics” MIT Press. 2005.
2. K.S.FU, R.C. Gonzalez, and C.S.G.Lee., “Robotics control, Sensing, Vision, and Intelligence”, Prentice Hall, 1987.
3. G.Bekey, “Autonomous Robots”, MIT Press, 2005.
4. J.J.Craig, “Introduction to Robotics”, Addision Wesley Publishers, 2018.
5. Subir Kumar Saha, “Introduction to Robotics”, Tata McGraw-Hill Education, 2nd edition, 2007. Deepak Khemani , “A First Course in Artificial Intelligence”, McGraw-Hill Education, 2013.

Extensive Reading:

• http://www.galileo.org/robotics/
• http://www.learnaboutrobots.com/
• http://www.roboanalyzer.com/
• http://timobrien.tech/projects/mars-rover/
• http://blueye.co.kr/skin/page/farmdrone.html

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-	2	-
CO3	2	3	-	3	2	-	-	-	-	-	-	-	2	-
CO4	2	3	3	2	3	-	-	-	-	-	-	-	2	-
CO5	3	3	2	2	3	-	-	-	-	-	-	-	2	-
CO6	3	3	2	3	2	-	-	-	-	-	-	-	2	-
Avg.	3	3	2	2	2	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
PAD2414	Business Intelligence for FinTech	PEC	2	0	2	3

Course Objectives:

- To understand the evolution of FinTech and the "ABCD" (AI, Blockchain, Cloud, Data) framework.
- To study the transition from traditional data systems to data-driven digital transformation
- To analyze Business Intelligence frameworks in financial services
- To explore regulatory technologies and data-driven compliance systems
- To apply analytics techniques for financial decision-making

UNIT I Digital Transformation & FinTech Evolution 6

Evolution of FinTech: Post-Crisis Paradigm – Digitisation vs. Data-driven transformation – The FinTech 4.0 Era: TechFins and BigTechs in finance – Drivers of Change: Efficiency, Financial Inclusion, and Sustainability – Infrastructure for Digital Transformation: Digital Identity and Payment Systems.

UNIT II Business Intelligence and Data Management in Finance 6

Business Intelligence concepts and architecture – Data sources in financial services – ETL (Extract, Transform, Load) processes – Data warehousing and data marts – OLAP operations (drill-down, roll-up, slice, dice) – Data governance and data quality – Cloud-based BI and Data Lakes.

UNIT III Financial Analytics and Data-driven Decision Making 6

Financial analytics: Descriptive, predictive and prescriptive analytics – Case Study: Kreditech's self-learning algorithm – Customer Knowledge Management (CKM) and Customer Lifetime Value (CLV) – Credit analytics fundamentals – Use of alternative data in credit scoring – Case study: AI-based credit scoring models – Process Innovation through Big Data analytics.

UNIT IV RegTech, SupTech & Intelligent Financial Systems 6

Evolution of financial regulation – Risk-based and data-driven regulation – RegTech for monitoring, compliance, and reporting – SupTech for supervisory analytics and visualization – Fraud detection and anomaly detection techniques – AI-driven financial decision systems and Explainable AI (XAI).

UNIT V Future of FinTech: Platforms, AI and Digital Currencies 6

Platform-based financial services: Players, Platforms, Partners, Public – Neo Banking and digital banking ecosystems – Blockchain and Distributed Ledger Technology (DLT) – Embedded finance and API economy – Central Bank Digital Currencies (CBDCs) and Stablecoins – Generative AI in finance – Ethical issues, data privacy and cybersecurity – ESG analytics in finance.

Periods: 30 hours

List of Experiments:

1. Map the FinTech ecosystem for a specific region using BI visualization.
2. Design a "V4 Framework" for a fictional InsurTech initiative.
3. Simulate a credit scoring model using alternative data points (Telco/E-commerce).
4. Develop a dashboard visualizing "Customer Knowledge Management" metrics (CLV, CKM).
5. Implement a RegTech reporting automation script for AML/KYC.
6. Build a predictive model for transaction anomaly detection.
7. Analyze a Blockchain-based payment flow (Stablecoin/CBDC).
8. Mini Project: Develop a "Platform Strategy" BI solution for a traditional bank's transition.

Periods: 30
Total Periods: 60

Suggested Activities:

1. Debate: "BigTech in Finance: Systemic Risk vs. Market Innovation".
2. Case Study: Analysis of Europe's transition to data-driven finance (Open Banking/GDPR).
3. Concept Map: The interaction between AI, Blockchain, and Financial Regulation.
4. Case Study: AI applications in credit scoring, loan analysis, and financial risk assessment using fintech platforms

Course Outcomes:

On completion of the course, the students will be able to

CO1: Explain the evolution of FinTech and digital financial systems
CO2: Apply Business Intelligence and data management techniques in finance services
CO3: Analyze financial data using analytics and visualization methods
CO4: Evaluate regulatory technologies (RegTech/SupTech) and AI-driven financial systems
CO5: Assess emerging trends, risks, and ethical issues in FinTech ecosystems
CO6: Design and develop BI-based solutions (dashboards/models) for real-time financial decision-making

Text Books:

1. Ross P. Buckley, Douglas W. Arner, and Dirk A. Zetzsche, *FinTech: Finance, Technology and Regulation*, Cambridge University Press, 2024.
2. Bernardo Nicoletti, *The Future of FinTech: Integrating Finance and Technology in Financial Services*, Palgrave Macmillan, 2017.
3. Ramesh Sharda et al., *Business Intelligence, Analytics, and Data Science: A Managerial Perspective*, Pearson.

References:

1. Douglas W. Arner et al., "The Evolution of FinTech: A New Post-Crisis Paradigm?", *Georgetown Journal of International Law*, 2016.
2. Institute of International Finance (IIF), *RegTech in Financial Services: Technology Solutions for Compliance and Reporting*.
3. "Business Intelligence Guidebook: From Data Integration to Analytics" by *Rick Sherman*.
4. Recent IEEE / Springer research articles on FinTech analytics

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	2	-	-	-	-	-	-	-	-
CO2	2	3	2	2	3	-	-	-	-	-	-	-	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	-
CO4	2	3	-	2	3	3	-	-	-	-	-	-	2	-
CO5	2	3	2	2	3	2	-	-	-	-	-	-	2	-
CO6	2	3	2	3	2	2	-	-	-	-	-	-	2	-
Avg.	2	3	2	2	2	2	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
PAD2415	Social Media Analytics	PEC	2	0	2	3

Course Objectives:

- To introduce the fundamentals of social media analytics and its importance in today's digital landscape.
- To understand essential network concepts and analytical techniques used in social media analysis.
- To apply techniques such as text and link analytics on social media data.
- To analyze the influence of social media actions on user engagement.
- To explore the use of web analytics tools for campaign evaluation and performance measurement.

UNIT I INTRODUCTION TO SOCIAL MEDIA ANALYTICS 6

Introduction: Social media landscape, Need for SMA; Types of SMA; SMA Cycle, Tools, Application of SMA in different areas like marketing, health, and politics, Challenges to Social Media Analytics

UNIT II SOCIAL MEDIA NETWORK ANALYTICS 6

Basic Concept: Network definitions, centrality measures: Degree Centrality, Eigenvector Centrality, Katz Centrality, PageRank, Betweenness Centrality, Closeness Centrality, Group Centrality, Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence Applications: Types of Network, Network Terminologies, Tools for Network Analytic, Detection communities, identification of key influencers, and their roles in network dynamics.

UNIT III SOCIAL MEDIA LINK AND TEXT ANALYTICS 6

Link analysis: Random graphs and network evolution, Link Prediction, Collective Classification, Collecting and analyzing social media data, and clustering techniques Text Analytics: Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text Analysis Tools.

UNIT IV SOCIAL MEDIA ACTIONS AND HYPERLINK ANALYTICS 6

Actions Analytics: Introduction to Actions Analytics, Common Social Media Actions, Actions Analytics Tools. Case Study: Cover-More Group Hyper link Analytics: Types of Hyperlinks, Hyperlink Analytics, Types of Hyper link Analytics, Hyperlink Analytics

UNIT V WEB ANALYTICS TOOLS 6

Web2.0 Analytics: Click stream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis Visualization Techniques: Visualization techniques for social media data, Dashboards, word clouds, network graphs. Web 3.0 Analytics - Semantic web, decentralized applications and smart contracts.

Periods: 30 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the significance and applications of social media analytics.
CO2: Apply network concepts and analytical tools to analyze social media networks.
CO3: Perform link prediction and text analysis to derive insights from social media data.
CO4: Assess the role of social media actions and hyperlinks in enhancing content engagement.
CO5: Apply web analytics to evaluate the effectiveness of campaigns and present insights using advanced visualization techniques.
CO6: Design an end-to-end social media analytics pipeline

Suggested Activities

1. Case study analysis on the role of Social Media Analytics (SMA) in marketing, healthcare, and political campaigns.
2. Mini project on collecting, preprocessing, and analyzing social media text data using basic text analytics techniques.
3. Case study and hands-on exposure using Google Analytics for web analytics and customer lead generation
4. Seminar presentation on emerging trends in Web 3.0 analytics, decentralized applications, and smart contracts in social media platforms.

Practical Exercises

1. Analyze a case study by simulating hypothetical campaign data, applying analytical methods to identify patterns, and evaluating strategies based on key performance metrics.
2. Analyze social media networks using Python to identify influencers, calculate centrality measures, and detect community structures.
3. Apply network metrics using Python or relevant tools to analyze structure, equivalence, and user roles in professional networks.
4. Analyze social media reviews using Python and machine learning libraries or NLP techniques to perform sentiment analysis, extract key phrases, and apply clustering techniques for actionable insights.
5. Predict future connections in a social network using algorithms such as Adamic-Adar or Jaccard similarity, and validate predictions with network evolution data.
6. Analyze engagement data using Python and visualization tools to identify patterns in likes, comments, and shares, and visualize user engagement trends.
7. Analyze video platform data using Python and APIs to identify factors influencing content virality.
8. Collect and analyze social media data using Python and visualization tools to evaluate campaign performance through clickstream and sentiment analysis, and present insights using dashboards.
9. Analyze social media page performance using Python and business intelligence tools by examining reach, engagement, and demographics, and visualize results with time-series and network graphs.
10. Mini Project

Text Books:

1. Dr. Gohar F. Khan, “Creating Value with Social Media Analytics”, Third Edition, May2024
2. Charu C. Aggarwal,“Social Network Data Analytics”, Springer-Verlag NewYork Inc., 2011th edition, 2011.

References:

1. Matthew Ganis, Avinash Kohirkar Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media, IBM Press, 1st edition, 14 December2015.
2. Marshall Sponder, "Social Media Analytics: Effective Tools for Building, Interpreting and Using Metrics", McGrawHill, 1st edition, September 2011.
3. Subhasinin Chellappan, "Big Data and Analytics", Seema Acharya, Wiley Publications, January 2019
4. Melissa S. Barker, DonaldI. Barker, Nicholas F.Bormann, Krista E.Neher, Social Media Marketing: A Strategic Approach, Cengage,1st edition, January 2013.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	2	-	-	-	-	-	-	2	-
CO2	2	3	2	2	3	-	-	-	-	-	-	-	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	-
CO4	2	3	-	2	3	3	-	-	-	-	-	-	2	-
CO5	2	3	2	2	3	2	-	-	-	-	-	-	2	-
CO6	2	3	2	3	2	2	-	-	-	-	-	-	2	-
Avg.	2	3	2	2	2	2	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
PAD2416	AI IN AUTONOMOUS VEHICLES	PEC	3	0	0	3

Course Objectives:

- To Understand Autonomous Driving Basics.
- To Study the role of control in autonomous systems
- Understand map databases, path planning techniques, and vehicle communication technologies for practical autonomous vehicle applications.
- Learn about the use of deep learning in autonomous driving for perception, prediction, routing and reinforcement learning-based control.
- Explore AI algorithms, data management, cognitive decision-making, and the impact of autonomous vehicle technologies on industry and society.

UNIT I INTRODUCTION TO AUTONOMOUS GROUND VEHICLES 9

Introduction to Autonomous Driving -Autonomous Driving Algorithms, Autonomous Driving Client System, Autonomous Driving Cloud Platform - Autonomous Vehicle Localization - Localization with GNSS, Localization with LiDAR and High-Definition Maps, Visual Odometry, Dead Reckoning and Wheel Odometry, Sensor Fusion - Perception in Autonomous Driving -Detection, Segmentation, Stereo, Optical and Scene Flow

UNIT II CONTROL IN AUTONOMOUS SYSTEMS 9

Role of Control in Autonomous Systems - Feedback, Autonomous Control - System Architecture and Hybrid System Modeling - System Architecture, Hybrid System Formulation, State Machines for Different Challenge Events - Sensors and Estimation - Vehicle Internal State Sensing, External World Sensing, Estimation, Situational Awareness

UNIT III PATH PLANNING AND APPLICATIONS 9

Maps and Path Planning - Map Databases - Raster, Vector and Utilizing Map Data - Path Planning - Vehicle to Vehicle and Vehicle to Infrastructure Communication - V2V Communications, V2I Communications, Communication Technologies, 802.11p/WAVE DSRC Architecture, Applications in Autonomous, Vehicles - Examples of Autonomy - Cruise Control, Antilock-Brake Systems, Steering Control and Lane Following, Parking

UNIT IV DEEP LEARNING IN AUTONOMOUS DRIVING 9

Deep Learning in Autonomous Driving Perception - Convolutional Neural Networks, Semantic Segmentation - Prediction and Routing - Planning and Control, Traffic Prediction, Lane Level Routing - Decision, Planning, and Control - Behavioral Decisions, Motion Planning, Feedback Control, Bicycle Model, PID Control - Reinforcement Learning-Based Planning and Control - Reinforcement Learning, Learning-Based Planning and Control in Autonomous Driving

UNIT V AI AND SOFTWARE ENABLERS FOR AUTONOMOUS GROUNDED VEHICLES 9

Human-like reasoning - Hybrid , configurable AI algorithms - Data management environment for analyzing AI Algorithms - Dynamic Selection - Dynamic Integration - Cognitive decision making for Autonomous Driving - Autonomous Support - Automation and Autonomy - Advantages of AV Technologies - Adoptions scenarios for AVs -Industry 4.0 AVs - Major Pillars in the evolution of AVs - Spillovers and Impact of AVs

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: To identify the fundamental concepts and algorithms used in autonomous ground vehicles.
CO2: To Comprehend and explain the principles of deep learning in autonomous driving.
CO3: Apply AI and software enablers in the context of autonomous ground vehicles and analyze the impact of autonomous vehicles in industry.
CO4: Evaluate the challenges and considerations related to control in autonomous systems.
CO5: Design and develop path planning algorithms and applications for autonomous vehicles and implement autonomy features.
CO6: Assess the security vulnerabilities and risks associated with autonomous ground vehicle systems, including potential cyber-attacks, sensor spoofing, and system vulnerabilities.

Suggested Activities

1. Case Study on Multi-Agent Cooperative Localization and Dynamic Mapping using Scouting Vehicles

2. Develop a simple CNN-based model for object detection, lane detection, or semantic segmentation using autonomous driving image datasets
3. Case Study on Autonomous Vehicle Technologies Such as Tesla Autopilot, Waymo, or Industry 4.0 AV applications focusing on perception, planning, and safety mechanisms.

Text Books:

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, "Creating Autonomous Vehicle Systems", Morgan & Claypool, 2018.
2. Autonomous Vehicles Technologies, Regulations, and Societal Impacts George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos · 2021

References:

1. Umit Ozguner, Tankut Acarman, Keith Redmill, "Autonomous Ground Vehicles", Artech House, 2011.
2. George A. Berkey, Autonomous Robots: From Biological Inspiration to Implementation and Control (Intelligent Robotics and Autonomous Agents series) , MIT Press, 2005
3. Hong Cheng, "Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation", Springer, 2011. 6. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, "Global Navigation Satellite Systems, Inertial Navigation, and Integration", Third Edition, John Wiley & Sons, 2013.
4. Ian Goodfellow, Yoshua Bengio and Aaron courville, Deep Learning, MIT Press, 2016
5. Karl Johan Astrom, Richard M. Muray, Feedback System: An Introduction for scientist and Engineers, Princeton University Press, 2021

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	2	-	-
CO3	2	3	-	3	2	-	-	-	-	-	-	2	-	-
CO4	2	3	3	2	3	-	-	-	-	-	-	2	-	-
CO5	3	3	2	2	3	-	-	-	-	-	-	2	-	-
CO6	3	3	2	3	2	-	-	-	-	-	-	2	-	-
Avg.	3	3	2	2	2	-	-	-	-	-	-	2	-	-

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

Course Code	Course Name	Category	L	T	P	C
PCS2447	Ethics and AI	PEC	2	0	2	3

Course Objectives:

- Study the morality and ethics in AI
- Learn ae Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and ethics – challenges and opportunities

UNIT I INTRODUCTION 6

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.

UNIT II ETHICAL INITIATIVES IN AI 6

International ethical initiatives—ethical harms and concerns—case study: healthcare robots, autonomous vehicles, warfare, and weaponization.

UNIT III AI STANDARDS AND REGULATION 6

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 IMPLICATIONS OF ROBOTICS 6

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

UNIT V AI AND ETHICS – CHALLENGES AND OPPORTUNITIES 6

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 Periods: 30

PRACTICAL EXERCISES:

1. Recent case study of ethical initiatives in healthcare, autonomous vehicles, and defense.
2. Exploratory data analysis on a 2-variable linear regression model
3. Experiment with the regression model without a bias and with bias
4. Classification of a dataset from the UCI repository using a perceptron with and without bias
5. Case study on ontology where ethics is at stake
6. Identification of optimisation in AI affecting ethics

Total Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Learn about morality and ethics in AI

CO2: Acquire the knowledge of real time application ethics, issues and its challenges.
CO3: Understand the ethical harms and ethical initiatives in AI
CO4: Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
CO5: Understand the concepts of Roboethics and Morality with professional responsibilities.
CO6: Learn about the societal issues in AI with National and International Strategies on AI

Suggested Activities

- Hands-on demonstration on tools like Nmap, Wireshark, Metasploit, and Snort.
- Basic ethical hacking challenges could be conducted on Password cracking, SQL injection simulation, and Network scanning tasks
- Presentation of case studies on cybercrime laws and legal actions in India.
- Poster / Infographic Presentation on Topics like Cyber hygiene, Social engineering awareness, OWASP Top 10 vulnerabilities

TEXT BOOKS:

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield," The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service, Scientific Foresight Unit (STOA), PE 634.452 – March 2020
2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.

REFERENCES:

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017.
2. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020

WEB LINK:

1. https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65
2. https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/
3. https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/
4. https://sci-hub.mksa.top/10.1159/000492428

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	3	1	-	-	1	2	1	1	3	1	1
CO2	2	1	1	2	1	-	-	1	2	1	1	3	3	1

CO 3	2	3	1	1	3	-	-	2	1	1	2	3	2	2
CO 4	3	1	3	3	2	-	-	2	2	3	1	2	1	3
CO 5	3	1	1	3	3	-	-	2	3	3	3	1	3	3
CO 6	3	1	1	3	3	-	-	2	3	3	3	1	3	3
Avg .	2.7	1.5	1.7	2.5	2.2	-	-	1.7	2.2	2.0	1.8	2.4	2	2

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

Course Code	Course Name	Category	L	T	P	C
PCS2417	**Data Warehousing and Data Mining Techniques**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand the fundamental concepts of data warehousing and data mining.
- To learn data preprocessing and integration techniques for analytical modeling.
- To explore association rule mining and pattern discovery methods.
- To study classification and clustering algorithms for predictive analysis.
- To understand implementation using modern data analytics and visualization tools.
- To analyze real-world case studies applying mining techniques for decision support systems.

UNIT I INTRODUCTION TO DATA WAREHOUSING AND DATA MINING 6

Data Warehouse – Evolution, Components, and Architecture – Data Mart – OLAP and OLTP systems – ETL Process – Data Cube and Multidimensional Models – Data Warehouse Design – Star and Snowflake Schemas – Introduction to Data Mining – Knowledge Discovery Process – Data Objects and Attributes – Types of Data – Data Mining Functionalities.

UNIT II DATA PREPROCESSING AND INTEGRATION 6

Data Cleaning, Integration, and Transformation – Handling Missing and Noisy Data – Data Reduction: Attribute and Instance Reduction – Data Discretization and Concept Hierarchy Generation – Data Integration using SQL and Python – Feature Engineering for Machine Learning Models.

UNIT III ASSOCIATION AND PATTERN DISCOVERY 6

Basic Concepts of Association Rule Mining – Market Basket Analysis – Apriori Algorithm – FP-Growth Algorithm – Mining Multi-level and Multidimensional Association Rules – Constraint-based Association Mining – Correlation Analysis – Sequential Pattern Mining – Evaluation of Discovered Patterns.

UNIT IV CLASSIFICATION AND CLUSTERING 6

Classification: Decision Tree Induction – Bayesian Classification – k-Nearest Neighbor – Support Vector Machines – Ensemble Methods (Random Forest, Gradient Boosting) – Model Evaluation Metrics – Clustering: K-Means, Hierarchical Clustering, DBSCAN – Cluster Validity and Interpretation – Applications in AI, Healthcare, and Business.

UNIT V APPLICATIONS AND MODERN DATA MINING TOOLS 6

Applications of Data Mining: Web Mining, Text Mining, and Social Media Mining – Data Mining in E-commerce and Business Analytics – Integration with Big Data Frameworks (Hadoop, Spark

MLlib) – Data Visualization for Mining Results – Case Studies using Python, Tableau, and Power BI – Ethics and Privacy in Data Mining.

Periods: 30

LIST OF EXPERIMENTS:

1. Perform data preprocessing including cleaning, integration, transformation, and normalization using Python (Pandas, NumPy).
2. Design and implement a data warehouse schema (Star and Snowflake) using SQL with dimension and fact tables.
3. Execute OLAP operations – roll-up, drill-down, slice, dice, and pivot – using SQL or BI tools.
4. Implement Apriori algorithm for association rule mining using Python or Weka.
5. Perform FP-Growth algorithm for frequent pattern mining and compare performance with Apriori.
6. Apply Decision Tree classification on a dataset and evaluate accuracy metrics.
7. Implement Naïve Bayes and k-Nearest Neighbour classifiers for predictive analytics.
8. Conduct Clustering analysis using K-Means and DBSCAN algorithms with visualization.
9. Perform Text or Web Mining using TF-IDF, tokenization, and generate visual insights.
10. Create an interactive dashboard or visualization report using Tableau, Power BI, or Python (Matplotlib/Seaborn).

Periods: 30

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Describe data warehousing architecture, design, and implementation principles.
CO2: Apply preprocessing and integration techniques for preparing analytical datasets.
CO3: Use association and pattern discovery techniques to uncover hidden insights.
CO4: Implement supervised and unsupervised learning methods for classification and clustering.
CO5: Apply mining techniques using modern tools like Python, SQL, and visualization platforms.
CO6: Analyze and evaluate real-world business and AI applications using data mining models.

Suggested Activities:

- Hands-on / In-class Activities
- Mini Project
- Case Studies

Text Books:

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, 4th Edition, Morgan Kaufmann, 2022.
2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education, 2019.

References:

1. Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining and OLAP, Tata McGraw Hill, 2017.
2. G. K. Gupta, Introduction to Data Mining with Case Studies, PHI Learning, 2018.
3. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2016.
4. Charu C. Aggarwal, Data Mining: The Textbook, Springer, 2015.

5. Benjamin Bengfort, Rebecca Bilbro, Applied Text Analysis with Python, O'Reilly, 2021.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	-	-	-	2	1	-
CO2	2	3	3	3	2	-	-	-	-	-	-	2	2	-
CO3	3	3	3	3	2	-	-	-	-	-	-	3	2	-
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	-
CO5	3	3	3	3	3	-	-	-	-	3	-	3	3	-
CO6	3	3	3	2	3	-	-	-	-	3	-	3	3	-
Avg.	2.8	2.8	2.8	2.7	2.5	-	-	-	-	3	-	2.7	2.3	-

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

Course Code	Course Name	Category	L	T	P	C
PCS2418	Virtualization	PEC	2	0	2	3

Course Objectives:

- To Learn the basics and types of Virtualization
- To understand the Hypervisors and its types
- To Explore the Virtualization Solutions
- To Experiment the virtualization platforms

UNIT I INTRODUCTION TO VIRTUALIZATION 7

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisors.

UNIT II SERVER AND DESKTOP VIRTUALIZATION 6

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization

UNIT III NETWORK VIRTUALIZATION 6

Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization-VLAN-WAN Architecture-WAN Virtualization.

UNIT IV STORAGE VIRTUALIZATION 5

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID

UNIT V VIRTUALIZATION TOOLS 6

VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.

Periods: 30

LIST OF EXPERIMENTS:

1. Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on that VMWARE.
2. a. Shrink and extend virtual disk
   b. Create, Manage, Configure and schedule snapshots
   c. Create Spanned, Mirrored and Striped volume
   d. Create RAID 5 volume
3. a.Desktop Virtualization using VNC
   b.Desktop Virtualization using Chrome Remote Desktop
4. Create type 2 virtualization on ESXI 6.5 server
5. Create a VLAN in CISCO packet tracer
6. Install KVM in Linux
7. Create Nested Virtual Machine(VM under another VM)

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the fundamental concepts of virtualization and its significance in modern computing environments.
CO2: Analyze various types of virtualization and hypervisors to identify their features and applications.
CO3: Apply virtualization techniques to implement real-world computing solutions.
CO4: Install and configure different virtual machine platforms for server and desktop environments.
CO5: Experiment with virtual machines by deploying and managing software applications on them.
CO6: Evaluate and compare different virtualization tools and platforms for optimized resource utilization.

Suggested Activities:

- Mini Project
- Case Studies
- Simulation

Text Books:

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach

4. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.
5. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.

References:

1. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	2	-	2	3	2	1
CO2	3	3	2	2	-	-	-	-	2	-	2	3	2	2
CO3	2	3	3	2	2	-	-	1	2	-	2	3	3	2
CO4	2	2	3	2	3	-	-	1	2	-	2	3	3	2
CO5	2	2	3	3	3	-	-	2	2	-	2	3	3	2
CO6	3	3	3	2	2	-	-	1	3	-	3	3	3	2
Avg.	2.5	2.5	2.5	2.2	2.5	-	-	1.3	2.2	-	2.2	3.0	2.7	1.8

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

Course Code	Course Name	Category	L	T	P	C
PCS2419	Cloud Services Management	PEC	2	0	2	3

Course Objectives:

- Introduce Cloud Service Management terminology, definition & concepts
- Compare and contrast cloud service management with traditional IT service management
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment
- Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

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 CLOUD SERVICES STRATEGY 6

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

UNIT III CLOUD SERVICE MANAGEMENT 6

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity

Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

UNIT IV CLOUD SERVICE ECONOMICS 6

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models

UNIT V CLOUD SERVICE GOVERNANCE & VALUE 6

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership

Periods: 30

LIST OF EXPERIMENTS:

1. Create a Cloud Organization in AWS / Google Cloud / OpenStack / Eucalyptus / OpenNebula with Role-Based Access Control (RBAC)
2. Create a Cost Model for a Web Application using Various Services and Perform Cost-Benefit Analysis
3. Create Alerts for Cloud Resource Utilization
4. Create Billing Alerts for your Cloud Organization
5. Compare Cloud Cost for a Simple Web Application across AWS, Azure, and GCP and Suggest the Best Option
6. Deploy a Scalable Web Application using Auto-Scaling and Load Balancing
7. Implement a Backup and Disaster Recovery Plan for Cloud Resources
8. Design and Implement a Simple Serverless Application using Cloud Functions / Lambda / Cloud Run
9. Monitor and Visualize Cloud Metrics Using Open-Source Tools

Periods: 30

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Construct a basic website using HTMLand Cascading StyleSheets

CO2: Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.

CO3: Develop server-side programs using Servlets and JSP.

CO4: Construct simple webpages in PHP and to represent data in XML format

CO5: Develop interactive web applications.

CO6: Solve the real-world problems using Cloud Services and Technologies.

Suggested Activities:

- Hands-on / In-Class Activities
- Optimization Activity
- Mini Project
- Case Studies

Text Books:

1. **Haque, E., "***Cloud Service Management and Governance: Smart Service Management in Cloud Era",* Enel Publications, London, UK, **2020**

2. **Erl, T., Puttini, R., & Mahmood, Z., "***Cloud Computing: Concepts, Technology & Architecture",* Prentice Hall/Pearson, Upper Saddle River, NJ, **2013**
3. **Erl, T., Cope, R., & Naserpour, A., "***Cloud Computing Design Patterns* – Prentice Hall", Upper Saddle River, NJ, **2015**

References:

1. Ayyappa, P., "Economics of Cloud Computing. Saarbrücken, Germany: LAP Lambert Academic Publishing, 2012.
2. Buyya, R., Vecchiola, C., & Selvi, S. T., "Mastering Cloud Computing: Foundations and Applications Programming", New Delhi, India: McGraw-Hill Education, 2013.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	-	2	-	-	-	-	-	2	3	3	-
CO2	3	2	2	1	2	-	-	-	-	-	2	2	2	-
CO3	2	3	3	-	3	-	-	-	1	-	2	3	3	1
CO4	2	2	2	-	2	-	-	-	-	1	3	2	2	-
CO5	2	2	2	-	3	-	-	-	1	1	2	2	3	-
CO6	3	3	3	2	3	1	1	1	3	2	3	3	3	2
Avg.	2.5	2.3	2.5	1.5	2.5	1.0	1.0	1.0	1.7	1.3	2.3	2.5	2.7	1.5

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

Course Code	Course Name	PEC	L	T	P	C
PCS2420	Security and Privacy in Cloud		2	0	2	3

Course Objectives:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

UNIT I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS 7

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 6

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 6

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 6

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 5

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

Periods: 30

LIST OF EXPERIMENTS:

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim
2. simulate resource management using cloud sim
3. simulate log forensics using cloud sim
4. simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)
6. Implement any encryption algorithm to protect the images
7. Implement any image obfuscation mechanism
8. Implement a role-based access control mechanism in a specific scenario
9. Implement an attribute-based access control mechanism based on a particular scenario
10. Develop a log monitoring system with incident management in the cloud

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the fundamental concepts of cloud security, including confidentiality, integrity, authentication, and access control.
CO2: Analyze security design principles and architectures for securing cloud infrastructure, data, and virtualization environments.

CO3: Apply identity and access management techniques such as RBAC, MFA, and SSO for secure cloud operations.
CO4: Implement and evaluate cloud security design patterns for ensuring secure data communication and cloud resource access.
CO5: Develop and simulate secure mechanisms for data protection, encryption, and intrusion prevention in cloud environments.
CO6: Monitor, audit, and manage cloud security events using proactive incident response and logging techniques.

Suggested Activities:

- Mini Project
- Assignments
- Group Activities
- Hands-on
- Tools Exposure

Text Books:

1. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, "Cloud Computing", Wiley, 2013
2. Dave Shackleford, "Virtualization Security", SYBEX (A Wiley Brand), 2013
3. Mather, Kumaraswamy, Latif, "Cloud Security and Privacy", O'Reilly, 2011

References:

1. Mark C. Chu-Carroll, "Code in the Cloud, CRC Press, 2011
2. RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi, "Mastering Cloud Computing Foundations and Applications Programming", McGraw Hill Education, 2013

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	-	-	-	2	-	2	3	2	2
CO2	3	3	2	2	2	-	-	-	2	-	3	3	3	2
CO3	2	3	3	2	3	-	-	1	2	-	2	3	3	2
CO4	2	3	3	3	3	-	-	1	3	-	3	3	3	3
CO5	3	3	3	3	3	-	-	2	2	-	3	3	3	3
CO6	2	3	2	3	3	2	-	1	3	-	3	3	3	3
Avg.	2.5	2.8	2.3	2.6	2.5	2.0		1.3	2.3		2.7	3.0	2.8	2.5

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

Course Code	Course Name	Category	L	T	P	C
PCS2421	Storage Technologies	PEC	3	0	0	3

Course Objectives:

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies

- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

UNIT I STORAGE SYSTEMS 9

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT II INTELLIGENT STORAGE SYSTEMS AND RAID 5

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale-out storage Architecture.

UNIT III STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION 13

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNIT IV BACKUP, ARCHIVE AND REPLICATION 12

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS)

UNIT V SECURING STORAGE INFRASTRUCTURE 6

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the fundamentals of information storage management, including storage system components, functions, and cloud infrastructure models.
CO2: Demonstrate the use of advanced intelligent storage systems and analyze various RAID levels for performance and reliability.
CO3: Explain different storage networking architectures such as DAS, NAS, and SAN, and evaluate their suitability for specific applications.
CO4: Apply concepts of storage virtualization and data management techniques in enterprise and cloud environments.
CO5: Examine disaster recovery strategies and remote replication technologies for ensuring business continuity.
CO6: Analyze the security challenges in storage systems and implement appropriate data protection and access control measures.

Text Books:

1. J. Tate, P. Beck, H. H. Ibarra, S. Kumaravel, and L. Miklas, "Introduction to Storage Area Networks, 9th ed., IBM Redbooks, 2017.
2. U. Troppens, R. Erkens, W. Mueller-Friedt, R. Wolafka, and N. Haustein, "Storage Networks Explained", 2nd ed., Wiley, 2009.

References:

1. "EMC Education Services, Information Storage and Management: Storing, Managing and Protecting Digital Information in Classic, Virtualized and Cloud Environments", 2nd ed., Wiley, 2012.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	-	2	-	-	-	-	-	2	3	3	-
CO2	3	2	2	1	2	-	-	-	-	-	2	2	2	-
CO3	2	3	3	-	3	-	-	-	1	-	2	3	3	1
CO4	2	2	2	-	2	-	-	-	-	1	3	2	2	-
CO5	2	2	2	-	3	-	-	-	1	1	2	2	3	-
CO6	3	3	3	2	3	1	1	1	3	2	3	3	3	2
Avg.	2.5	2.3	2.5	1.5	2.5	1.0	1.0	1.0	1.7	1.3	2.3	2.5	2.7	1.5

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

Course Code	Course Name	Category	L	T	P	C
PCS2422	Software Defined Networks	PEC	2	0	2	3

Course Objectives:

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

UNIT I SDN: INTRODUCTION 6

Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane, Control plane and Application Plane

UNIT II SDN DATA PLANE AND CONTROL PLANE 6

Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers

UNIT III SDN APPLICATIONS 6

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking

UNIT IV NETWORK FUNCTION VIRTUALIZATION 6

Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture

UNIT V NFV FUNCTIONALITY 6

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV

Periods: 30

LIST OF EXPERIMENTS:

1. Introduction to Mininet Environment. Setup your own virtual SDN lab
   i) Virtualbox/Mininet Environment for SDN - http://mininet.org
   ii) https://www.kathara.org
   iii) GNS3
2. Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc
3. Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.
4. Implement Flow Rules using OpenFlow Controller (Ryu/POX/Floodlight)
5. Design and Deploy a Simple SDN Application (Firewall / Load Balancer)
6. Configure an SDN topology to implement network slicing or tenant isolation using OpenFlow VLAN Support.
7. Deploy a fundamental network function (e.g., a simple Web Proxy or NAT VNF) as a Docker container on a Mininet host.
8. Create a simple end-to-end network service chain with two Virtualized Network Functions (VNFs)
9. Install the open-source MANO (OSM) platform and use its components to onboard and orchestrate a complex network service consisting of multiple VNFs

10. Case Study / Mini Project: Real-Time SDN-Based Traffic Control

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Describe the motivation behind SDN.
CO2: Identify the functions of the data plane and control plane.
CO3: Design and develop network applications using SDN.
CO4: Orchestrate network services using NFV.
CO5: Explain various use cases of SDN and NFV.
CO6: Evaluate SDN–NFV integration for research and emerging networks.

Suggested Activities:

- Hands-On Activities
- Group Discussion
- Case Study
- Mini Project

Text Books:

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015.

References:

1. Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.
2. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
4. Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
5. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	-	-	-	-	1	-	3	2	-
CO2	3	3	2	-	2	-	-	-	-	-	1	2	2	-
CO3	3	3	3	2	3	-	-	-	1	2	2	3	3	2
CO4	2	2	3	1	3	-	-	-	-	1	3	2	3	1
CO5	2	2	2	-	2	1	-	-	1	2	2	2	2	1
CO6	3	3	3	2	3	2	1	-	3	3	3	3	3	2
Avg.	2.7	2.5	2.6	1.7	2.5	1.5	1.0	-	1.7	1.8	2.2	2.5	2.5	1.5

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

PCS2424	Fog and Edge Computing	PEC	L	T	P	C
			3	0	0	3

Course Objectives:

- To understand the fundamentals of edge computing architecture and its distinction from cloud computing.
- To explore edge devices, fog nodes, and communication protocols used in edge environments.
- To design and implement edge-based applications for real-time data processing.
- To analyze security, privacy, and resource management challenges in edge computing.
- To apply edge computing concepts in IoT, smart systems, and industrial applications.
- To develop innovation and research skills in emerging edge and fog computing technologies.

UNIT I INTRODUCTION TO FOG COMPUTING 9

Introduction to Fog Computing, Limitation of Cloud Computing, Differences between Cloud and Fog Computing, Advantages, Business Models, Architecture, Opportunities and Challenges.

UNIT II CHALLENGES IN FOG RESOURCES 9

Taxonomy and Characteristics, Resource Scheduling, Resource Management Challenge, Optimization Challenges, Miscellaneous Challenges.

UNIT III IOT AND FOG 9

Programming Paradigms, Research Challenges and Research Directions, Fog Protocols, Management and Orchestration of Network Slices in 5G, Fog, Edge and Clouds, Data Management and Analysis in Fog Computing, Case Studies.

UNIT IV INTRODUCTION TO EDGE COMPUTING 9

Origins of Edge, Edge Helping Low-End IoT Nodes, Architecture, Edge Processing, Edge Helping Higher-Capability IoT Nodes, Case Study: Raspberry Pi as an Edge Computing Device.

UNIT V APPLICATIONS OF FOG AND EDGE COMPUTING 9

Mobile Offloading, Edge Helping the Cloud, Edge for Augmented Reality, Data Processing on the Edge, Dispersed Learning with Edge/Fog Computing, Video Analytics on the Edge, Edge Computing Applications.

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the fundamentals of edge computing architecture and its relationship with cloud and fog computing.
CO2: Design and implement edge-based data processing pipelines using edge devices and protocols.

CO3: Analyze real-time data management and offloading strategies in edge computing environments.
CO4: Understand the security challenges and resource management techniques in edge computing.
CO5: Apply edge computing principles to IoT, smart city, and industrial automation use cases.
CO6: Demonstrate innovation and research orientation in edge and fog computing technologies.

Suggested Activities:

- Hands-on / Practical Activities
- Mini Projects / Innovation Activities
- Collaborative / Skill Development
- Research & Higher Learning
- Ethics & Societal Relevance

Textbooks:

1. Buyya, Rajkumar, and Satish Narayana Srirama, "Fog and Edge computing: Principles and Paradigms", 1st edition, John Wiley & Sons, USA, 2019
2. Wei Change and Jie Wu, "Fog/Edge Computing for Security, Privacy and Applications", Springer, 2021.

References:

1. Bahga, Arshdeep, and Vijay Madisetti, "Cloud computing: A hands-on approach, CreateSpace Independent Publishing Platform", USA, 2nd edition, 2014.
2. OvidiuVermesan, Peter Friess, "Internet of Things –From Research and Innovation to Market Deployment", 1st edition, River Publishers, 2014

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	2	-	3	-	-	-	-	-	-	3	2	-
CO3	3	2	-	2	-	-	-	-	-	-	-	-	2	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	2	3
CO5	-	-	2	2	3	-	-	-	-	-	-	-	3	3
CO6	-	-	2	-	-	-	2	3	2	2	-	-	-	3
Avg.	1.5	1.7	1.3	0.7	1.3	-	0.3	0.5	0.3	0.3	-	0.8	2.2	1.5

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

Course Code	Course Name	Category	L	T	P	C
PCS2437	Quantum Computing	PEC	3	0	0	3

Course Objectives:

- To provide introduction to quantum computation and quantum mechanics.
- To design and construct quantum circuits using quantum gates.
- To convert classical algorithms into quantum algorithms.

- To understand quantum machine learning concepts.
- To apply quantum computing concepts for solving real-world problems.
- To develop innovation and research skills in emerging quantum technologies.

UNIT I INTRODUCTION TO QUANTUM COMPUTING 9

Quantum Computing Basics – Limitations of Classical Computing – Principles of Quantum Mechanics – Qubits and Quantum States – Bloch Sphere Representation – Superposition and Measurement – Postulates of Quantum Mechanics – Classical Computing vs Quantum Computing.

UNIT II QUANTUM SYSTEMS AND CIRCUITS 9

Matrices and Linear Algebra for Quantum Computing – Unitary Matrices – Quantum Postulates – Tensor Products – Hilbert Space – Quantum Gates – Single Qubit Systems – Multi Qubit Systems – Quantum Circuit Design and Representation.

UNIT III QUANTUM ALGORITHMS 9

Deutsch-Jozsa Algorithm – Grover's Search Algorithm – Shor's Factoring Algorithm – Quantum Fourier Transform (QFT) – Applications and Advantages of Quantum Algorithms.

UNIT IV QUANTUM INFORMATION & QUANTUM MACHINE LEARNING 9

Bell States and Quantum Entanglement – No Cloning Theorem – Basics of Quantum Machine Learning – Comparison of Classical Machine Learning and Quantum Machine Learning – Applications of Quantum AI and Intelligent Systems.

UNIT V QUANTUM PROGRAMMING, POST-QUANTUM SECURITY AND FUTURE TRENDS 9

Introduction to Qiskit and Quantum Programming Tools – Quantum Simulators – Executing Programs on Real-Time Quantum Computers – Benchmarking and Comparing Experimental Quantum Computing Setups – Introduction to Post-Quantum Cryptography and Post-Quantum Management – Security Challenges in the Quantum Era – Implications of AI Advancements in Quantum Computing – Future Trends and Emerging Applications of Quantum Technologies.

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the basic principles of quantum computation and quantum mechanics.
CO2: Design quantum circuits using quantum gates.
CO3: Analyse the behaviour of basic quantum algorithms.
CO4: Understand the difference between classical and quantum machine learning.
CO5: Apply quantum computing concepts to real-world problems using tools like Qiskit.
CO6: Demonstrate innovation and research orientation in quantum technologies.

Suggested Activities:

- Hands-on / Practical Activities
- Mini Projects / Innovation Activities

- Collaborative / Skill Development
- Research & Higher Learning
- Ethics & Societal Relevance

Textbooks:

1. Sutor, R. S., Dancing with Qubits, 2nd Edition, Packt Publishing, 2024.
2. Nielsen, M. A., & Chuang, I. L., Quantum Computation and Quantum Information, 10th Anniversary Edition, Cambridge University Press, 2010.
3. McMahon, D., Quantum Computing Explained, 1st Edition, Wiley-Interscience / IEEE Computer Society, 2008.

References:

1. Benenti, G., Casati, G., & Strini, G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts; Vol. II: Basic Tools and Special Topics, World Scientific, 2004.
2. Pittenger, A. O., An Introduction to Quantum Computing Algorithms, 1st Edition, Birkhäuser, 2000.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	2	-	3	-	-	-	-	-	-	3	2	-
CO3	3	2	-	2	-	-	-	-	-	-	-	-	2	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	2	3
CO5	-	-	2	2	3	-	-	-	-	-	-	-	3	3
CO6	-	-	2	-	-	-	2	3	2	2	-	-	-	3
Avg.	1.5	1.7	1.3	0.7	1.3	-	0.3	0.5	0.3	0.3	-	0.8	2.2	1.5

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

Course Code	Course Name	Category	L	T	P	C
PCS2434	Augmented Reality/Virtual Reality	PEC	2	0	2	3

Course Objectives:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION 7

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture

Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT II VR MODELING 6

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.

UNIT III VR PROGRAMMING 6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.

UNIT IV APPLICATIONS 6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V AUGMENTED REALITY 5

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices

30 PERIODS

LIST OF EXPERIMENTS:

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling the camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
10. Develop simple MR enabled gaming applications.

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Explain the fundamental concepts of Virtual Reality (VR) and Augmented Reality (AR), including system components and technologies.
CO2: Understand and describe various input/output devices, tracking systems, and sensors used in AR/VR environments.
CO3: Apply modeling techniques such as geometric, kinematic, and physical modeling for designing virtual environments.
CO4: Analyze VR programming concepts using toolkits, scene graphs, and development platforms.
CO5: Evaluate human factors, safety issues, and diverse application areas of AR/VR in real-world scenarios.
CO6: Design and develop AR/VR applications using appropriate tools and technologies for different domains.

Suggested Activities:

- Assignment: Study different AR technologies and present findings.
- Case Study: Analyze real-world VR modeling.
- Tool Comparison: Compare World Toolkit and Java 3D features.
- Mini Project: Build a basic interactive VR environment.
- Assignment: Study popular VR SDKs (Unity, Unreal Engine).
- Role Play: Simulate VR usage in different domains (business, training).
- Survey Activity: Collect user feedback on VR usability.
- Computer Vision Demo: Object detection using OpenCV.
- Mini Project: Develop a simple AR-based educational app.
- Presentation: Study wearable AR devices (HoloLens, smart glasses).

Textbooks:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016
3. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003
5. Micheal Lanham, “Learn ARCore – Fundamentals of Google ARCore”, 1st Edition, Packt Publishing, 2018.
6. Alan B. Craig, “Understanding Augmented Reality: Concepts and Applications”, Morgan Kaufmann, 2013.

References:

1. Paul Mealy, John Carucci, “Virtual & Augmented Reality for Dummies”, 1st Edition, For Dummies, 2017

2. Tomas Akenine-Möller, Eric Haines, “Real-Time Rendering”, 4th Edition, A K Peters/CRC Press, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	–	–	2	–	–	–	–	–	2	2	2	–
CO2	3	2	–	–	3	–	–	–	–	–	2	2	3	–
CO3	3	2	3	2	3	–	–	–	–	–	2	3	3	–
CO4	3	3	2	3	3	–	–	–	–	–	3	3	3	1
CO5	2	3	2	2	2	3	2	–	–	–	3	2	3	1
CO6	3	3	3	3	3	2	2	2	2	1	3	3	3	2
Avg.	2.83	2.50	2.50	2.50	2.67	2.50	2.00	2.00	2.00	1.00	2.50	2.50	2.83	1.33

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

Course Code	Course Name	Category	L	T	P	C
PCS2428	Modern Cryptography	PEC	3	0	0	3

Course Objectives:

- 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.

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 Predicates.

UNIT II MATHEMATICAL FOUNDATION 9

Probability and Information Theory – Basic Calculation – Finite Probability Space and Random Variables – The Weak Law of Large Numbers – Birthday Paradox – Information Theory – Redundancy in Natural Language – Number Theory – Euler's Phi Function – Quadratic Residues – Modular Square Roots – Blum Integers – Coin-Tossing Algorithms – Monte Carlo and Las Vegas Algorithms

UNIT III AUTHENTICATION AND CRYPTOGRAPHIC PROTOCOLS 9

Authentication and Notions – Authentication Techniques – Password-based Authentication – Authenticated Key Exchange – Attacks on Authentication Protocols – SSH Remote Login Protocol

–Directory-Based Authentication – Non-Directory Based Authentication – Cryptographic Protocols – Identification Schemes – Commitment Schemes – Electronic Elections – Digital Cash

UNIT IV RANDOM ORACLES 9

One-way functions - Discrete Exponential Function – Uniform Sampling Algorithms – Modular Powers and Squaring - Formal Definition of One-way function – Hard Core Predicates - Bit Security - Exp Family - Square Family – RSA Bit – ElGamal Bit – Rabin Bit – Discrete Logarithm Bit – Pseudo-random Generators (PRG) - Yao's Theorem

UNIT V PROVABLE SECURITY ENCRYPTION AND DIGITAL SIGNATURE 9

Introduction – Provably Security Encryption: Secrecy and Probabilistic Attacks – Public Key One Time Pads – Passive Eaversdroppers – Chosen-Cipher Attacks – Unconditional Security of Cryptosystems - Provably Security Digital Signature: Attacks and Level of Security – Claw-Free Pairs and Collision Resistant Hash functions – Authentication-Tree-Based Signatures – A State-Free Signature Scheme – Provable Security for ElGamal-family Signatures.

45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the fundamentals of symmetric and asymmetric cryptography
CO2: Interpret the basic principles of cryptography and general cryptanalysis.
CO3: Analyse and apply core mathematical concepts relevant to cryptographic systems.
CO4: Analyse authentication techniques and cryptographic protocols to identify attacks and their countermeasures in real-world systems
CO5: Apply one-way functions for the construction of secure cryptographic protocols.
CO6: Analyse provable security models for encryption and digital signature schemes

Suggested Activities:

- Cryptography Algorithm Implementation
- Simulation on Attacks
- Case Study on Security Breaches
- Mini Project
- Research Paper Writing

Textbooks:

1. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag, 2nd edition, 2007
2. Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition), 2003

References:

1. ShaffiGoldwasser and MihirBellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2. OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23

3. William Stallings, “Cryptography and Network Security: Principles and Practice”, PHI 3rd Edition, 2006.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	1	-	-	-	-	-	1			
CO2	2	2	-	-	1	-	-	-	-	-	1			
CO3	3	3	1	2	2	-	-	-	-	-	1			
CO4	2	3	2	2	2	1	1	-	1	-	1			
CO5	3	2	2	1	3	-	-	-	-	-	1			
CO6	2	3	2	2	2	1	1	-	1	-	2			
Avg.	2.5	2.3	1.75	1.75	1.8	1	1	-	1	-	1.67			

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

Course Code	Course Name	Category	L	T	P	C
PAD2416	GPU ARCHITECTURE AND PROGRAMMING	PEC	3	0	0	3

Course Objectives:

- Learn the fundamentals of GPU architecture.
- Explore CUDA's programming and execution models, memory hierarchy, optimization techniques and debugging methods.
- Understand OpenCL’s architecture, platform and execution models, memory management and synchronization.
- To explore and analyse GPU programming using PyCUDA.
- Apply GPU algorithms and optimize memory usage with different data formats

UNIT I GPU ARCHITECTURE 9

Introduction - Heterogeneous parallel computing - Need for parallelism –Challenges in parallel programming – Green computing and energy-efficient parallel architectures – Evolution of GPU architectures – Understanding Parallelism with GPU – Architecture of a modern GPU - Block scheduling - Synchronization and transparent scalability - Warps and SIMD hardware.

UNIT II GPU PROGRAMMING: CUDA 9

CUDA's programming model: threads, blocks, and grids - CUDA's execution model: streaming multiprocessors and warps - CUDA compilation process - Memory hierarchy - Optimization of CUDA applications - Graphs - Warp functions - Dynamic parallelism - Debugging CUDA programs.

UNIT III GPU AND ACCELERATOR PROGRAMMING: OpenCL 9

The OpenCL architecture - The platform model - The execution model - The programming model - The memory model - Shared virtual memory - Atomics and synchronization - Events and profiling OpenCL programs - OpenCL and other parallel software platforms

UNIT IV GPU PROGRAMMING: PyCUDA 9

GPU programming using PyCUDA: kernals, threads, blocks, and grids – thread synchronization and intercommunication – Parallel prefix algorithm – Streams, events, contexts, and concurrency.

UNIT V ALGORITHMS ON GPU 9

Parallel Patterns: Parallel convolution: a basic algorithm, Constant memory and caching, Tiled convolution using caches for halo cells - Prefix scan: Parallel scan with the Brent-Kung algorithm, Segmented parallel scan for arbitrary-length inputs - Sparse Matrix computation: A simple SpMV kernel with the COO format - Grouping row nonzeros with the CSR format - Improving memory coalescing with the ELL format.

Periods: 45 hours

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the need for parallel programming
CO2: Describe the GPU Architecture
CO3: Program GPU using CUDA and PyCUDA
CO4: Program GPU using OpenCL
CO5:Compare the CUDA and OpenCL programming.
CO6: Identify efficient parallel programming patterns to solve problems

Suggested Activities
1. Case study analysis on heterogeneous parallel computing systems and energy-efficient GPU architectures used in high-performance computing applications.
2.Hands-on programming activity using CUDA for implementing threads, blocks, grids, and memory optimization techniques.
3.Mini project on GPU programming using OpenCL/PyCUDA for parallel data processing and synchronization mechanisms.
4.Seminar presentation on green computing, scalable GPU systems, and emerging accelerator technologies in AI and scientific computing.

References:
1.David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands on Approach, Fourth Edition, Morgan Kaufmann, 2022.
2. Gerassimos Barlas, Multicore and GPU Programming: An Integrated Approach, Second Edition, Morgan Kaufmann, 2022
3. Brian Tuomanen, Hands-On Gpu Programming with Python and CUDA: Explore high performance parallel computing with CUDA, Packt Publishing Limited, 2018
4. Shane Cook, CUDA Programming: ―A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
5. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, ―Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.
6. Nicholas Wilt, ―CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison – Wesley, 2013.

7. Jason Sanders, Edward Kandrot, ―CUDA by Example: An Introduction to General Purpose GPU Programming, Addison – Wesley, 2010.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	-	-	-	-	-	-	-	1	-
CO2	2	2	2	1	2	-	-	-	-	-	-	-	2	-
CO3	2	2	2	2	3	-	-	-	-	-	-	-	2	-
CO4	2	2	2	2	3	-	-	-	-	-	-	-	2	-
CO5	2	2	2	2	2	-	-	-	-	-	-	-	2	-
CO6	2	2	2	2	3	-	-	-	-	-	-	-	2	-
Avg.	2	2	2	3	3	-	-	-	-	-	-	-	2	-

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

Course Code	Course Name	Category	L	T	P	C
PCS2433	Robotic Process Automation and Intelligent Agents	PEC	3	0	0	3

Course Objectives:

- To understand the basic concepts of robotic process automation.
- To expose 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.

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 9

Emergence and Evolution of Robotic Process Automation (RPA), Differentiating RPA from Traditional Automation, Benefits and Challenges of RPA, Application Areas of RPA, Components and Architecture of RPA, RPA Platforms and Tools, Templates, User Interface, Domains in Activities, Workflow Files, Industry Use Cases and Trends in RPA.

UNIT II AUTOMATION PROCESS ACTIVITIES 9

Sequence, Flowchart, and Control Flow – Sequencing the Workflow, Activities, and Decision-Making using Control Flow. Data Manipulation – Variables, Collections, Arguments, Data Tables, Clipboard Management, and File Operations. Controls – Finding controls, waiting for controls, acting on controls, UiExplorer, and handling events. Recording Mouse and Keyboard Actions, Scraping Data from Websites, and Writing to CSV - Introduction to Process Mining. Comparative Study of RPA and Intelligent Agents.

UNIT III INTRODUCTION TO AGENTIC AI AND AGENT DEVELOPMENT 9

Introduction to Agentic AI, Evolution of Intelligent Agents, Characteristics of AI Agents, Types of Agents – Reactive, Deliberative, Goal-Based and Autonomous Agents. RPA vs AI Agents, Agent

Architectures and Workflows, Fundamentals of Agent Development, Prompt Engineering for Agents, Multi-Agent Systems, Overview of Google Agent Development Concepts and Frameworks.

UNIT IV AGENT DESIGN, INTEGRATION AND MAINTENANCE 9

Design and Development of AI Agents, Agent Integration with Applications and APIs, Context Management, Memory and Tool Usage in Agents, Exception Handling in Agents, Logging and Debugging Techniques, Agent Monitoring, Error Reporting, Security and Ethical Considerations in Agent Systems. Code Management and Maintenance – Reusability, Templates, Workflow Nesting, State Machines and Version Control for Agents.

UNIT V DEPLOYMENT, ORCHESTRATION AND FUTURE TRENDS 9

Deployment of Bots and AI Agents, Publishing and Managing Updates, Orchestration Servers, Controlling and Monitoring Bots and Agents, License Management, Cloud-Based Agent Deployment, Open-Source RPA and Agent Frameworks, Maintenance of Intelligent Agents, Human-in-the-Loop Systems, Future Trends in RPA and Agentic AI, Generative AI Integration, Enterprise AI Agents and Emerging Industry Applications.

45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the basics of RPA, its tools and applications.
CO2: Create automation workflows using RPA activities and controls.
CO3: Explain the concepts of Agentic AI and intelligent agents.
CO4: Develop and integrate AI agents with applications and APIs.
CO5: Apply debugging, security and maintenance techniques for bots and agents.
CO6: Deploy and manage bots and AI agents using orchestration platforms and cloud environments.

Suggested Activities:

- Case Study Discussion
- Group Presentation
- Data Handling Task
- Mini Project

Textbooks:

1. Alok Mani Tripathi, “Learning Robotic Process Automation: Create Software Robots and Automate Business Processes with the Leading RPA Tool”, UiPath, Packt Publishing, 2018
2. Tom Taulli, “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, Apress, 2020

References:

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston – Introduction to Robotic Process Automation: A Primer – Institute of Robotic Process Automation; Amazon Asia-Pacific Holdings Private Limited – 2018
2. Richard Murdoch – Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant – Amazon Asia-Pacific Holdings Private Limited – 2018

3. A. Gerardus Blokdyk – Robotic Process Automation (RPA): A Complete Guide – 5STARCooks (independently published) – 2020

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	-	-	-	-	-	2	2	2	–
CO2	2	3	3	-	3	-	-	2	-	-	2	3	2	–
CO3	2	2	3	2	3	-	-	2	-	-	2	3	3	–
CO4	2	3	2	2	3	-	-	1	-	-	2	3	2	–
CO5	2	2	3	-	3	1	-	2	-	2	2	3	3	–
CO6	1	2	-	-	-	3	2	-	2	1	3	2	3	1
Avg.	2.00	2.33	2.75	2.00	2.60	2.00	2.00	1.75	2.00	1.50	2.17	2.67	2.50	1.00

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

Course Code	Course Name	Category	L	T	P	C
PCS2432	Cryptocurrency and Blockchain Technologies	PEC	2	0	2	3

Course Objectives:

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

UNIT I INTRODUCTION TO BLOCKCHAIN 7

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

UNIT II BITCOIN AND CRYPTOCURRENCY 6

Basics of cryptocurrency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transactions in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT III BITCOIN CONSENSUS 6

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

UNIT IV HYPERLEDGER FABRIC & ETHEREUM 6

Architecture of Hyperledger fabric v2.5- chaincode-pluggable consensus-Raft. Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity and use cases.

UNIT V BLOCKCHAIN APPLICATIONS 5

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

30 PERIODS

LIST OF EXPERIMENTS:

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.
2. Create and deploy a blockchain network using Hyperledger Fabric SDK using Java/python 3.x.Set up and initialize the channel, install and instantiate chaincode, and perform invoke and query on your blockchain network.
3. Create an Interactive app to test the blockchain network and protocols. Execute transactions and requests.
4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.
5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.
6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chaincode while storing results and data in the starter plan.

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

On completion of the course, the students will be able to

CO1: Understand the fundamentals of blockchain models.
CO2: Analyze the working of bitcoin cryptosystem.
CO3: Analyze the consensus mechanisms and their associated challenges.
CO4: Implement Hyperledger Fabric v2.5 and compare its performance with Ethereum.
CO5: Develop and deploy smart contracts and decentralized applications (DApps) using tools such as Solidity.

CO6: Identify and evaluate the major research challenges and technical gaps existing between theory and practice in real time use cases (healthcare,finance,supplychain etc.).

Suggested Activities:

- Mini Project: Design a conceptual blockchain-based solution
- Literature review on recent blockchain trends
- Quiz/Debate on blockchain vs traditional systems
- Case study on blockchain in supply chain or banking
- Group discussion on public vs permissioned blockchains

Textbooks:

1. Andreas M. Antonopoulo, Mastering Bitcoin-programming the open Blockchain, O'Reilly,2nd edition,2017.
2. Bashir and Imran, "Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks", Packt Publishing Ltd., 2017.

References:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing, 2018.
3. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.
4. Nitin Gaur et al., Hands-On Blockchain with Hyperledger, Packt Publishing, 2018.
5. Andreas M. Antonopoulos and Gavin Wood, Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, 2018.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	1	2	1	-
CO2	3	3	1	1	-	-	-	-	-	-	-	2	2	-
CO3	2	3	2	2	-	-	-	-	-	-	-	3	2	-
CO4	2	2	3	2	3	-	-	1	1	-	-	3	3	-
CO5	2	2	3	1	3	1	1	2	2	1	-	3	3	1
CO6	2	3	2	3	2	3	2	2	2	1	2	3	3	1
Avg.	**2.33**	**2.50**	**2.20**	**1.80**	**2.67**	**2.00**	**1.50**	**1.67**	**1.67**	**1.00**	**1.50**	**2.67**	**2.33**	**1.00**

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

Course Code	Course Name	Category	L	T	P	C
PCS2429	Security and Trust in IoT	PEC	3	0	0	3

Course Objectives:

- To understand the security challenges and threat landscape in IoT systems
- To study privacy preservation mechanisms in IoT applications
- To analyze trust models and authentication techniques in IoT
- To explore data security and secure communication protocols
- To examine governance, policy and social aspects of IoT security

UNIT I THREATS AND ATTACKS IN IoT 9

IoT architecture – Phases of IoT system – Introduction to Operational Technology (OT) – Convergence of IoT and OT – IoT as interconnection of threats – Classification of attacks: phase-based, architecture-based and component-based attacks – Network robustness and defense mechanisms – Sybil attack detection – Malware propagation in IoT – Attack vectors in smart home systems.

UNIT II PRIVACY PRESERVATION IN IoT 9

Privacy issues in IoT – Privacy preservation in data dissemination – Privacy in smart buildings – Location privacy in IoT systems – Lightweight privacy protection schemes – Privacy in participatory sensing and wearable IoT applications.

UNIT III TRUST AND AUTHENTICATION IN IoT 9

Trust concepts and trust models – Trust-based architectures in IoT – Self-organising trust systems – Access control mechanisms – Prevention of unauthorised access to sensor data – Authentication techniques in IoT – Device and identity authentication – Trust management in industrial IoT environments.

UNIT IV IoT DATA SECURITY 9

Computational security in IoT – Security in data processing – Privacy-preserving data aggregation – Secure path generation – Security protocols for IoT access networks – IoT communication security protocols: MQTT, CoAP, DTLS, TLS – Data transmission and storage security – Secure communication in industrial IoT systems.

UNIT V GOVERNANCE, POLICY, AND SOCIAL ASPECTS 9

User-centric privacy and trust frameworks – Governance models in IoT – Policy-based approaches for informed consent – Legal and regulatory issues in IoT – Security impact of IoT on mobile networks – Operational technology governance – Challenges in OT and IoT integration – Security and compliance issues in industrial IoT environments.

45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to

CO1: Explain IoT architecture, system phases, and fundamental security requirements.
CO2: Identify and analyze various security threats, attacks, and vulnerabilities in IoT systems.
CO3: Apply privacy preservation techniques for secure data handling in IoT applications.
CO4: Analyze trust models, authentication mechanisms, and access control strategies in IoT.
CO5: Evaluate data security techniques, secure communication protocols, and defense mechanisms in IoT.
CO6: Examine governance models, policy frameworks, and social aspects of IoT security.

Suggested Activities:

- Case Study
- Tool Demo
- Group Discussion
- Mini Project
- Seminar

Textbooks:

1. Fei Hu (Ed.), Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, CRC Press, 2016.

References:

1. Brian Russell, Drew Van Duren, “Practical Internet of Things Security”, Packt Publishing, 2016
2. S. Sicari et al., “Security, Privacy and Trust in Internet of Things”, Computer Networks Journal (Elsevier), 2015
3. William Stallings, “Cryptography and Network Security”, Pearson, 2017
4. NIST (National Institute of Standards and Technology), “Guidelines for IoT Security”, NIST, 2018

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	2	2	2	-
CO2	2	3	-	2	-	1	-	-	-	-	2	2	3	-
CO3	2	2	3	-	2	1	-	-	-	-	2	3	3	-
CO4	2	3	2	-	2	1	1	-	-	-	2	3	3	-
CO5	2	2	2	2	3	1	-	-	-	-	2	3	3	-
CO6	-	2	-	-	-	3	3	-	2	1	2	2	3	1
Avg.	2.00	2.40	2.33	2.00	2.33	1.40	2.00	-	2.00	1.00	2.00	2.60	3.00	1.00

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

Course Code	Course Name	Category	L	T	P	C
PCS2438	Metaverse	PEC	3	0	0	3

Course Objectives:

- To understand the History of Metaverse.
- Explore the role of Metaverse to connect the real world and blockchain.
- To understand the advanced development of blockchain in the future.
- To study an open ecosystem of smart properties and assets.
- To explore the integration of futuristic technologies such as blockchain, crypto currency, DAO, AR/VR

UNIT I INTRODUCTION TO METAVERSE 6

Introduction to Metaverse and immersive experience- History of Metaverse- Metaverse value chain with 7 layers.

UNIT II TECHNOLOGIES INVOLVED IN THE METAVERSE 6

Metaverse as a product of Extended Reality- Augmented Reality (AR)- Virtual Reality (VR) Benefits of AR/VR-Difference between AR/ VR - Mixed Reality (MR)-Artificial Intelligence (AI) Introduction in Metaverse-Financial and Economics of Metaverse-Benefits of Metaverse

UNIT III BLOCKCHAIN ADOPTION IN METAVERSE 6

Blockchain Overview-History of Blockchain-Need of Decentralization in MV-Smart Contract Capabilities in Blockchain - Blockchain in Metaverse -Understanding Tokens-Understanding the NFT-NFT Token Standards-NFTs in MV-Cryptocurrency in MV

UNIT IV AR, VR, AND MR IN METAVERSE 6

Everything about VR (Virtual Reality)-Everything about AR (Augmented Reality)-Everything about MR (Mixed Reality)-Block chain Identity Management in Metaverse -NFT (non-fungible token) for Metaverse-Introduction to NFTs-History of NFTs-Benefits of NFTs

UNIT V USE-CASES 6

Gaming in Metaverse-Meetings in Metaverse-Virtual Learning in Metaverse-Social Interactions in Metaverse-Virtual Real-estate in Metaverse-e-commerce in Metaverse-Travel in Metaverse- Personalized Avatars-Digital Identity in Metaverse

30 PERIODS

LIST OF EXPERIMENTS:

1. Installations: Hardware Required: Android phone, Cardboard Viewer, PC with Dedicated Graphics Card and atleast 32GB RAM.
   Software required: Android Studio, Cardboard SDK, Android NDK, Google Carboard XR plugin for Unity, Unity, Nethereum library to (as needed)
2. Using Google Cardboard SDK for Creating simple AR/VR (XR) applications in Unity.
3. Creating blockchain applications in metaverse, by creating virtual assets, smart Contracts for exchange of assets using utility tokens and NFTs.
4. Create any Metaverse based application by picking one usecase.

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Explain the fundamentals of the Metaverse, its evolution, immersive experiences, and value chain components.
CO2: Analyze the role of Extended Reality technologies (AR, VR, MR) and Artificial Intelligence in enabling Metaverse applications.
CO3: Describe blockchain technology, decentralization, and smart contracts, and their significance in the Metaverse ecosystem.
CO4: Examine the concepts of tokens, NFTs, and cryptocurrencies and their applications within the Metaverse.
CO5: Evaluate identity management, digital ownership, and security aspects in Metaverse platforms.
CO6: Analyze various applications of the Metaverse, including gaming, education, social interaction, e-commerce, and virtual environments.

Suggested Activities:

- Mini Project
- Poster/Presentation
- Literature Review
- Quiz/Debate

Textbooks:

1. Ball, M., “The Metaverse: And How It Will Revolutionize Everything”, 1st Edition, Liveright Publishing, 2022.
2. Terry, Q., & Keeney, S., “The Metaverse Handbook: Innovating for the Internet’s Next Tectonic Shift”, 1st Edition, Wiley, 2022.

References:

1. Raad, H., “The Wearable Technology Handbook”, Scholar Publications, 2017.

2. Liew Voon Kiong, “Metaverse Made Easy: A Beginner's Guide to the Metaverse”, Liew Voon Kiong (Self-Published), 2022.
3. Freeman, D., “Metaverse for Beginners and Advanced: A Complete Journey into the Metaverse Virtual World (Web 3.0)”, Darell Freeman (Self-Published), 2022.
4. Dastikop, R., “Metaverse Glossary: Your Gateway to the Future”, Evincepub Publishing, 2022.
5. Winters, T., “The Metaverse: Prepare Now for the Next Big Thing”, Winters Media Publication, 2021.

MAPPING OF COs WITH POs AND PSOs

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	–	–	1	–	–	–	–	–	2	2	2	–
CO2	3	3	2	2	2	–	–	–	–	–	3	2	3	1
CO3	3	3	2	2	2	1	1	–	–	–	3	2	3	1
CO4	2	3	2	2	2	1	1	–	–	–	3	2	3	1
CO5	2	3	2	2	2	3	2	–	–	–	3	2	3	1
CO6	2	3	2	2	2	2	1	2	2	1	3	2	3	1
Avg.	2.50	2.83	2.00	2.00	1.83	1.75	1.25	2.00	2.00	1.00	2.83	2.00	2.83	1.00

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