Loyola-ICAM
College of Engineering and Technology (LICET)
(Autonomous)
Loyola Campus, Nungambakkam, Chennai – 600 034

Curriculum and Syllabi (R-2024)

B.E. COMPUTER SCIENCE AND ENGINEERING

Loyola-ICAM
College of Engineering and Technology (LICET)
(Autonomous)
CURRICULUM AND SYLLABI (R-2024)
CHOICE BASED CREDIT SYSTEM (CBCS)

B.E. COMPUTER SCIENCE AND ENGINEERING

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.

Vision of the Department:

- To form competent computing engineers who are motivated towards innovation and collaborative research, to serve the ever changing needs of the society.

Mission of the Department:

M1: To inculcate learnability skills in the student to acquire knowledge in the fundamentals of Computer Science and Engineering.
M2: To bring out the creativeness in the mind of the student leading to innovation and research.
M3: To develop professional skills and adaptiveness through collaborative activities.
M4: To create awareness on ethical values and involve the student to serve the societal needs.

Programme Educational Objectives:

PEO1: Graduates will have successful careers in computer engineering fields.
PEO2: Graduates will be able to pursue higher education in reputed institutions.
PEO3: Graduates will adapt to rapidly changing work environment through effective communication, collaborative work and professionalism.
PEO4: Graduates will engage in lifelong learning and prioritize ethical values for addressing the needs of the society.

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 software engineering principles and practices for developing quality software for scientific and business applications.
PSO2 – Adapt to emerging Information and Communication Technologies (ICT) to innovate ideas and solutions to existing novel problems.
PSO3 – Attain excellence in emerging fields of Machine Learning and Data Science.

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CURRICULUM AND SYLLABI (R-2024)
CHOICE BASED CREDIT SYSTEM (CBCS)
B.E. COMPUTER SCIENCE AND ENGINEERING

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	MA24201	Probability and Queuing Theory	BSC	3	1	0	4	4
2	CS24201	Programming in C	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	CS24221	C Programming 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	BS24301	Environmental Science and Sustainability	BSC	3	0	0	3	3
3	CS24301	Data Structures	PCC	3	0	0	3	3
4	CS24302	Database Management Systems	PCC	3	0	0	3	3
LABORATORY INTEGRATED THEORY COURSES								
5	CS24311	Digital Principles and Computer Organization	ESC	3	0	2	5	4
6	CS24312	Object Oriented Programming in JAVA	PCC	2	0	4	6	4
LABORATORY COURSES								
7	CS24321	Data Structures Laboratory	PCC	0	0	3	3	1.5
8	CS24322	Database Management Systems Laboratory	PCC	0	0	3	3	1.5
FORMATION COURSES								
9	FC24301	Soft Skills[$]	HSMC	2	0	0	2	1
10	BS24321	System Discovery and Analysis	BSC	0	0	2	2	0
			TOTAL	19	1	14	34	25

[$]Skill based courses

SEMESTER – IV

S. No.	Course Code	Course Title	Category	Periods per week			Total Periods	Credits
				L	T	P		
THEORY COURSES								
1	MA24401	Linear Algebra and Number Theory	BSC	3	1	0	4	4
2	CS24401	Operating Systems	PCC	3	0	0	3	3
3	CS24402	Microprocessors and Micro Controllers	PCC	3	0	0	3	3
LABORATORY INTEGRATED THEORY COURSES								
4	CS24411	Design and Analysis of Algorithms	PCC	3	0	2	5	4
5	CS24412	Object Oriented Software Engineering	PCC	3	0	2	5	4
6	CS24413	Foundations of Data Science	PCC	2	0	2	4	3
LABORATORY COURSES								
7	CS24421	Operating Systems Laboratory	PCC	0	0	3	3	1.5
8	CS24422	Microprocessors and Micro Controllers Laboratory	PCC	0	0	3	3	1.5
FORMATION COURSES								
9	HS24321	Communication Skills Building Laboratory[$]	HSMC	0	0	2	2	1
10	CS24423	Project Driven Learning[$]	EEC	0	0	2	2	1
			TOTAL	17	1	16	34	26

[$]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	CS24501	Theory of Computation	PCC	3	0	0	3	3
2	GE24501	Project Management and Operations Management	HSMC	2	0	0	2	2
LABORATORY INTEGRATED THEORY COURSES								
3	CS24511	Artificial Intelligence and Machine Learning	PCC	3	0	2	5	4
4	CS24512	Computer Networks	PCC	3	0	2	5	4
5		Professional Elective – I	PEC	-	-	-	-	3
6		Professional Elective – II	PEC	-	-	-	-	3
FORMATION COURSES								
7	FC24501	Universal Human Values and Service Learning	HSMC	1	0	1[*]	1	1
8	BS24502	Logical Reasoning and Aptitude Training	BSC	2	0	0	2	1[#]
9	GE24503	Financial Literacy	HSMC	2	0	0	2	0
			TOTAL	-	-	-	-	20

[$]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	CS24601	Compiler Design	PCC	4	0	0	4	4
2	GE24502	Entrepreneurship and International Business Market	HSMC	2	0	0	2	2
LABORATORY INTEGRATED THEORY COURSES								
3	CS24611	Distributed and Cloud Computing	PCC	3	0	2	5	4
4	CS24612	Embedded Systems and IoT	PCC	3	0	2	5	4
5	CS24613	Internet Programming	PCC	3	0	2	5	4
6		Professional Elective – III	PEC	-	-	-	-	3
7		Professional Elective – IV	PEC	-	-	-	-	3
FORMATION COURSES								
8	GE24621	Interdisciplinary Project	EEC	0	0	2	2	1
9	GE24622	Problem Solving Techniques	EEC	0	0	2	2	1[#]
			TOTAL	-	-	-	-	25

[$]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 – I	OEC	3	0	0	3	3
2		Open Elective – II	OEC	3	0	0	3	3
3		Audit Courses	HSMC	2	0	0	2	0
4	GE24701	Working to Engineer a Better World	HSMC	2	0	0	2	2
LABORATORY INTEGRATED THEORY COURSES								
5	CS24711	Cryptography and Cyber Security	PCC	3	0	2	5	4
6		Professional Elective - V	PEC	-	-	-	-	3
7		Professional Elective - VI	PEC	-	-	-	-	3
LABORATORY COURSES								
8	CS24721	Professional Project - I	EEC	0	0	4	4	2
FORMATION COURSES								
9	CS24722	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	CS24821	Professional Project – II	EEC	0	0	20	20	10
			TOTAL	0	0	20	20	10

Total Credits: 169

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 integral.

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	-	-	-
CO2	3	2	1	1	2	-	-	-	-	-	2	-	-	-
CO3	3	2	1	1	2	-	-	-	-	-	2	-	-	-
CO4	3	2	1	1	2	-	-	-	-	-	2	-	-	-
CO5	3	2	1	1	2	-	-	-	-	-	2	-	-	-
CO6	3	2	1	1	2	-	-	-	-	-	2	-	-	-
Avg.	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**

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**	**-**	**1.7**	**-**	**-**	**-**	**-**	**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 AND PSOs

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.

			L	T	P	C
GE24101	**தமிழர் மரபு**	**HSMC**	**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

			L	T	P	C
CY24121	**Engineering Chemistry Laboratory**	**BSC**	**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
  1)Strengths, 2)Limitations, 3)Characteristics, 4)Habits and Experiences
- Sense of SELF
  1)Self Awareness, 2)Self Image, 3)Self-esteem, 4)Self Love, 5)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

MA24201	Probability and Queueing Theory	BSC	L	T	P	C
			3	1	0	4

Course Objectives:

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

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – The axioms of probability – Conditional probability –Total Probability theorem – 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 (statement only)

UNIT III RANDOM PROCESSES 12

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations (statement only) – Limiting distributions

UNIT IV QUEUEING MODELS 12

Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms

UNIT V ADVANCED QUEUEING MODELS 12

Finite source models – M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/Ek/1 as special cases – Series queues – Open Jackson networks

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: To understand the concepts of probability and one-dimensional random variables
CO2: To apply standard distributions in real-life phenomena
CO3: To understand the concept of two-dimensional random variables
CO4: To understand and apply the concepts of stochastic process in real life scenario.
CO5: Acquire skills in analyzing queueing models
CO6: To understand and characterize phenomenon which evolve with respect to time in a probabilistic manner

Suggested Activities:
- Generate random variables using scientific tool
- Generate two-dimensional random variables using scientific tool
- Simulation of random processes using scientific tool
- Simulation of queueing models using scientific tool

Text Books:

1. Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., “Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.
2. Ibe, O.C., “Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.

References:

1. Hwei Hsu, "Schaum’s Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2. Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016.
3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
4. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 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	2	2	2	-	-	-	-	-	2	-	-	1
CO2	3	2	2	2	2	-	-	-	-	-	2	-	-	1
CO3	3	2	2	2	2	-	-	-	-	-	2	-	-	1
CO4	3	2	2	2	2	-	-	-	-	-	2	-	-	1
CO5	3	2	2	2	2	-	-	-	-	-	2	-	-	1
CO6	3	2	2	2	2	-	-	-	-	-	2	-	-	1
Avg.	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**1**

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

CS24201	**Programming in C**	**PCC**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives:

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

UNIT I BASICS OF C PROGRAMMING 9

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

UNIT II ARRAYS AND STRINGS 9

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

UNIT III FUNCTIONS AND POINTERS 9

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions –Pointers - Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Function pointers - Parameter passing: Pass by value, Pass by reference.

UNIT IV STRUCTURES AND UNION 9

Structure - Nested structures – Pointer and Structures – Array of structures – Self referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

UNIT V FILE PROCESSING 9

Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments.

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to
CO1: Develop simple applications in C using basic constructs.
CO2: Develop simple applications in C using control flow constructs.
CO3: Design and implement applications using arrays and strings.
CO4: Develop and implement modular applications in C using functions.
CO5: Develop applications in C using structures and pointers.
CO6: Design applications using sequential and random-access file processing.

Suggested Activities:

- Create exercises where students write their own macros and use preprocessor directives like #define, #include, etc., in various scenarios.
- Quizzes on Code Snippets.
- Assignment on numerical problems.
- Present real-world problem scenarios that can be solved using C. For example, writing a simple command-line calculator, implementing sorting algorithms, or creating a small text-based game.
- External Learning – Graphics in C.

Text Books:

1. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.

References:

1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.
5. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson 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	-	-	-	-	3	1	-	-	-	2	-
CO2	3	2	1	-	-	-	-	3	1	-	-	-	2	-
CO3	3	2	1	-	-	-	-	3	1	-	-	-	2	-
CO4	3	2	2	-	-	-	-	3	1	-	-	-	2	-
CO5	3	2	2	1	-	-	-	3	1	-	-	-	2	-
CO6	3	2	2	1	-	-	-	3	1	-	-	-	2	-
Avg.	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**3**	**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 wavefunctions-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. 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

CS24221	**C Programming Laboratory**	**PCC**	**L**	**T**	**P**	**C**
			0	**0**	**4**	**2**

Course Objectives:

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

LIST OF EXPERIMENTS:

Note: The lab instructor is expected to design problems based on the topics listed.

1. I/O statements, operators, expressions
2. decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Develop simple applications in C using basic constructs
CO2: Develop simple applications in C using control flow constructs
CO3: Design and implement applications using arrays and strings
CO4: Develop and implement modular applications in C using functions
CO5: Develop applications in C using structures and pointers
CO6: Design applications using sequential and random-access file processing

References:

1. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.
2. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.
3. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.
4. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
6. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.

Laboratory Requirements:

Sl.No.	Description of Equipment	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	Dev C++ / Linux Operating System with GNU compiler / equivalent open source IDE	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	-	-	-	-	3	1	-	-	-	2	-
CO2	3	2	1	-	-	-	-	3	1	-	-	-	2	-
CO3	3	2	1	-	-	-	-	3	1	-	-	-	2	-
CO4	3	2	2	-	-	-	-	3	1	-	-	-	2	-
CO5	3	2	2	1	-	-	-	3	1	-	-	-	2	-
CO6	3	2	2	1	-	-	-	3	1	-	-	-	2	-
Avg.	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**3**	**1**	**-**	**-**	**-**	**2**	**-**

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

			L	T	P	C
GE24122	**Engineering Practices Laboratory – Electrical and Electronics**	**ESC**	**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. https://www.interaction-design.org/
2. https://online.hbs.edu/

3. https://dschool.stanford.edu/

MAPPING OF COs WITH POs AND PSOs

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

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

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	-	-	-	-	-	1.5	-	2	1	-	2	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	2	-	2	1	-	2	-	-	-
Avg.	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**1**	**-**	**2**	**-**	**-**	**-**

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

MA24301	Discrete Mathematics	BSC	L	T	P	C
			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 9+3

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

UNIT II COMBINATORICS 9+3

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

UNIT III GRAPHS 9+3

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 9+3

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 9+3

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	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO6	3	2	1	2	-	-	-	-	-	-	-	-	-	-
Avg.	**3**	**2**	**1**	**1.5**	-	-	-	-	-	-	-	-	-	-

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

			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 understand 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**	**-**	**-**	**2.3**	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**-**

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

CS24301	Data Structures	PCC	L	T	P	C
			3	0	0	3

Course Objectives:

- To understand the concepts of ADTs.
- To learn linear data structures – stacks, and queues.
- To understand non-linear data structures – trees.
- To understand non-linear data structures – graphs.
- To understand sorting, searching and hashing algorithms.

UNIT I LINEAR DATA STRUCTURES – 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 Manipulation.

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations – Applications: Evaluating arithmetic expressions, Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue - deQue – applications of queues.

UNIT III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT – AVL Trees – B-Tree - B+ Tree – Heap: Introduction, Min Heap, Max Heap – Applications of heap.

UNIT IV NON LINEAR DATA STRUCTURES – GRAPHS 9

Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

UNIT V SEARCHING SORTING AND HASHING TECHNIQUES 9

Searching – Interpolation search - Sorting - Merge Sort - Insertion sort - Shell sort – Radix sort – Heap 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: Apply the fundamental concepts of linear data structures to implement lists using arrays and linked list.
CO2: Implement stack and queue ADTs and demonstrate their use in real-time applications.
CO3: Construct and traverse various tree data structures including binary trees, AVL trees, and heaps.
CO4: Apply graph traversal and representation techniques to solve problems involving network analysis and pathfinding.
CO5: Implement and analyze searching and sorting algorithms to solve data organization and retrieval problems efficiently.
CO6: Apply hashing techniques to implement efficient data retrieval.

Suggested Activities:

- Engage in projects that involve implementing common data structures like linked lists, binary search trees, and heaps, as well as algorithms like sorting and graph traversal.
- Participate in coding challenges on platforms like HackerRank and LeetCode.
- Consider creating projects like a sorting visualizer, a maze solver, or a social media friend recommendation system.
- Create a tool that visually demonstrates the steps of different sorting algorithms (e.g., bubble sort, merge sort, quicksort).

Text Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Reema Thareja, “Data Structures Using C”, Second Edition, Oxford University Press, 2011.

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Aho, Hopcroft and Ullman, “Data Structures and Algorithms”, Pearson Education,1983.
3. Stephen G. Kochan, “Programming in C”, 3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, Second Edition, University Press, 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	3	2	-	-	2	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	2	-	-	-	-	-	-	-	3	-
CO3	3	2	2	-	2	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	2	-	-	-	-	-	-	-	3	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	3
CO6	3	2	2	-	3	-	-	-	-	-	-	-	3	3
Avg.	**3**	**2.2**	**2.3**	**2**	**2.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2.5**

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

CS24302	**Database Management Systems**	**PCC**	**L**	**T**	**P**	**C**
			3	0	0	3

Course Objectives:

- To learn the fundamentals of data models, relational algebra and SQL
- To represent a database system using ER diagrams and to learn normalization techniques
- To understand the fundamental concepts of transaction, concurrency and recovery processing
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design
- To have an introductory knowledge about the Distributed databases, NOSQL and database security

UNIT I RELATIONAL DATABASES 9

Purpose of Database System – View of data – Database Architecture. Introduction to relational Model: Structure of Relational Databases – Database Schema – Keys – Relational Algebra. Introduction to SQL: Data Definition – Basic Operations - Set Operations – Aggregate Functions. Intermediate SQL: Join – Views – Integrity Constraints. Advanced SQL: Accessing SQL from a Programming Language – Functions and Procedures – Triggers.

UNIT II DATABASE DESIGN 9

Database Design and the ER Model: The Entity-Relationship Model – ER Diagrams – Reduction to Relational Schemas – ER Design Issues – Enhanced ER Features. Relational Database Design: Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III DATA STORAGE AND QUERYING 9

Storage and File Structure: RAID – File Organization – Organization of Records in Files – Data Dictionary Storage – Database Buffer. Indexing and Hashing: Ordered Indices – B+ tree Index Files – Static Hashing – Dynamic Hashing – Index Definition in SQL. Query Processing: Overview – Measure of Query Cost – Selection Operation – Sorting – Join Operation – Evaluation of Expressions. Query Optimization: Overview – Transformation of Relational Expressions – Heuristics in Optimization.

UNIT IV TRANSACTION MANAGEMENT 9

Transaction Management: Transaction Concepts – ACID Properties – Serializability – Transaction Isolation and Atomicity - Transaction support in SQL. Concurrency Control: Lock based Protocols – Deadlock Handling – Multiple Granularity - Timestamp – Validation – Multiversion – Snapshot Isolation. Recovery System: Failure Classification – Storage - Recovery and Atomicity – Recovery Algorithm – Buffer Management – ARIES Algorithm – Remote Backup Systems.

UNIT V DISTRIBUTED SYSTEMS, NO SQL DATABASES AND DATABASE SECURITY 9

Distributed Databases: Data Storage – Transactions – Commit Protocols – Concurrency Control - Query Processing. – NOSQL Databases: Introduction – CAP Theorem – Document based Systems – Key Value Stores – Column Based Systems – Graph Databases. Database Security: Introduction to Security Issues – Access Control based on Granting and Revoking Privileges – Multilevel Security - SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Challenges.

Total Periods: 45

Course Outcomes:

On completion of the course, the students will be able to
CO1: Implementation of Relational Databases using Structure Query Language
CO2: Design and Normalize Databases using ER Models
CO3: Compare and Optimize Indexing Strategies for Performance Tuning.
CO4: Construct SQL Queries for Transaction Processing and Consistency
CO5: Implement Access Control with Privileges and Roles
CO6: Design a Real-Time Application using a suitable Database

Suggested Activities
- Case Study to ER Diagram Conversion (Team Activity)
- Normalization of Real-World Data (Hands-On Exercise)
- SQL Query Challenges & Competitive Quizzes

- Comparative Analysis: Relational vs. NoSQL Databases
- 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.

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	3	3	-	-	-	3	3	3	3	2	-
CO2	3	2	1	3	3	-	-	-	3	3	3	3	2	-
CO3	3	2	1	3	3	-	-	-	3	3	3	3	2	-
CO4	3	2	1	3	3	-	-	-	3	3	3	3	2	-
CO5	3	2	1	3	3	-	-	-	3	3	3	3	2	-
CO6	3	3	2	3	3	-	-	-	3	3	3	3	3	-
Avg.	**3**	**2**	**1**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**2**	**-**

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

			L	T	P	C
CS24311	**Digital Principles and Computer Organization**	**ESC**	3	0	2	4

Course Objectives:

- Understand the fundamentals of number systems, codes, and combinational logic circuits.
- Analyze 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.

Suggested Activities
- Virtual lab
- Tutorial
- Peer group study
- Gate questions

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:

1. Digital Trainer Kit
2. ICs - OR, AND, NOT, NAND, XOR, 4 bit Adder, FFs
3. Connecting Wires

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

CS24312	**Object Oriented Programming in Java**	**PCC**	**L**	**T**	**P**	**C**
			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: 6**0**

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	3	2	-
CO2	3	2	3	-	3	-	-	-	-	-	2	3	2	-
CO3	3	2	3	-	3	-	-	-	-	-	2	3	2	-
CO4	3	2	3	-	3	-	-	-	-	-	2	3	2	-
CO5	3	2	3	-	3	-	-	-	-	-	2	3	2	-
CO6	3	2	3	-	3	-	-	-	-	-	2	3	2	-
Avg.	**3**	**2**	**2.8**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**-**

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

CS24321	**Data Structures Laboratory**	**PCC**	**L**	**T**	**P**	**C**
			0	0	3	1.5

Course Objectives:

- To demonstrate array implementation of linear data structure algorithms.
- To implement the applications using Stack.
- To implement the applications using Linked list
- To implement Binary search tree and AVL tree algorithms.

- To implement the Heap algorithm.
- To implement Sorting, Searching and Hashing algorithms.

LIST OF EXPERIMENTS:

1. Implementation of singly, doubly and circular linked list.
2. Represent a polynomial as a linked list and write functions for polynomial addition.
3. Implement Stack and use it to covert, Infix to Postfix expression.
4. Array and linked list implementation of Queue ADTs.
5. Implementation of Stack using Queue and Queue using Stack.
6. Implement a double-ended queue (deQue) where insertion and deletion operations are possible at both the ends.
7. Implement an expression tree. Produce its pre-order, in-order, and post-order traversals.
8. Implementation of Binary Search Trees.
9. Implementation of AVL Trees.
10. Implementation of Heaps using Priority Queues.
11. Implementation of Breadth first and Depth first traversal.
12. Implementation of Insertion sort, Merge sort and Heap sort.
13. Implement hashing using open addressing.

Total Periods: 45

Course Outcomes:

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

CO1: Implement Linear data structure algorithms.
CO2: Implement applications using Stacks and Linked lists
CO3: Implement Binary Search tree and AVL tree operations.
CO4: Implement graph algorithms.
CO5: Analyze the various searching and sorting algorithms.
CO6: Implement hashing algorithms.

References:

1. Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan AndersonFreed, Universities Press.
2. Data structures A Programming Approach with C, D.S.Kushwaha and A.K.Misra, PHI.
3. Data structures: A Pseudo code Approach with C, 2nd edition, R.F.GilbergAndB.A.Forouzan, Cengage Learning.
4. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
5. Data Structures using C, A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
6. Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung,Pearson

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. 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	1	2	2	1	-	-	-	-	2	1	2	2	2	2
CO2	3	3	1	1	-	-	-	-	1	1	1	3	1	2
CO3	2	1	3	1	-	-	-	-	1	1	2	3	3	3
CO4	3	1	3	3	-	-	-	-	1	2	3	3	2	1
CO5	3	2	1	1	2	-	-	-	3	3	3	1	3	1
CO6	2	1	2	1	1	-	-	-	1	2	1	1	2	1
Avg.	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**

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

CS24322	**Database Management Systems Laboratory**	**PCC**	**L**	**T**	**P**	**C**
			0	0	3	1.5

Course Objectives:

- To learn and implement important commands in SQL.
- To learn the usage of nested and joint queries.
- To understand functions, procedures and procedural extensions of databases.
- To understand design and implementation of typical database applications.
- To be familiar with the use of a front end tool for GUI based application development.

LIST OF EXPERIMENTS:

1. Create a database table, add constraints (Primary Key, Unique, Check, Not Null), insert rows, update and delete rows using SQL DDL and DML commands.
2. Create a set of tables, add foreign key constraints and incorporate referential integrity.
3. Query the database tables using different 'where' clause conditions, implement aggregate functions and set operations.
4. Query the database tables to explore sub queries and join operations.
5. Write user defined functions and stored procedures in SQL.
6. Execute complex transactions and realize DCL and TCL commands.
7. Write SQL Triggers for insert, delete, and update operations in a database table.
8. Create PL/SQL code to demonstrate the purpose of implicit and explicit cursors.
9. Write PL/SQL code to trap a predefined and non-predefined Oracle Server error.
10. Create View and Index for database tables with a large number of records.
11. Create an XML database and validate it using XML schema.
12. Create Document, column and graph based data using NOSQL database tools.
13. Develop a simple GUI based real life database application from the following list
    a) Inventory Management for a EMart Grocery Shop
    b) Society Financial Management
    c) Cop Friendly App – Eseva
    d) Property Management – eMall
    e) Star Small and Medium Banking and Finance

    and perform the following operations
    - Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.
    - Apply Normalization rules in designing the tables in scope.
    - Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.

- Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.
- Ability to showcase ACID Properties with sample queries with appropriate settings

Total Periods: 45

Course Outcomes:

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

CO1: Create and manipulate relational database tables using SQL DDL and DML commands, incorporating key constraints and referential integrity.
CO2: Develop and execute SQL queries involving conditional statements, aggregate functions, set operations, subqueries, and various types of joins.
CO3: Implement database programming constructs such as user-defined functions, stored procedures, triggers, and cursors using PL/SQL.
CO4: Apply transaction control and data control operations using DCL and TCL commands to ensure data integrity and access control.
CO5: Design and manage data using semi-structured (XML) and NoSQL (document, column, and graph-based) databases.
CO6: Design and develop GUI-based real-time database applications using advanced features like entity modeling, normalization, triggers, and stored procedures.

References:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2020.
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.

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. Oracle Database 12 or higher, MySQL 5.7 or higher versions, SQL Server 2022(16.x)

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	2
CO2	3	3	2	2	2							2	3	2
CO3	3	2	3	2	3						1	2	3	3
CO4	3	2	2	2	2							2	3	2
CO5	3	2	2	2	3						1	2	2	3
CO6	3	3	3	2	3	2			2		3	3	3	3
Avg.	**3.0**	**2.3**	**2.3**	**2**	**2.5**	**2.0**			**2.0**		**1.7**	**2.2**	**2.8**	**2.5**

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

FC24301	Soft Skills	HSMC	L	T	P	C
			2	0	0	1

Course Objectives:

- Understand and 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

BS24321	**System Discovery and Analysis**	**BSC**	**L**	**T**	**P**	**C**
			0	0	2	0

Course Objectives:

- To identify key components of any hardware.
- To analyse individual components and its working.
- To understand how data and control flows within a system
- To identify the need, the user, and functional specifications of the system
- To understand 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
CO1: Identify and describe the essential components and architecture of commonly used hardware systems.
CO2: Evaluate and document system design requirements, including end-user needs, functional goals, constraints, and standards.
CO3: Use project management tools, bull and octopus diagrams to understand the existing system.
CO4: Disassemble and analyze systems to distinguish between hardware, software, and network components
CO5: Understand and articulate how information is processed, transmitted, and stored.
CO6: 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**	**-**	**-**	**-**

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

MA24401	**Linear Algebra and Number Theory**	**HSMC**	**L**	**T**	**P**	**C**
			3	1	0	4

Course Objectives:

- 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
- To understand the basic concepts in number theory

- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

UNIT I VECTOR SPACES 9+3

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

UNIT II LINEAR TRANSFORMATION AND DIAGONALIZATION 9+3

Linear transformation — Null spaces and ranges — Dimension theorem — Matrix representation of a linear transformations — Eigenvalues and eigenvectors — Diagonalizability.

UNIT III INNER PRODUCT SPACES 9+3

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

UNIT IV DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS 9+3

Division algorithm — Base b representations — Number patterns — Prime and composite numbers (proof excluded) — GCD (proof excluded) — Euclidean algorithm — Fundamental theorem of arithmetic — LCM (proof excluded).

UNIT V DIOPHANTINE EQUATIONS, CONGRUENCES AND ITS CLASSICAL THEOREMS, MULTIPLICATIVE FUNCTIONS 9+3

Linear Diophantine equations (proof excluded) — Congruence's (proof excluded) — Linear Congruence's (proof excluded) — Applications: Divisibility tests — Modular exponentiation — Chinese remainder theorem — 2 x 2 linear systems — Wilson's theorem — Fermat's little theorem — Euler's theorem — Euler's Phi functions — Tau and Sigma functions.

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Apply the knowledge to solve problems involving linear combinations, independence, and dimension.
CO2: Understand the concepts of linear transformations and diagonalization
CO3: Effectively use the concepts of orthogonalization and least square method to solve problems
CO4: Understand the concept of divisibility and base-b number representations
CO5: Solve linear Diophantine equations and systems of congruences
CO6: Understand the classical theorems

Suggested Activities
- Explore linear span and linear dependence graphically using Mathematical tool.
- Convert verbal description into linear transformation and represent those using matrices.
- Google Pagerank Algorithm.
- Fit a line to non-perfect data points using Mathematical tool.
- Use clock face analogies to solve modular arithmetic problems.

Text Books:
1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007.
2. Koshy, T., ―Elementary Number Theory with Applications, Elsevier Publications, New Delhi, 2002.

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. Niven, I., Zuckerman.H.S., and Montgomery, H.L., ―An Introduction to Theory of Number, John Wiley and Sons , Singapore, 2004.
6. San Ling and Chaoping Xing, ―Coding Theory – A first Cours, Cambridge Publications, Cambridge, 2004.

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	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	-	-
Avg.	**3**	**1.8**	**1**	**1.7**	-	-	-	-	-	-	-	-	-	-

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

CS24401	**Operating Systems**	**PCC**	**L**	**T**	**P**	**C**
			3	0	0	3

Course Objectives:

- Understand core operating system concepts and their role in modern computing environments.
- Analyze the management of processes and multithreaded programs.
- Study CPU scheduling algorithms and mechanisms for process synchronization.
- Understand 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	3	-	-
CO2	3	3	-	2	-	-	-	-	-	-	2	3	-	-
CO3	3	3	2	2	-	-	-	-	-	-	2	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	2	3	-	-
CO5	3	2	2	2	-	-	-	-	-	-	2	3	-	-
CO6	3	2	-	-	-	-	-	-	-	-	2	3	-	-
Avg.	**3**	**2.5**	**2**	**2**	-	-	-	-	-	-	**2**	**3**	-	-

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

			L	T	P	C
CS24402	**Microprocessor and Microcontrollers**	**PCC**	3	0	0	3

Course Objectives:

- To introduce the architecture, instruction set, and programming of the 8086 microprocessors.
- To explain the 8086-system bus structure, signal operations, timing, and multiprocessor configurations.
- To familiarize students with the architecture, addressing modes, and programming techniques of the 8051 microcontrollers.
- To impart knowledge on interfacing techniques and peripherals with 8051, including timers, ADC/DAC, sensors, and memory interfacing.
- To expose students to the concepts of advanced processors and microcontrollers, highlighting RISC and CISC architectures.
- To develop the ability to design and implement basic embedded system applications like traffic light control, washing machine control, and temperature monitoring.

UNIT I THE 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, closely coupled and loosely Coupled configurations

UNIT III 8051 MICROCONTROLLERS 9

Difference Between Microprocessor and Microcontroller-Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming

UNIT IV INTERFACING AND PROGRAMMING 8051 MICROCONTROLLER 9

Programming 8051 using SFRs- Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface-

Stepper Motor and Waveform generation.

UNIT V INTRODUCTION TO ADVANCED PROCESOSR AND SYSTEM DESIGN 9

Introduction to advanced processors and microcontrollers – Introduction to FPGA - Difference between RISC vs CISC. Case studies – Traffic light control, washing machine control, Temperature control system.

Periods: 45 Hours

Course Outcomes:

On completion of the course, the students will be able to
CO 1: Analyse the architecture, addressing modes, and instruction set of the 8086 microprocessor.
CO 2: Design and implement systems using 8086 microprocessors with proper bus structures and multiprocessor configurations.
CO 3: Write assembly language programs for the 8051 microcontroller using different addressing modes and SFRs.
CO 4: Interface 8051 microcontroller with peripherals like LCDs, keyboards, ADCs, DACs, sensors, and stepper motors.
CO 5: Differentiate between RISC and CISC processor architectures and explain their impact on system design.
CO 6: Develop basic embedded system solutions for real-world problems like traffic management, appliance control, and temperature regulation.

Text Books:

1. Krishna Kant, "MICROPROCESSORS AND MICROCONTROLLERS Architecture, programming and system design using 8085, 8086, 8051 and 8096". PHI 2007
2. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.

References:

1. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2007.
2. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware:,TMH, 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	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	3	2	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-		-	-	-	-	-	1	-	-	-
CO6	3	3	3	3	2	2	-	2	2	2	2	-	-	-
Avg.	**3.00**	**2.33**	**2.67**	**2.33**	**2.00**	**2.00**	**-**	**2.00**	**2.00**	**2.00**	**1.50**	**-**	**-**	**-**

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

CS24411	Design and Analysis of Algorithms	PCC	L	T	P	C
			3	0	2	4

Course Objectives:

- To understand and apply the algorithm analysis techniques.
- To critically analyze the efficiency of graph algorithms.
- To understand different algorithm design techniques.
- To solve programming problems using state space tree.
- To understand the concepts behind NP Completeness, Approximation algorithms.

UNIT I INTRODUCTION 9

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

UNIT II BRUTE FORCE AND GRAPH ALGORITHMS 9

Brute Force – Computation a^n – String Matching - Closest-Pair and Convex-Hull Problems - Exhaustive Search - Travelling Salesman Problem - Knapsack Problem - Assignment problem. Graph algorithms: Representations of graphs - Minimum spanning tree: Kruskal's and Prim's algorithm- Shortest path: Bellman-Ford algorithm - Dijkstra's algorithm - Floyd-Warshall algorithm.

UNIT III ALGORITHM DESIGN TECHNIQUES 9

Divide and Conquer methodology: Finding maximum and minimum - Merge sort - Quick sort. Dynamic programming: Principle of Optimality - Elements of dynamic programming — Matrix-chain multiplication - Multi stage graph — Optimal Binary Search Trees. Greedy Technique: Elements of the greedy strategy - Activity-selection problem – Optimal Merge pattern — Huffman Trees.

UNIT IV STATE SPACE SEARCH ALGORITHMS 9

Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem - Assignment problem – Knapsack Problem - Travelling Salesman Problem.

UNIT V NP-COMPLETE AND APPROXIMATION ALGORITHM 9

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation – Lower - Bound arguments - NP-algorithms - NP-hardness and NP-completeness – SAT. Approximation Algorithms for NP-Hard problems – Travelling Salesman problem – Knapsack problem.

Total Periods: 45

LIST OF EXPERIMENT:

1. Implement linear search and binary search. Determine the time required to search for an element. Repeat the experiment for different values of n, the number of elements in the list to be searched and plot a graph of the time taken versus n.
2. Given a text txt [0...n-1] and a pattern pat [0...m-1], write a function search (char pat [ ], char txt [ ]) that prints all occurrences of pat [ ] in txt [ ]. You may assume that n > m.
3. Sort a given set of elements using the Merge sort and Quick sort methods and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n.
4. From a given vertex in a weighted connected graph, develop a program to find the shortest paths to other vertices using Dijkstra's algorithm.
5. Find the minimum cost spanning tree of a given undirected graph using Prim's algorithm.
6. Implement Floyd's algorithm for the All-Pairs- Shortest-Paths problem.
7. Implement optimal binary search tree using Dynamic programming.
8. Implement activity selection problem using Greedy technique.
9. Implement N Queens problem using Backtracking.
10. Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.

Periods: 30

Total Periods: 75

Course Outcomes:

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

CO1: Analyze the efficiency of algorithms using various frameworks.
CO2: Apply graph algorithms to solve problems and analyze their efficiency.
CO3: Make use of algorithm design techniques like dynamic programming and greedy techniques to solve problems
CO4: Use the state space tree method for solving problems.
CO5: Analyze the efficiency of various NP problems.
CO6: Solve problems using approximation algorithms.

Suggested Activities

- Write code for various algorithms using your preferred programming language (e.g., Java, Python, C++, C).
- Create visual representations of algorithms in action (e.g., sorting, searching) to aid understanding.
- Participate in coding platforms (e.g., HackerRank, LeetCode) to solve algorithmic problems.
- Apply algorithm design principles to practical projects like developing a recommendation system, building a search engine, or implementing a data compression algorithm.
- Participate in algorithm design and analysis contests to enhance problem-solving skills.

Text Books:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2007.

References:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

3. Harsh Bhasin, “Algorithms Design and Analysis”, Oxford university press, 2016.
4. S. Sridhar, “Design and Analysis of Algorithms”, Oxford university press, 2014.
5. http://nptel.ac.in/

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. Dev C++ / Eclipse CDT / Code Blocks / CodeLite / equivalent open source IDE/ SonarQube

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	2
CO2	3	3	3	2	2							2	2	2
CO3	3	3	3	2	2							2	2	2
CO4	3	3	3	2	–							2	2	2
CO5	3	3	2	2	–							2	2	1
CO6	3	3	2	2	1							2	2	1
Avg.	3.0	3.0	2.5	2.0	1.7							2	2.0	1.7

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

CS24412	Object Oriented Software Engineering	PCC	L	T	P	C
			3	0	2	4

Course Objectives:

- Understand foundational software engineering principles and lifecycle models.
- Apply Agile Methodologies for iterative software development.
- Model system requirements and behaviour using UML diagrams.
- Design software solutions using standard Design Patterns, with Java-based examples.
- Manage software projects with industry-standard practices.
- Understand the basics of DevOps as part of modern project management approaches.

UNIT I SOFTWARE ENGINEERING PRINCIPLES AND MODELS 6

Overview of Software Engineering - Software Development Life Cycle (SDLC) Models: Waterfall, Incremental, Spiral, V-Model - Modern Practices: Agile and Lean Software Development - Principles of Good Software Engineering: Modularity, Reusability, Maintainability and Scalability.

UNIT II AGILE SOFTWARE DEVELOPMENT 9

Agile Manifesto and Principles - Scrum Framework: Roles, Artifacts, Events - Kanban and Lean Software Development - Extreme Programming (XP) Practices (TDD, Pair Programming) - Agile Estimation Techniques: Story Points, Planning Poker - Agile Metrics: Velocity, Burn-down and Burn-up Charts - Case Study: Simulating an Agile Sprint

UNIT III REQUIREMENTS MODELING USING UML 10

Introduction to Requirement Elicitation - Preparing Software Requirements Specifications (SRS) - Introduction to UML (Unified Modeling Language) - Use Case Diagrams for Requirements Capture

- Structural Modeling: Class Diagrams, Object Diagrams - Behavioral Modeling: Sequence Diagrams, Activity Diagrams, State Machine Diagrams - Tools for UML Modeling.

UNIT IV SOFTWARE DESIGN PATTERNS USING JAVA 11

Introduction to Design Principles: SOLID Principles - Overview of Design Patterns: Creational Patterns: Singleton, Factory Method - Structural Patterns: Adapter, Façade - Behavioral Patterns: Observer, Strategy - Architectural Pattern: Model-View-Controller (MVC) – Publish-Subscribe Pattern - Application of Patterns in Java - Hands-on Case Study: Applying patterns to a mini project

UNIT V SOFTWARE TESTING AND PROJECT MANAGEMENT 9

Introduction to Software Testing - Levels of Testing: Unit, Integration, System, Acceptance - Types of Testing: Manual, Automation, Regression, Performance - Test Case Design Techniques - Software Project Management Basics - Project Planning and Scheduling (Work Breakdown Structure, Gantt Charts) - Risk Management - JIRA for Project Management

Periods: 45

LIST OF EXPERIMENTS:

1. Identify a real-world problem statement and Create a Software Requirements Specification (SRS) document.
2. Develop a Use Case diagram representing the main functionalities of the system.
3. Create a UML Class Diagram identifying important classes, attributes, methods, and relationships.
4. Design Sequence Diagrams for at least two important system use cases.
5. Create a State Diagram for a key entity in the system
6. Structure the project based on the Model–View–Controller (MVC) architectural pattern.
7. Code the Model classes handling business logic and data management.
8. Code the View components (UI screens).
9. Code the Controller classes handling interaction between Model and View.
10. Integrate all components, perform basic testing, and demonstrate the working application.

Periods: **30**

Total Periods: 75

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand and apply software engineering lifecycle models and principles.
CO2: Implement Agile methodologies (Scrum, Kanban, XP) in software development.
CO3: Analyze and model system requirements using UML diagrams.
CO4: Design software systems using appropriate design patterns with Java implementations.
CO5: Apply basic project management techniques and risk management.
CO6: Apply fundamental software testing principles to design effective test cases and perform various levels of testing.

Suggested Activities

- SDLC Model Pitch
- Agile Scrum Simulation
- Form teams and assign simple real-world problems
- Mini Project Management Plan
- Identify test scenarios, design test cases and execute unit, integration, and system tests for a simple web based application

Text Books:

1. Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, Mc Graw-Hill International Edition, 2014.
2. Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, 3rd Edition, Pearson, 2005.

References:

1. Eric Freeman, Elisabeth Robson, Head First Design Patterns, 2nd Edition, O'Reilly Media, 2020.
2. Ken Schwaber, Jeff Sutherland, The Scrum Guide, November 2020.
3. Bob Hughes, Mike Cotterell, Rajib Mall, Software Project Management, 6th Edition, McGraw Hill, 2017.
4. Sommerville, Ian, Software Engineering, 10th Edition, Pearson Education, 2015.

Laboratory Requirements:

1. INTEL based desktop PC with min. 16 GB RAM and 512 GB SSD
2. UML Modelling Tools – ArgoUML/StarUML
3. Java Development Kit (JDK) — Version 17 or above
4. Integrated Development Environment (IDE) – Eclipse/ IntelliJ IDEA Community Edition/VS 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	3		
CO2	3	3	3		3			2	2	2	2	3	3	
CO3	3	3	3	2				2	2		2	3	2	
CO4	3	2	3		3			2	2		2	3	2	
CO5	2	2	2					2	2	2	2	3		
CO6	3	2	2	2	3			2	2		2	3	2	
Avg.	**2.8**	**2.3**	**2.6**	**2**	**3**			**2**	**2**	**2**	**2**	**3**	**2.3**	

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

CS24413	**Foundations of Data Science**	**PCC**	**L**	**T**	**P**	**C**
			2	0	2	3

Course Objectives:

- To understand the data science fundamentals and process.
- Equip students with practical skills in data collection, cleaning, and preparation.
- Provide a solid foundation in statistical thinking and inference.
- Teach effective data visualization and storytelling methods.
- To present and interpret data using visualization libraries in Python

UNIT I INTRODUCTION 6

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

UNIT II DATA COLLECTION, CLEANING, AND PREPARATION 6

Data Collection Techniques: Surveys, APIs, Scraping, Logs - Data Cleaning Techniques: Missing Values, Duplicates, Outliers - Data Transformation: Normalization, Scaling, Encoding (One-Hot, Label) - Handling Textual and Categorical Data - Feature Engineering Basics: Date-Time Features, Aggregations, Binning

UNIT III DESCRIBING DATA 6

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

UNIT IV DESCRIBING RELATIONSHIPS 6

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

UNIT V DATA VISUALIZATION AND INTERPRETATION 6

Principles of Data Visualization: Clarity, Integrity, Aesthetics - Visualization Types: Line, Bar, Histogram, Boxplot, Heatmap, Scatterplot - Visualizing Categorical vs. Numerical Data - Tools: Python (Matplotlib, Seaborn), Tableau, Excel - Dashboarding Concepts and Use Cases - Visual Storytelling: Communicating Findings Effectively

Periods: 30

LIST OF EXPERIMENTS:

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.
2. Data Cleaning with Uncleaned Laptop Price Dataset
3. EDA with Iris/Indian Diabetes Dataset
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
b. Bivariate analysis: Linear and logistic regression modelling
c. Multiple Regression analysis
d. Also compare the results of the above analysis for the two data sets.
6. Apply and explore various plotting functions on UCI data sets.
a. Normal curves
b. Density and contour plots
c. Correlation and scatter plots
d. Histograms
e. Three-dimensional plotting
7. Creating an Interactive Sales Dashboard.

Periods: **30**

Total Periods: 60

Course Outcomes:

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

CO1: Understand the data science process
CO2: Apply practical skills in data collection, cleaning and preparation
CO3: Apply descriptive statistics to summarize, analyze and interpret data in the data science process
CO4: Apply correlation and regression techniques to analyze relationships among data
CO5: Apply visualization libraries in Python, explore data using visualization tools and interpret them
CO6: Perform end-to-end data analysis by integrating data preparation, statistical methods and visualization techniques to derive and communicate actionable insights

Suggested Activities:

1. Mini Project: Real-time Data Collection
2. Data Cleaning Challenge
3. EDA Storytelling Contest
4. Data Cleaning + Regression Modeling
5. Dashboard Creation, Data Story Video Presentation, Hackathon

Text Books:

1. Davy Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2. Jason Brownlee, "Data Preparation for Machine Learning", Machine Learning Mastery, 2020. (Unit II)
3. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Unit III and IV)
4. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Unit V)

References:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
2. Cole Nussbaumer Knaflic, "Storytelling with Data: A Data Visualization Guide for Business Professionals", Wiley, 2015.

Laboratory Requirements:

1. INTEL based desktop PC with min. 16 GB RAM and 512 GB SSD
2. Python Version: 3.8 to 3.12 - Environment Manager: Anaconda Distribution (Recommended)/ Miniconda/ Virtualenv + pip
3. Integrated Development Environment (IDE) – Jupyter Notebook / JupyterLab / VS Code (with Python and Jupyter extensions)/ R PyCharm (Community Edition or Professional)

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														
CO2														
CO3														
CO4														
CO5														
CO6														
Avg.														

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	2	-	-
CO2	3	1	1	2	2	-	-	3	2	1	1	3	-	-
CO3	3	3	2	1	2	-	-	3	3	1	2	2	-	-
CO4	1	2	2	3	2	-	-	3	1	3	1	2	-	-
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**	**1.8**	-	-

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

CS24422	**Microprocessor and Microcontrollers Laboratory**	**PCC**	**L**	**T**	**P**	**C**
			0	**0**	**3**	**1.5**

Course Objectives:

- To introduce the architecture and operation of the 8086 microprocessor and develop assembly language programs for basic arithmetic, logical operations, and data conversion techniques.
- To explore advanced programming techniques using the 8086 microprocessor, including string manipulation, byte search, and number sorting algorithms.
- To introduce the 8051 microcontroller, its architecture, and programming concepts with a focus on arithmetic and logical operations.
- To provide hands-on experience with 8051 microcontroller interfacing, including ADC, DAC, display/keypad, and stepper motor interfacing.
- To develop real-time embedded systems by simulating applications like traffic light controllers and designing system solutions.
- To enhance problem-solving skills by integrating microcontrollers with various peripherals to design and implement real-world embedded systems.

LIST OF EXPERIMENTS:

Experiments using 8086:

1. Arithmetic and Logical operations
2. Code conversion
3. BCD conversion
4. String manipulation
5. Search the byte of number
6. Number sorting (Ascending and Descending)

Experiments using 8051:

1. Arithmetic and logical operations
2. Find the Square and cube for the given number
3. Unpacked BCD to ASCII

Interface Experiments using 8051:

1. ADC Interface
2. DAC interface
3. Display and keypad interface
4. Stepper motor interface
5. Traffic light controller interface

Total Periods: 45

Course Outcomes:

CO1: Demonstrate the ability to write assembly language programs for basic arithmetic, logical, and data conversion tasks using the 8086 microprocessor.
CO2: Design and implement advanced 8086 microprocessor programs for string manipulation, number searching, and sorting.
CO3: Program the 8051 microcontroller for arithmetic and logical operations, and handle data conversion tasks like BCD to ASCII.
CO4: Interface external devices like ADC, DAC, displays, keypads, and stepper motors with the 8051 microcontroller and program them effectively.
CO5: Design embedded systems and real-time applications such as traffic light controllers and temperature control systems using microcontrollers.
CO6: Integrate 8051 microcontroller with various peripherals to solve complex problems and demonstrate real-time system design and implementation.

References:

1. Krishna Kant, “MICROPROCESSORS AND MICROCONTROLLERS Architecture, programming and system design using 8085, 8086, 8051 and 8096”. PHI 2007
2. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.

Laboratory Requirements:

1. 8086 trainer kit- 15
2. 8051 trainer kit -15
3. Interface kit- ADC,DAC, Stepper motor, Keyboard and display interface,traffic light – 3 no’s each.

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											
CO2	3	3	2											
CO3	3	3	2											
CO4	3	3	3	2	2									
CO5	3	3	3	2	2	2		2	2		2			
CO6	3	3	3	2	2	2		2	2		3			
Avg.	**3**	**3**	**2.5**	**2**	**2**	**2**		**2**	**2**		**2.5**			

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

HS24321	Communication Skills Building Laboratory	HSMC	L	T	P	C
			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:
CO1: Construct coherent and professional sentences tailored to various workplace scenarios
CO2: Analyze and critically interpret professional texts and multimedia content
CO3: Document, summarize, and report information effectively across multiple formats
CO4: Communicate effectively in professional and social interactions
CO5: Demonstrate teamwork, networking, and interview skills relevant to career development
CO6: 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

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**	**1**	**-**	**-**	**-**

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

			L	T	P	C
CS24423	**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.

Periods: 30

Course Outcomes:

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

CO1: Identify a problem statement and relevant stakeholders using design thinking principles.
CO2: Develop a structured project plan by defining objectives, technology stack and execution roadmap.
CO3: Design and implement a functional prototype with essential features.
CO4: Evaluate project performance through benchmarking, testing and optimization.
CO5: Present and deploy the project using appropriate tools and effective communication.
CO6: Demonstrate end-to-end project development skills by integrating problem-solving and technical implementation 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	2	3	2		2	-	-	2	2	-		2	3	
CO2	2	2	3		3	-	-	-	2	3	2	3	3	
CO3	2	2	3	2	3	-	-	-	2	-		3	3	2
CO4	2	3	2	3	3	-	-	-	-	-	2	2	3	3
CO5			2		2	-	-	-	3	3	2	2	2	2
CO6	3	3	3	2	3	-	-	2	3	2	3	3	3	3
Avg.	2.2	2.6	2.5	2.33	2.67	-	-	2	2.4	2.67	2.25	2.5	2.83	2.5

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

CS24501	Theory of Computation	PCC	L	T	P	C
			3	0	0	3

Course Objectives:

- To understand foundations of computation including automata theory
- To construct models of regular expressions and languages.
- To design context free grammar and push down automata.
- To understand Turing machines and their capability
- To understand Undecidability and NP class problems

UNIT I REGULAR LANGUAGES 12

Introduction to Formal Languages and Automata – Finite Automata – Deterministic Finite Automata – Non–deterministic Finite Automata – Finite Automata with Epsilon Transitions – Regular Expression – Finite Automata and Regular Expressions – Proving Languages not to be Regular – Closure Properties of Regular Languages – Decision Properties of Regular Languages – Equivalence and Minimization of Finite Automata.

UNIT II CONTEXT FREE LANGUAGES 8

Context– Free Grammar – Parse Trees – Ambiguity in Grammars and Languages – Normal Forms of Context Free Grammars – The Pumping Lemma for Context Free Languages – Closure Properties of Context Free Languages – Decision Properties of Context Free Languages.

UNIT III PUSH DOWN AUTOMATA 8

Push Down Automata – Language of Push Down Automata – Equivalence of Pushdown Automata and Context Free Languages – Deterministic Push Down Automata.

UNIT IV TURING MACHINES 9

Turing Machines – Language of a Turing Machine – Programming Techniques for Turing Machine – Extensions to Turing Machines – Restricted Turing Machine Two– way Infinite Tape, Equivalence of One Way Infinite Tape and Two– way Infinite Tape Turing Machines – Multi Tape Turing Machines, Non– deterministic Turing Machine.

UNIT V UNDECIDABILITY 9

A Language that is not Recursively Enumerable – An Undecidable Problem that is Recursively Enumerable – Undecidable Problems about Turing Machine – Post‘s Correspondence Problem – Other Undecidable Problems.

TOTAL: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to
CO1: Classify languages according to Chomsky hierarchy
CO2: Design finite automata and prove its equivalence with other forms
CO3: Construct Context Free Grammar (CFG) and identify the ambiguity in CFG
CO4: Design push down automata and prove its equivalence with context free grammar
CO5: Design Turing Machine and prove the equivalence of different extensions of Turing Machine
CO6: Prove the undecidability of Recursively Enumerable Languages

Suggested Activities:
Concept Mapping
Create a concept map linking language, automata, DFA, NFA, and regular expressions to visualize interrelationships.
Hands-on Simulation (Tool-based):
Use tools like JFLAP or Automata Editor to design and simulate DFA/NFA for given regular languages.
Conversion Practice:
Perform step-by-step conversion of:
NFA → DFA
ε–NFA → NFA
Regular Expression ↔ Finite Automata
Mini Project:
Design a DFA that accepts identifiers in a programming language or binary numbers divisible by 3.
Grammar Writing Exercise:
Write CFGs for various patterns (palindromes, balanced parentheses, arithmetic expressions).
Parse Tree Construction:
Construct parse trees for given strings and identify ambiguous grammar.
Conversion Practice:
Convert CFG into Chomsky Normal Form (CNF) and Greibach Normal Form (GNF).
Group Work:
Apply the Pumping Lemma to prove that a given language is not context-free.
Visualization Activity:
Compare and visualize the difference between regular and context-free languages.
Quiz / Kahoot:
Short quiz on identifying language types and closure properties.
Constructive Exercises:
Design PDA for:
Balanced parentheses {}
Palindromes over {a, b}
$a^n b^n$ pattern
Tool-based Simulation:
Use JFLAP to simulate PDA operations and visualize stack behavior.
Comparison Chart:
Compare DFA vs. PDA in a tabular format (memory, acceptance, language type).
Proof Demonstration:
Present equivalence proof between PDA and CFG through group presentations.
Think-Pair-Share:
Discuss limitations of deterministic PDA (DPDA) vs. non-deterministic PDA.
Machine Design Practice:

Design simple Turing Machines for:
Unary addition and subtraction
Checking palindrome strings
Visualization:
Use Turing Machine simulators (like JFLAP or Tursi) to test designed machines.
Comparative Chart:
Compare DFA, PDA, and Turing Machines in terms of computational power.
Group Mini-Project:
Design a Turing Machine that simulates a simple computational task (like multiplication).
Case Study:
Explore "Real-world analogies of Turing Machines" (e.g., CPU operation or algorithm execution).
Think-Pair-Share:
Discuss the meaning of decidability with examples of solvable and unsolvable problems.
Proof Demonstrations:
Step-by-step proof explanation of the Halting Problem and Post's Correspondence Problem.
Case Analysis:
Classify given problems as decidable, semi-decidable, or undecidable.
Mind Map:
Create a visual map showing relationships among RE, Recursive, and Non-RE languages.
Group Presentation:
Each group presents an undecidable problem and explains its practical implications.

Text Books:

1. John E Hopcroft, Rajeev Motwani, and Jeffery D Ullman, "Introduction to Automata Theory, Languages and Computations", Pearson Education, 3rd Edition, 2009.
2. Peter Linz, "An Introduction to Formal Languages and Automata", Sixth Edition, Jones and Bartlett Publishers, 2016.
3. H.R. Lewis and C.H. Papadimitriou, " Elements of the theory of Computation", Second Edition, Pearson Education, 2003.
4. J. Martin, "Introduction to Languages and the Theory of Computation", Third Edition, Tata McGraw Hill, 2003.

References:

1. Micheal Sipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997.
2. Harry R. Lewis and Christos H. Papadimitriou, "Elements of the Theory of Computation", Prentice Hall, Second Edition,1997.
3. Dexter C. Kozen, "Automata and Computability", Springer, 1997.

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	2	1	1	1	-	-	-	-	1	-	2	-
CO2	2	3	3	3	3	2	-	-	-	-	1	-	2	2
CO3	2	3	3	3	3	2	-	-	-	-	1	-	2	2
CO4	2	3	3	3	3	2	-	-	-	-	1	-	2	2
CO5	2	3	3	3	3	2	-	-	-	-	1	-	2	2
CO6	3	3	3	3	2	2	-	-	-	-	1	2	2	-
Avg.	**2.0**	**2.7**	**2.8**	**2.7**	**2.5**	**1.8**	**-**	**-**	**-**	**-**	**1.0**	**2.0**	**2.0**	**2.0**

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

GE24501	PROJECT MANAGEMENT AND OPERATIONS MANAGEMENT	PCC	L	T	P	C
			2	0	2	3

Course Objectives:

- To understand 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, Indian 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

CS24511	Artificial Intelligence and Machine Learning	PCC	L	T	P	C
			3	0	2	4

Course Objectives:

- To introduce the fundamental concepts of intelligent agents, search strategies, and AI problem-solving.
- To teach the principles and application of supervised and unsupervised machine learning models.
- To develop an understanding of model evaluation, optimization, and ensemble techniques.
- To provide a foundational knowledge of neural networks and deep learning architectures.
- To build practical skills in implementing AI and ML algorithms to solve real-world problems.

UNIT I FOUNDATIONS OF AI & INTELLIGENT AGENTS 11

Agents - Concept of Agents, PEAS, Types of agents; Problem Solving with Search Algorithms - Formulating problems, state-space search, Uninformed Search, Informed Search - Heuristics, Greedy Best-First Search, A* Search; Adversarial Search - minimax algorithm, Alpha-Beta Pruning; Constraint Satisfaction Problems – eg. Cryptarithmetic.

UNIT II SUPERVISED LEARNING 11

Regression - Simple Linear Regression, Multiple Linear Regression, Regression Metrics - Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared; Classification - Logistic Regression, Classification Metrics - Confusion Matrix, Precision, Recall, F1-Score, ROC/AUC; Naive Bayes classifier, Decision Trees, K-Nearest Neighbours, Support Vector Machines.

UNIT III ENSEMBLE TECHNIQUES & OPTIMIZATION 7

Ensemble Techniques, Random Forest, Gradient Boosting; Model Validation - Bias and Variance - overfitting and underfitting - K-Fold Cross Validation; Hyperparameter Tuning: GridSearchCV and RandomizedSearchCV

UNIT IV UNSUPERVISED LEARNING & DIMENSIONALITY REDUCTION 9

Unsupervised Learning: Clustering Algorithms - K- Means, Hierarchical Clustering; Association Rules –Apriori Algorithm; Dimensionality Reduction – Curse of dimensionality, Principal Component Analysis, Singular Value Decomposition (SVD)

UNIT V NEURAL NETWORKS 7

Neural Networks Basics –Perceptron – Multilayer perceptron – Activation Functions - Back Propagation – Deep Neural Networks – Hyperparameter tuning – Batch Normalization - Softmax Regression – Softmax classifier – Optimizers - Adam, SGD; Regularization and Dropout.

45 PERIODS

LIST OF EXPERIMENTS:

1. Implement the A* search algorithm to find the shortest path in a grid.
2. Build an unbeatable AI for Tic-Tac-Toe using the minimax algorithm.
3. Build and compare Linear Regression and Multiple Linear Regression. Evaluate with R^2 and MSE. Dataset: Boston Housing or California Housing dataset.
4. Build Decision trees and Random forests
5. Build a Support Vector Machine model.
6. Use K-Means (and the Elbow method) to cluster data. Analyze how their results differ. Dataset: Mall_Customers.csv.

7. Implement Principal component analysis
8. Build Deep learning NN models

30 PERIODS
TOTAL PERIODS: 75

Course Outcomes:

On completion of the course, the students will be able to
CO1: Apply AI foundations and search algorithms to solve complex problems.
CO2: Implement and evaluate various supervised learning models using key metrics.
CO3: Optimize ML models using ensemble techniques, validation, and hyperparameter tuning.
CO4: Apply unsupervised learning techniques and dimensionality reduction methods.
CO5: Explain the core concepts of Neural Networks.
CO6: Develop and test practical AI/ML solutions for real-world applications.

Suggested Activities

- Kaggle-in-Class: Host a 1-2 week mini-competition using a dataset from Kaggle. Students can apply regression, classification, and ensemble methods to compete for the best score, applying concepts from Units II and III.
- Model Comparison Showcase: Have student groups use a common dataset and apply one model from each main category (e.g., KNN, SVM, Decision Tree, K-Means). They must then present a comparison of the results, performance metrics, and suitability of each model for the data.
- AI Ethics Debate: Organize a debate on a current AI topic, such as “Are adversarial search algorithms used for autonomous weapons ethical?” or “Data privacy vs. model accuracy in unsupervised learning.”

Text Books:

1. Artificial Intelligence: A Modern Approach (4th Edition), Stuart Russell and Peter Norvig, Pearson, 2020.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd Edition), Aurélien Géron, O'Reilly Media, 2022.

References:

1. An Introduction to Statistical Learning: with Applications in R (or Python), Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Springer, 2021.
2. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016.
3. Machine Learning, Tom M. Mitchell, McGraw-Hill, 1997.
4. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber, and Jian Pei, Morgan Kaufmann, 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	3	2	-	2	-	-	-	-	-	-	2	-	3
CO2	3	3	-	2	3	-	-	-	-	-	-	2	-	3
CO3	3	3	-	3	3	-	-	-	-	-	-	2	-	3
CO4	3	3	3	2	3	-	-	-	-	-	-	2	-	3
CO5	3	3	3	-	3	-	-	-	-	-	-	2	3	3
CO6	2	3	2	-	3	2	-	-	-	2	3	2	3	3
Avg.	**2.8**	**3.0**	**2.5**	**2.3**	**2.8**	**2.0**	**-**	**-**	**-**	**2.0**	**3.0**	**2.0**	**3.0**	**3.0**

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

CS24512	Computer Networks	PCC	L	T	P	C
			3	0	2	4

Course Objectives:

- To understand the concept of layering in networks
- To understand 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 understand 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

45 PERIODS

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: Understand the basic layers of computer networks and understand the physical layer functionalities
CO2: Understand the data link layer functionalities and analyze the protocols used in the Data Link Layer.
CO3: Understand the process of subnetting and analyze the various Internet protocols and routing algorithms
CO4: Understand the functions of the transport layer and analyze the transport layer protocols.
CO5: Understand 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.

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

FC24501	Universal Human Values and Service Learning	HSMC	L	T	P	C
			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. Analyze 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	-	-	-	-			
CO2	-	-	-	-	-	3	3	-	-	-	-			
CO3	-	-	-	-	-	3	3	3	3	-	-			
CO4	-	-	-	-	-	3	3	-	3	-	3			
CO5	-	-	-	-	-	3	3	-	-	-	3			
CO6	-	-	-	-	-	-	3	-	-	-	-			
Avg.	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**-**	**3**			

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

BS24502	Logical Reasoning and Aptitude Training	BSC	L	T	P	C
			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

GE24503	**Financial Literacy**	**HSMC**	**L**	**T**	**P**	**C**
			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		
		Total Periods: 30

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:

1. "Principles and Practices of Banking" – Indian Institute of Banking & Finance (IIBF)
2. Financial Education Handbook For New Entrants at Workplace, National Centre for Financial Education (NCFE), First Edition September 2024.
3. Tulsi Bharatbhai Raval, "Financial Planning", Study Guide Educational Publication, December 2021.
4. 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

CS24601	**Compiler Design**	**PCC**	**L**	**T**	**P**	**C**
			3	**1**	**0**	**4**

Course Objectives:

- Introduce the structure and functioning of a compiler.
- Enable understanding of lexical, syntactic, and semantic analysis techniques.
- Familiarize students with intermediate code generation and optimization.
- Develop practical skills in implementing compiler phases using tools like Lex and Yacc.

UNIT I FRONT END OF COMPILERS 14

Language Processors – Structure of a Compiler – Lexical Analysis: Role of Lexical Analyzer – Specification of Tokens – Recognition of Tokens. Syntax Analysis: Introduction – Context Free Grammars – Using ambiguous Grammars–Top-Down Parsing – Bottom–Recursive Descent parser – LL(1) Parser – Bottom-Up Parsing –Shift Reduce Parser – SLR, CLR, LALR Parsers.

UNIT II TYPE CHECKING AND RUNTIME ENVIRONMENTS 12

Syntax Directed Definitions –Construction of Syntax Tress –Type Systems – Specification of a Simple Type Checker– Equivalence of Type Expressions –Type Conversations– Attribute Grammar for a Simple Type checking system–Runtime Environments: Storage Organization – Stack Allocation of space – Access to Nonlocal Data on the Stack – Storage allocation Strategies – Parameter Passing – Symbol Table.

UNIT III INTERMEDIATE CODE GENERATION 12

Intermediate Representations– Syntax Tree, Three Address Code, Static Single Assignment(SSA)– Types and Declarations – Translations of Expressions — Control Flow – Backpatching – switch-case statements – Intermediate code for procedures.

UNIT IV CODE GENERATION 11

Issues in the Design of a Code generator – Target Language – Address of the target code – Simple Code Generator – Register Allocation and Assignment – Code Generation – Instruction Selection by Tree Rewriting – Optimal Code Generation for Expressions – Dynamic Programming Code Generation

UNIT V CODE OPTIMIZATION 11

Basic Blocks and Flow Graphs – Optimization of Basic Blocks – Peephole Optimization – Principal Sources of Optimization – Introduction to Data Flow Analysis – Partial Redundancy Elimination – Loops in Flow Graphs

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to
CO1: Comprehensively explain the analysis phases of compiler
CO2: Develop scanners and parsers.
CO3: Develop type checking systems for a given language specification
CO4: Convert programs into intermediate code representations.
CO5: Generate target machine code using the runtime environment.
CO6: Optimize the code by applying various optimization techniques

Suggested activities:
Concept Mapping:
Create a diagram showing different phases of a compiler and their interactions (Lexical, Syntax, Semantic, Intermediate, Optimization, Code Generation).
Lexical Analyzer Simulation:
Implement a simple token recognizer in Python or C to identify identifiers, keywords, and numbers.
Tool-Based Exercise:
Use LEX/FLEX to create a lexical analyzer for a simple language (e.g., recognizing valid variable names or arithmetic operators).

Grammar Practice:
Write context-free grammars (CFGs) for simple programming constructs like if–else, while, and for loops.
Parser Simulation:
Use YACC/Bison to generate an LL(1) or SLR parser and test with sample inputs.
Ambiguity Analysis:
Given an ambiguous grammar, demonstrate ambiguity using multiple parse trees and resolve it.
Mini Project:
Design a front-end (Lexical + Syntax Analyzer) for a small expression language using LEX and YACC.
Syntax Tree Construction:
Write a program to generate a syntax tree from arithmetic expressions.
Type Checking Simulation:
Implement a small type checker for arithmetic and logical expressions.
Attribute Grammar Exercise:
Design an attribute grammar for evaluating arithmetic expressions.
Symbol Table Implementation:
Develop a simple symbol table using C/C++/Python to store variable names, types, and scopes.
Parameter Passing Comparison:
Demonstrate call by value, call by reference, and call by name with short code examples.
Case Study:
Analyze how runtime environments handle recursion using a visual tool
IR Practice:
Generate three-address code (TAC) for simple arithmetic and conditional statements.
SSA Representation:
Convert given TAC into Static Single Assignment (SSA) form.
Tool Demonstration:
Use an online compiler visualization tool to inspect intermediate representations.
Flow Graph Construction:
Draw control flow graphs (CFG) for a given piece of code.
Switch-Case Implementation:
Design intermediate code for a simple switch-case construct.
Mini Project:
Develop a module that translates arithmetic expressions into three-address code.
Instruction Selection Practice:
Write assembly-like code for arithmetic expressions based on stack and register machines.
Register Allocation Simulation:
Manually allocate registers for given expressions using graph coloring.
Code Generation Exercise:
Implement a simple code generator from three-address code to target assembly.
Tree Rewriting Demonstration:
Show instruction selection using tree patterns and rewriting rules.
Dynamic Programming Approach:
Use dynamic programming to determine optimal instruction sequences for expressions.
Case Study:
Study real compiler code generation (e.g., GCC intermediate output using -S option).
Basic Block Identification:
Identify and label basic blocks in given code fragments.
Flow Graph Construction:
Construct flow graphs and mark loops.
Peephole Optimization Practice:
Simplify sequences of instructions manually by applying peephole optimization rules.
Data Flow Analysis Demonstration:
Perform simple live variable analysis and constant propagation.

Partial Redundancy Elimination:
Analyze and eliminate redundant computations from intermediate code.
Optimization Project:
Write a small script to optimize intermediate code (constant folding, dead code elimination).
Case Study:
Review optimization reports from compilers like GCC or LLVM and interpret results.
Compiler Construction Mini Project:
Integrate all front-end and back-end phases to build a simple compiler for arithmetic expressions.
Quiz/Game:
Conduct a "Compiler Design Challenge" where students debug or optimize given code snippets.

Text Books:

1. Alfred Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman, "Compilers Principles, Techniques and Tools", Pearson Education, Asia 2014.
2. Andrew W Appel, " Modern Compiler Implementation in ML", Cambridge University Press, December 1997.
3. Kenneth C. Louden, "Compiler Construction: Principles and Practice", Cengage Learning, First Edition, 1997.

References:

1. Steven. S. Muchnick, " Advanced Compiler Design and Implementation", Morgan Kaufman Publishers, First Edition, 1997.
2. Randy Allen and Ken Kennedy, " Optimizing Compilers for Modern Architectures: A Dependence based Approach", Morgan Kaufman, First Edition, 2001.
3. Y. N. Srikant, Priti Shankar, "The Compiler Design Handbook – Optimizations and Machine Code Generation", CRC Press, Second Edition, 2007.
4. John E Hopcroft and Jeffery D Ullman, " Introduction to Automata Theory, Languages and Computations", Narosa Publishing House, 2002.

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	2	2	1	1	1	-	-	-	1	2	2	-
CO2	1	2	2	2	3	1	1	-	-	1	1	2	2	-
CO3	1	2	2	2	3	1	1	-	-	1	1	2	2	-
CO4	1	2	2	2	3	1	1	-	-	1	1	2	2	2
CO5	1	2	2	2	3	1	1	-	1	1	1	2	2	2
CO6	3	3	2	3	3	1	1	-	1	1	1	2	2	2
Avg.	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**2**	**2**	**2**

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

			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

CS24611	Distributed and Cloud Computing	PCC	L	T	P	C
			3	0	2	4

Course Objectives:

- To understand 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.

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	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

CS24612	**Embedded Systems and IoT**	**PCC**	**L**	**T**	**P**	**C**
			3	**0**	**2**	**4**

Course Objectives:

- Provide foundation on embedded and real-time systems, architecture, constraints, and design methods.
- Understand programming models, compilation, multitasking, context switching, scheduling, and IPC.
- Develop skills in Arduino programming, sketches, and interfacing sensors and actuators.
- Learn IoT protocols (Bluetooth, WiFi, GSM, ZigBee) and work with Raspberry Pi, GPIO, and cloud connectivity.
- Design practical embedded and IoT applications like elevators, home automation, agriculture, and healthcare.
- Gain practical experience through 8051, Arduino–Raspberry Pi experiments, IoT communication, and a social-impact mini project.

UNIT I EMBEDDED SYSTEM 9

Introduction to Embedded System- Real Time system – Components of Embedded systems- Characteristics and Constraints of Embedded System-Embedded system Design Process- Design methodologies- Design flows – Requirement Analysis – Specifications-System analysis and architecture design. Design Example: Model train controller

UNIT II EMBEDDED PROGRAMMING AND REAL TIME SYSTEM 9

Components for embedded programs- Models of programs- Assembly, linking and loading-– compilation techniques- Multiple tasks and multi processes – Processes – Context Switching – Operating Systems –Scheduling policies-Inter Process Communication mechanisms

UNIT III IOT AND ARDUINO PROGRAMMING 9

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output from Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

UNIT IV IOT COMMUNICATION AND OPEN PLATFORMS 9

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V APPLICATIONS DEVELOPMENT 9

Case study: Development of Embedded Application – Elevator control-Internet enabled system – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare.

Periods: 45

LIST OF EXPERIMENTS:

Experiments using 8051(Simulator)

1. Write 8051 Assembly Language experiments using simulator.
2. Test data transfer between registers and memory.
3. Perform ALU operations.

Experiments using 8051(Embedded C using IDE)

4. Write Basic and arithmetic Programs Using Embedded C.
5. Port operation using Embedded C.
6. Programming using on-Chip ports in 8051. (ASM)
7. Programming using Serial Ports in 8051. (ASM)

Experiments using Arduino and Raspberry Pi.

8. Introduction to Arduino platform and programming
9. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)
10. Introduction to Raspberry PI platform and python programming
11. Interfacing sensors with Raspberry PI
12. Communicate between Arduino and Raspberry PI using any wireless medium
13. Setup a cloud platform to log the data

IoT Based System Design

14. Mini project on Social cause

Periods: 30
Total Periods: 75

Course Outcomes:

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

CO1: Identify the characteristics, constraints, architecture, and design flow of embedded systems and real-time systems. (Unit-I)
CO2: Develop programs using assembly & C, understand multitasking, processes, context switching, IPC, and scheduling methods. (Unit II + Lab Experiments 1–7)
CO3: Develop Arduino programs & integrate sensors/actuators. (Unit III + Experiments 8)
CO4: Apply communication protocols, Raspberry Pi programming, cloud setup. (Unit IV, Experiments 9–13)
CO5: Develop real-time embedded applications (Unit-V)
CO6: Design, implement, and evaluate an end-to-end Embedded and IoT system for real-world problems.

Suggested Activities

- Develop Embedded C programs for basic I/O interfacing (LED blinking, keypad scanning, LCD display).

- Compare IoT communication protocols (ZigBee, Bluetooth, Wi-Fi, GSM) using datasheets and practical demos.
- Implement IoT applications using Arduino and Raspberry Pi (e.g., temperature monitoring, light automation).
- Encourage students to explore open-source IoT development platforms.

Text Books:

1. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

References:

1. Michael J. Pont, "Embedded C", Pearson Education, 2007.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
3. Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

MAPPING OF COs WITH POs AND PSOs

COs	PSOs													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1	2	1	–	–	1	–	1	3	1	2
CO2	3	3	2	2	3	–	–	1	1	1	2	3	2	2
CO3	2	2	2	1	3	–	–	2	1	1	2	3	3	2
CO4	2	2	2	2	3	1	–	2	1	1	2	2	2	2
CO5	2	2	3	2	3	1	–	2	2	2	2	3	3	2
CO6	2	3	3	3	3	2	1	3	3	3	3	3	3	3
Avg.	**2.3**	**2.3**	**2.16**	**1.8**	**2.8**	**1.25**	**1**	**2**	**1.5**	**1.6**	**2**	**2.8**	**2.3**	**2.2**

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

CS24613	**Internet Programming**	**PCC**	**L**	**T**	**P**	**C**
			3	**0**	**2**	**4**

Course Objectives:

- Establish a strong conceptual foundation in web architecture, protocols, and client-server communication models.
- Master the core technologies for creating structured, styled, and responsive user interfaces using HTML5 and CSS3.
- Develop proficiency in client-side scripting with JavaScript to create dynamic, interactive, and engaging web page behaviors.
- Acquire comprehensive skills in server-side programming using both Java Servlets and PHP to handle business logic, data persistence, and session management.
- Apply client-side and server-side technologies to design, build, and deploy a fully functional, data-driven web application.

UNIT I Basic Network & Web Concepts 6

Basics of Internet, WWW, Web Browsers, Web Servers and Clients; HTTP - Request/Response, Methods, Status Codes; URL Structure, Web Architecture – n-tier ; Introduction to Web Standards and Accessibility.

UNIT II Client-Side Design - Structure & Presentation 10

HTML5: Document Structure, Text Formatting, Lists, Links, Images, Tables, Forms. CSS3: Selectors, Box Model, Layouts (Flexbox, CSS Grid), Responsive Design and Positioning.
Topics to self-explore: Bootstrap and Tailwind CSS, UI tools

UNIT III Client-Side Design - Interactivity & Dynamic HTML 12

Core JavaScript (ES6+): Syntax, Data Types, Functions, Events, DOM Manipulation; DHTML: Combining HTML, CSS, and JavaScript; Advanced JS: Objects, Arrays, JSON, AJAX (Fetch API).
Topics to self-explore: JS Frameworks

UNIT IV Server-Side Programming with Java Servlets 8

Introduction to Servlets: Lifecycle, HttpServletRequest and HttpServletResponse. Working with Parameters, Headers, and Cookies. Session Management using HttpSession. Database Connectivity with JDBC. Servlet-centric Design: Using Servlets as Controllers, forwarding requests, and generating dynamic content directly.
Topics to self-explore: Spring Boot

UNIT V Server-Side Programming with PHP 9

Introduction to PHP: Syntax, Embedding PHP in HTML, Variables, Data Types, Operators. Control Structures, Functions, Working with Forms ($_GET, $_POST, $_REQUEST). Working with Files and Directories. PHP Sessions and Cookies. Database Connectivity with MySQLi (Procedural & Object-Oriented) and Introduction to PDO. PHP Error Handling and Debugging.
Topics to self-explore: Laravel

Periods: 45 PERIODS

LIST OF EXPERIMENTS:

1. Creating a structured, semantic HTML5 document for a personal profile page.
2. Styling the profile page with CSS3 (Box Model, Fonts, Colors, Flexbox/Grid).
3. Building a responsive multi-column web page layout using Media Queries.
4. Creating and validating an interactive user registration form with HTML5 form controls.
5. Implementing basic DOM manipulation with JavaScript (e.g., show/hide elements, change styles).
6. Building an interactive To-Do List application using JavaScript (Events, DOM, Local Storage).
7. Java Servlet Basics: Creating a Servlet to handle GET/POST requests and return a dynamic HTML response.
8. Java Servlet & Session: Building a login/logout system using Servlets and HttpSession.
9. Java Servlet & DB: Developing a Servlet to perform CRUD operations on a MySQL database (e.g., a product catalog).
10. PHP Basics: Creating a PHP page to display dynamic data and process a simple form.
11. (Mini-Project 1 - PHP): Develop a simple "Blog Application" or "Contact Manager" with user authentication, using PHP, HTML, CSS, JS, and MySQL.
12. (Mini-Project 2 - Java Servlet): Develop a simple "Student Course Registration" or "Book Inventory" system using Java Servlets, HTML, CSS, JS, and MySQL.

Periods: 30
Total Periods: 75

Course Outcomes:

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

CO1: Explain the fundamental architecture of the web and the HTTP protocol.
CO2: Design and implement responsive, accessible, and standards-compliant web pages using HTML5 and CSS3.
CO3: Develop dynamic client-side user interfaces and interactions using JavaScript and the DOM.
CO4: Construct the controller logic for server-side applications using Java Servlets to handle HTTP requests, manage sessions, and interact with a database.
CO5: Build dynamic web applications using PHP for server-side scripting, form handling, session management, and database operations.
CO6: Integrate client-side and server-side components to build cohesive, data-driven web applications.

Suggested Activities/Topics to explore:

- Micro projects on static website development
- Flipped classroom – concepts on CSS
- Online course modules – Coursera/EdX/MIT Courseware/Etc.

Text Books:

1. Felke-Morris, T., "Web Development and Design Foundations with HTML5", 9th ed., Pearson, 2019.
2. Flanagan, D., "JavaScript: The Definitive Guide: Master the World's Most-Used Programming Language", 7th ed., O'Reilly Media, 2020.
3. Hall, M., & Brown, L., "Core Servlets and JavaServer Pages: Volume 1: Core Technologies", 2nd ed., 2004.
4. Duckett, J., "PHP & MySQL: Server-side Web Development", Wiley, 2022.

References:

1. Duckett, J., "HTML and CSS: Design and Build Websites", Wiley, 2011.
2. Haverbeke, M., "Eloquent JavaScript: A Modern Introduction to Programming", 3rd ed., No Starch Press, 2018.
3. Basham, B., Sierra, K., & Bales, B., "Head First Servlets and JSP: Passing the Sun Certified Web Component Developer Exam", 2nd ed., O'Reilly Media, 2008.
4. Busuioc, A., David, C., Finn, T., & Jain, A., "The PHP Workshop", Packt Publishing, 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	1	-	-	-	1	-	-	-	-	1	-	1	-
CO2	2	2	3	-	2	2	-	-	-	-	1	2	2	-
CO3	2	2	3	-	2	1	-	-	-	-	1	2	2	-
CO4	3	3	3	1	3	1	1	1	1	1	2	3	2	1
CO5	3	3	3	1	3	1	1	1	1	1	2	3	2	1
CO6	3	3	3	2	3	1	1	2	2	2	2	3	2	1
Avg.	**2.5**	**2.3**	**3.0**	**1.3**	**2.6**	**1.2**	**1.0**	**1.3**	**1.3**	**1.3**	**1.5**	**2.6**	**1.8**	**1.0**

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

PCS2401	Exploratory Data Analysis	PEC	L	T	P	C
			2	0	2	3

Course Objectives:

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

UNIT I EXPLORATORY DATA ANALYSIS 6

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT II EDA USING PYTHON 6

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT III UNIVARIATE ANALYSIS 6

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

UNIT IV BIVARIATE ANALYSIS 6

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

UNIT V MULTIVARIATE AND TIME SERIES ANALYSIS 6

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

Periods: 30

LIST OF EXPERIMENTS:

1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI.
2. Perform exploratory data analysis (EDA) with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
3. Working with Numpy arrays, Pandas data frames, Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
5. Perform Time Series Analysis and apply the various visualization techniques.
6. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc.

7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
8. Perform EDA on Wine Quality Data Set.
9. Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report.

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to:
CO1: Understand the fundamentals of exploratory data analysis.
CO2: Implement the data visualization using Matplotlib.
CO3: Perform univariate data exploration and analysis.
CO4: Apply bivariate data exploration and analysis.
CO5: Use Data exploration and visualization techniques for multivariate and time series data.
CO6: Perform Exploratory Data Analysis for the real time scenarios.

Suggested Activities:
- Hands-on / Lab Activities
- Mini Project

Text Books:
1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020. (Unit 1)
2. 2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017. (Unit 2)
3. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)

References:
1. Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019.
2. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.
3. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 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	-	-	-	-	-	-	-	2	2	3
CO2	-	1	1	3	3	-	-	-	-	-	-	2	2	3
CO3	2	3	1	3	2	-	-	-	-	-	-	3	2	3
CO4	2	3	2	3	-	-	-	-	-	-	-	3	2	3
CO5	-	3	2	3	3	-	-	-	-	-	-	3	2	3
CO6	2	2	3	2	2	3	3	3	3	3	3	3	2	3
Avg.	2.3	2.4	1.8	2.7	2.5	3.0	3.0	3.0	3.0	3.0	3.0	2.7	2.0	3.0

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

PCS2402	Recommender Systems	PEC	L	T	P	C
			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
- Practical learning – Implement collaborative filtering concepts
- 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

PCS2403	Text and Speech Analysis	PEC	L	T	P	C
			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

PCS2404	Healthcare Analytics	PEC	L	T	P	C
			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	-	1	2	-	-	1	-	2	2	1	2
CO2	3	2	1	-	1	2	1	-	1	-	2	2	1	2
CO3	2	3	2	3	3	1	1	-	1	-	3	2	2	3
CO4	2	2	3	3	3	2	1	-	1	-	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	-	2	-	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

PCS2405	Business Analytics	PEC	L	T	P	C
			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

PCS2406	**Image and Video Analytics**	**PEC**	**L**	**T**	**P**	**C**
			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

PCS2407	**Computer Vision**	**PEC**	**L**	**T**	**P**	**C**
			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

PCS2408	**Big Data Analytics**	**PEC**	**L**	**T**	**P**	**C**
			2	**0**	**2**	**3**

Course Objectives:

- To understand big data.
- To learn and use NoSQL big data management.
- To learn map reduce analytics using Hadoop and related tools.
- To work with map reduce applications
- To understand the usage of Hadoop related tools for Big Data Analytics

UNIT I UNDERSTANDING BIG DATA 5

Introduction to big data – convergence of key trends – unstructured data – industry examples of big data – web analytics – big data applications– big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics

UNIT II NOSQL DATA MANAGEMENT 7

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schema less databases – materialized views – distribution models – master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients

UNIT III MAP REDUCE APPLICATIONS 6

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 IV BASICS OF HADOOP 6

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration.

UNIT V HADOOP RELATED TOOLS 6

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.

Periods: 30

LIST OF EXPERIMENTS:

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories,
3. retrieving files and Deleting files
4. Implement of Matrix Multiplication with Hadoop Map Reduce
5. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
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.

Periods: 30
Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Describe big data and use cases from selected business domains
CO2: Explain NoSQL big data management.
CO3: Install, configure, and run Hadoop and HDFS.
CO4: Perform map-reduce analytics using Hadoop
CO5: Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.
CO6: Apply big data technologies to solve real-world data analytics problems.

Suggested Activities:

- Hands-on / Lab Activities
- Mini Projects
- Case Studies

Text Books:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Sadalage, Pramod J. “NoSQL distilled”, 2013

References:

1. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012. 126
2. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4. Alan Gates, "Programming Pig", O'Reilley, 2011.

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	3	3	-	-	-	2	2	3	1	3	3
CO2	3	3	2	3	2	-	-	-	2	2	3	2	3	2
CO3	3	3	3	2	3	-	-	-	2	2	1	2	3	3
CO4	2	3	3	3	3	-	-	-	2	2	3	3	3	2
CO5	3	3	3	3	3	-	-	-	3	1	3	3	2	3
CO6	3	3	3	3	3	-	-	-	2	2	3	3	3	3
Avg.	**2.8**	**3**	**2.8**	**2.8**	**2.8**	**-**	**-**	**-**	**2.2**	**1.8**	**2.7**	**2.3**	**2.8**	**2.7**

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

PCS2409	**Cloud Application Development**	**PCC**	**L**	**T**	**P**	**C**
			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

PCS2410	App Development	PEC	L	T	P	C
			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	2	3	-
CO2	2	1	3	2	2	-	-	3	2	2	3	3	2	-
CO3	2	2	2	1	2	-	-	1	1	1	1	1	1	-
CO4	1	3	1	1	3	-	-	1	1	3	2	1	3	-
CO5	1	1	3	1	3	-	-	1	1	2	1	3	2	-
CO6	1	1	3	1	3	2	1	1	1	2	1	3	2	-
Avg.	1.5	1.7	2.2	1.3	2.7	2.0	1.0	1.3	1.2	2.0	1.5	2.2	2.2	-

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

PCS2411	Full Stack Web Application Development	PEC	L	T	P	C
			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

PCS2412	UI and UX Design	PEC	L	T	P	C
			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	2	1	-
CO2	2	3	1	3	2	-	-	1	2	2	2	2	1	-
CO3	1	3	3	2	2	-	-	2	3	1	2	2	1	-
CO4	1	2	3	3	1	-	-	3	2	1	3	2	1	-
CO5	1	2	3	2	1	-	-	2	1	1	1	2	1	-
CO6	1	2	3	2	1	1	1	2	1	1	1	2	1	-
Avg.	**1.5**	**2.2**	**2.3**	**2.5**	**1.3**	**1.0**	**1.0**	**2.2**	**2.0**	**1.3**	**1.7**	**2.0**	**1.0**	**-**

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

PCS2413	**Software Testing and Automation**	**PEC**	**L**	**T**	**P**	**C**
			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	3	2	3
CO2	2	3	1	1	1	-	-	2	2	1	2	1	2	3
CO3	2	2	1	3	1	-	-	1	3	1	2	2	3	2
CO4	2	1	3	2	1	-	-	1	1	1	2	3	1	2
CO5	2	2	1	3	1	-	-	1	3	2	1	2	1	3
CO6	1	1	3	2	3	3	-	1	3	2	2	2	3	2
Avg.	2.0	2.0	1.8	2.0	1.5	3.0	-	1.2	2.2	1.7	1.8	2.2	2.0	2.5

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

PCS2414	Web Application Security	PEC	L	T	P	C
			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	-	2	-	-
CO3	3	3	1	3	3	-	-	-	3	-	1	2	-	-
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**	**2**	**-**	**-**

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

PCS2415	**DevOps**	**PEC**	**L**	**T**	**P**	**C**
			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 DevOps terminologies and apply different actions performed through Version control tools like Git.
CO2: Ability to compile and build using Maven and Gradle.
CO3: Perform Continuous Integration, Continuous Testing and Continuous Deployment using Jenkins.
CO4: Ability to do Configuration Management using Ansible.
CO5: Apply cloud-based DevOps practices by utilizing Azure DevOps tools for project planning, version control, continuous integration and continuous deployment.
CO6: Design, develop, and deploy a full-stack application using MVC architecture with the Spring Boot framework, integrating version control, CI/CD, configuration management and cloud-based DevOps tools.

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	2			3			2	2		2	3	2	
CO2	3	2	2		3					2	2	3	2	
CO3	3	2	2		3					2	2	3	2	
CO4	3	2	2		3					2	2	3	2	
CO5	3	2	2		3					2	3	3	2	
CO6	3	3	3	2	3			2	2	3	3	3	2	
Avg.	3	2.2	2.2	2	3	-	-	2	2	2.2	2.4	3	2	-

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

PCS2416	Principles of Programming Languages	PEC	L	T	P	C
			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	2	3	-
CO2	3	3	3	2	2	-	-	-	-	-	3	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	3	2	3	-
CO4	3	3	3	3	2	2	-	-	-	-	-	3	2	-
CO5	3	3	3	3	2	2	-	-	-	-	-	3	2	3
CO6	3	3	3	3	3	2.5	2	1	3	1	3	3	3	-
Avg.	**2.8**	**2.8**	**3.0**	**2.5**	**2.0**	**2.2**	**2.0**	**1.0**	**3.0**	**1.0**	**3.0**	**2.5**	**2.7**	**3.0**

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

			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

			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

			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

PCS2420	Security and Privacy in Cloud	PEC	L	T	P	C
			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

PCS2421	**Storage Technologies**	**PEC**	**L**	**T**	**P**	**C**
			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

			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

PCS2425	**Ethical Hacking**	**PEC**	**L**	**T**	**P**	**C**
			2	**0**	**2**	**3**

Course Objectives:

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

UNIT I INTRODUCTION 6

Ethical Hacking Overview - Role of Security and Penetration Testers - Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing - Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security.

UNIT II FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS 6

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT III ENUMERATION AND VULNERABILITY ANALYSIS 6

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities – Vulnerabilities of Embedded OS - Vulnerability Testing: Building Test Applications, Test Case Design, and Execution

UNIT IV SYSTEM HACKING 6

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade

UNIT V NETWORK PROTECTION SYSTEMS 6

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

30 PERIODS

LIST OF EXPERIMENTS:

1. Install Kali or Backtrack Linux / Metasploitable/ Windows XP

2. Practice the basics of reconnaissance.
3. Using FOCA / SearchDiggity tools, extract metadata and expand the target list.
4. Aggregates information from public databases using online free tools like Paterva's Maltego.
5. Information gathering using tools like Robtex.
6. Scan the target using tools like Nessus.
7. View and capture network traffic using Wireshark.
8. Automate dig for vulnerabilities and match exploits using Armitage

Kali or Backtrack Linux, Metasploitable, Windows XP

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the basics of computer-based vulnerabilities.
CO2: Understand different footprinting, reconnaissance, and scanning methods.
CO3: Analyze enumeration techniques and vulnerability assessment methods.
CO4: Analyze hacking techniques used in web and wireless applications.
CO5: Understand network protection mechanisms and security measures.
CO6: Apply ethical hacking tools to identify and expose system vulnerabilities.

Suggested Activities:
- Case study
- Group discussion
- Hands-on session
- Role-play activity
- Demo

Textbooks:
1. Thomas Wilhelm and Patrick Engebretson, "The Basics of Hacking and Penetration Testing", SYNGRESS, Elsevier, 3rd Edition, 2026.
2. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No Starch Press, 2024.
3. Dafydd Stuttard & Marcus Pinto, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", John Wiley & Sons, 2nd Edition, 2020.

References:

1. David Kennedy, Jim O'Gorman, Devon Kearns, Mati Aharoni, "Metasploit: The Penetration Tester's Guide", No Starch Press, 2023.
2. Allen Harper, Shon Harris, "Gray Hat Hacking: The Ethical Hacker's Handbook", 6th Edition, McGraw Hill, 2022.
3. Yuri Diogenes and Erdal Ozkaya, "Cybersecurity – Attack and Defense Strategies", 3rd Edition, Packt Publishing, 2022.
4. Donovan Martin, "Hacking: Learn the Basics of Ethical Hacking and Penetration Testing", Independently Published, 2019.
5. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2020.

Web References:
- https://www.kali.org/docs/
- https://attack.mitre.org/
- https://www.sans.org/security-resources/
- https://www.eccouncil.org/train-certify/certified-ethical-hacker-ceh/
- http://www.tenable.com/products/nessus.

- http://www.wireshark.org.
- https://www.blackhatethicalhacking.com/tools/armitage/

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	2	2	-
CO2	3	3	-	2	3	-	1	-	-	-	2	2	3	-
CO3	3	3	2	3	3	-	1	-	-	-	2	3	3	-
CO4	2	3	2	2	3	-	2	-	-	-	2	3	3	-
CO5	3	3	3	2	3	2	2	-	-	-	2	3	2	-
CO6	3	3	3	3	3	1	3	2	2	1	3	3	3	1
Avg.	**2.83**	**2.83**	**2.5**	**2.4**	**2.83**	**1.5**	**1.67**	**2**	**2**	**1**	**2.17**	**2.67**	**2.67**	**1**

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

PCS2426	**Digital and Mobile Forensics**	**PEC**	**L**	**T**	**P**	**C**
			2	**0**	**2**	**3**

Course Objectives:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation.
- To understand how to be prepared for digital forensic readiness.
- To understand and use forensics tools for iOS devices.
- To understand and use forensics tools for Android devices.

UNIT I INTRODUCTION TO DIGITAL FORENSICS 6

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase.

UNIT II DIGITAL CRIME AND INVESTIGATION 6

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – Web Forensics – International Cooperation to Collect Digital Evidence.

UNIT III DIGITAL FORENSIC READINESS 6

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics.

UNIT IV iOS FORENSICS 6

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud.

UNIT V ANDROID FORENSICS 6

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling.

30 PERIODS

LIST OF EXPERIMENTS:

1. Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.
2. Data extraction from call logs using Sleuth Kit.
3. Data extraction from SMS and contacts using Sleuth Kit.
4. Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups.
5. Process and parse records from the iOS system.
6. Extract installed applications from Android devices.
7. Extract diagnostic information from Android devices through the adb protocol.
8. Generate a unified chronological timeline of extracted records.

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Explain the fundamentals of digital forensics, including forensic science principles, digital evidence, and the phases of the digital forensic process.
CO2: Analyze digital crimes, relevant legal aspects, and investigation methods used for collecting digital evidence.
CO3: Apply digital forensic readiness concepts, frameworks, and methodologies in both law enforcement and enterprise environments.
CO4: Examine challenges in digital forensics and evaluate appropriate strategies for effective forensic investigations.
CO5: Investigate, identify, and extract digital evidence from iOS devices using standard procedures and forensic tools.
CO6: Investigate, identify, and extract digital evidence from Android devices using ADB, rooting techniques, and forensic tools.

Suggested Activities:

- Case Study Analysis
- Group Discussion
- Framework Analysis
- Design Activity
- Tool Demonstration: Autopsy, Sleuth Kit, Splunk / ELK Stack, MVT (Mobile Verification Toolkit), ADB (Android Debug Bridge)
- Case Simulation
- Technical Seminar
- Rooting Simulation
- App Analysis
- Tool Comparison

Textbooks:

1. Andre Arnes, “Digital Forensics”, 1st Edition, John Wiley & Sons, 2018.
2. Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, 1st Edition, CRC Press, 2022.
3. Thomas J. Holt, Adam M. Bossler, and Kathryn C. Seigfried-Spellar, “Cybercrime and Digital Forensics an Introduction”, 2nd Edition, Routledge, 2023.

References:

1. Vacca, J, “Computer Forensics, Computer Crime Scene Investigation”, 2nd Edition, Jones & Bartlett Learning, LLC, 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	3	2	–	–	2	–	1	–	–	–	2	2	2	–
CO2	3	3	–	2	2	1	2	–	–	–	2	2	3	–
CO3	3	2	2	2	2	1	2	–	–	–	3	3	3	–
CO4	2	3	2	3	2	2	2	–	–	–	3	3	3	–
CO5	2	3	2	3	3	1	2	2	1	–	3	3	3	1
CO6	2	3	2	3	3	1	2	2	1	–	3	3	3	1
Avg.	**2.50**	**2.67**	**2.00**	**2.60**	**2.33**	**1.20**	**1.83**	**2.00**	**1.00**	**-**	**2.67**	**2.67**	**2.83**	**1.00**

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

PCS2427	Social Network Security	PEC	L	T	P	C
			2	0	2	3

Course Objectives:

- To understand the concepts of Semantic Web, Social Web, and their applications.
- To learn ontology-based knowledge representation and Semantic Web technologies.
- To analyze social network communities and human behavior in online social environments.
- To understand community detection, privacy, trust, and data management in social networks.
- To learn graph-based visualization techniques and network analysis measures for social networks.

UNIT I INTRODUCTION 6

Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.

UNIT II MODELLING, AGGREGATING, AND KNOWLEDGE REPRESENTATION 6

Ontology and its role in the Semantic Web: Ontology-based knowledge representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

UNIT III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS 6

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Decentralized online social networks – Multi-Relational characterization of dynamic social network communities.

UNIT IV PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES 6

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 6

Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.

30 PERIODS

LIST OF EXPERIMENTS:

1. Design a social media application incorporating network analysis features such as friend recommendations and community detection
2. Analyze a real-world social network dataset using key measures such as degree, betweenness and closeness centrality using Network
3. Create and query an RDF-based knowledge graph representing social individuals and their relationships using Apache Jena
4. Detect and evaluate communities in a social network dataset using Louvain and Girvan-Newman algorithms
5. Create a Network model, read and write data, and find Friend of Friends using Neo4j
6. Implement secure search and a Privacy detector in a social media environment
7. Perform data mining on a social network dataset — collect, store and analyse patterns such as clustering and community structure
8. Visualize a social network using Node-Edge diagrams and Matrix representations using Gephi or D3.js

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

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

CO1: Understand the fundamentals of Semantic Web, Social Networking, and Social Network Analysis techniques.

CO2: Analyze security and privacy issues in social networks and apply secure knowledge representation techniques.

CO3: Apply data extraction, community mining, and data mining techniques to analyze patterns

CO4: Analyze human behavior prediction in social communities using Graph Theory and Neo4j.

CO5: Apply data warehousing and network analysis techniques to social network applications and visualizations.

CO6: Apply access control, identity management, and trust mechanisms in online social network environments.

Suggested Activities:

- Group Discussion
- Mini Project
- Guest Lecture
- Hand-on Session
- Real-time Case Studies

Textbooks:

1. Peter Mika,"Social Networks and the Semantic Web", First Edition, Springer 2007.
2. BorkoFurht, "Handbook of Social Network Technologies and Application", First Edition, Springer, 2010.
3. Jérôme Baton, Rik Van Bruggen, "Learning Neo4j 3.x", Second Edition, Packt publishing, 2018.
4. David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.

References:

1. Easley D. Kleinberg J., Networks, Crowds, and Markets, "Reasoning about a Highly Connected World", Cambridge University Press, 2010.
2. Jackson, Matthew O., "Social and Economic Networks", Princeton University Press, 2008.
3. GuandongXu,Yanchun Zhang and Lin Li, "Web Mining and Social Networking Techniques and applications", First Edition, Springer, 2011.
4. Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
5. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling", IGI Global Snippet, 2009.
6. John G. Breslin, Alexander Passant and Stefan Decker, The Social Semantic Web‖, Springer, 2009

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	–
CO2	2	2	–	1	–	2	2	–	–	–	1	2	3	–
CO3	2	3	2	2	3	–	–	–	–	–	1	3	3	1
CO4	2	3	1	2	2	–	–	–	–	–	1	2	3	2
CO5	2	1	–	–	–	–	–	–	–	–	1	2	2	–
CO6	2	2	2	1	2	2	2	–	–	–	1	3	3	–
Avg.	**2.00**	**2.00**	**1.67**	**1.50**	**2.33**	**2.00**	**2.00**	**–**	**–**	**–**	**1.00**	**2.33**	**2.67**	**1.50**

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

PCS2428	Modern Cryptography	PEC	L	T	P	C
			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	2	1	-
CO2	2	2	-	-	1	-	-	-	-	-	1	2	1	-
CO3	3	3	1	2	2	-	-	-	-	-	1	3	2	1
CO4	2	3	2	2	2	1	1	-	1	-	1	3	2	-
CO5	3	2	2	1	3	-	-	-	-	-	1	3	3	-
CO6	2	3	2	2	2	1	1	-	1	-	2	2	2	-
Avg.	**2.5**	**2.3**	**1.75**	**1.75**	**1.8**	**1**	**1**	**-**	**1**	**-**	**1.67**	**2.5**	**1.8**	**1**

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

PCS2429	**Security and Trust in IoT**	**PEC**	**L**	**T**	**P**	**C**
			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

PCS2430	Network Security	PEC	L	T	P	C
			3	0	0	3

Course Objectives:

- Understand fundamental security concepts and learn classical cryptography techniques.
- Understand principles of modern symmetric encryption and learn cryptanalysis techniques.
- Understand public key cryptosystems and key exchange methods.
- Understand digital signatures, certificates, and key management and learn authentication and secure communication protocols.
- Understand malware, access control mechanisms, system security and learn intrusion detection/prevention.

UNIT I FOUNDATIONS OF SECURITY AND MATHEMATICAL BASIS OF CRYPTOGRAPHY 9

Basics of Security: CIA Triad - Threats, Attacks and Services. Classical Cryptography: Substitution and Transposition ciphers. Introduction to Number Theory: The Euclidean Algorithm – Modular Arithmetic - Fermat's and Euler's Theorems – Testing for Primality – The Chinese Remainder Theorem – Discrete Logarithms.

UNIT II SYMMETRIC CRYPTOGRAPHY AND CRYPTANALYSIS 9

Symmetric Cipher - Block and Stream Cipher - Feistel Ciphers - Data Encryption Standard - DES Structure - Key Generation - Simplified DES - Linear and Differential cryptanalysis - CPA, CCA - Advanced Encryption Standard - Analysis of AES.

UNIT III ASYMMETRIC CRYPTOGRAPHY AND CRYPTOGRAPHIC PROTOCOLS 9

Public Key Cryptosystems: The RSA Algorithm - Diffie-Hellman Key Exchange - Elgamal Cryptosystems - Elliptic Curve Cryptography. Hash Functions - Hash Algorithms - Secure Hash Algorithm: SHA - MD5 - Message Authentication Codes - Zero Knowledge Protocols - Introduction to Quantum Cryptography - Threshold Cryptography.

UNIT IV PKI, DIGITAL SIGNATURES AND SECURE COMMUNICATION PROTOCOLS 9

Digital Signatures Schemes - Digital Certificate - Key Management - Kerberos - Key Agreement and Distribution - PKI - X.509 Certificate - E-Mail Security - PGP - S/MIME - IP security - Virtual Private Network - Web Security - Secure Socket Layer - Transport Layer Security - Secure Electronic Transaction.

UNIT V MALWARE, ACCESS CONTROL AND SECURITY TESTING 9

Malwares and Types of Malwares - Internet scanning worms - Mobile Malware and Botnets - Password Management - Access Control in Operating Systems: Discretionary, Mandatory and Role Based Access Control - Firewall - Intrusion Detection System and types - Intrusion Prevention System - Penetration testing: concept, types, steps - OWASP top ten vulnerabilities - Secure Coding

45 PERIODS

Course Outcomes:

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

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

CO1: Explain security principles, classical cryptography and mathematical foundations of cryptography.

CO2: Apply symmetric key cryptographic algorithms and analyze their security.

CO3: Apply public key cryptosystems, hash functions and authentication techniques.

CO4: Analyze security protocols and key management mechanisms used in secure communication.

CO5: Evaluate network attacks, malware and intrusion detection/prevention techniques.

CO6: Design secure systems and recommend security best practices and policies.

Suggested Activities:

- Solve modular exponentiation and multiplicative inverse using Fermat and Euler theorem.
- Demonstrate the working of DES and AES algorithms using CrypTool.
- Demonstrate the Hash code generation using MD5 and SHA 256 algorithm.
- Case studies on understand the components of X.509 Certificate and Blockchain.
- Demonstrate IP security and configure VPN connection.
- Implement the SSL/TLS in Web Server for a Web Application.

- Configure the Access Control List using firewall, and mitigate DoS attack.
- Simulate the importance of various security standards in WLAN.

Textbooks:

1. William Stallings, “Cryptography and Network Security Principles and Practices”, Pearson/PHI, Seventh Edition, 2017.

References:

1. Wenbo Mao, “Modern Cryptography Theory and Practice”, Pearson Education, 2004.
2. Pfleeger and Pfleeger, “Security in computing”, Third Edition, PHI/Pearson, 2003.
3. Behourz Forouzan, Debdeep Mukhopadyay, “Cryptography and Network Security”, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
4. Gilles van Assche, “Quantum Cryptography and Secret-Key Distillation”, Cambridge University Press, 2010.
5. Oded Goldreich, Foundations of Cryptography (two volumes) Cambridge university Press, 2004.
6. Patrick Engebretson, “The basics of Hacking and Penetration Testing”, Elsevier, 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	2	2	1	1	-	1	2	-	1	-	2	1	1	1
CO2	3	3	3	3	3	-	-	-	1	-	2	2	2	1
CO3	3	3	3	3	3	-	2	-	1	-	2	2	2	1
CO4	3	3	3	3	3	3	3	2	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg.	**2.83**	**2.83**	**2.67**	**2.67**	**3**	**2.5**	**2.6**	**2.67**	**2**	**3**	**2.5**	**2**	**2.33**	**2**

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

PCS2431	**Malware Analysis**	**PEC**	**L**	**T**	**P**	**C**
			2	**0**	**2**	**3**

Course Objectives:

- To introduce the fundamentals of malware, types and its effects
- To enable to identify and analyze various malware types by static analysis
- To enable to identify and analyze various malware types by dynamic analysis
- To deal with detection, analysis, understanding, controlling, and eradication of malware

UNIT I INTRODUCTION AND BASIC ANALYSIS 6

Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Signature-based Malware Analysis, Malware Signatures and Detection Techniques, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots.

UNIT II ADVANCED STATIC ANALYSIS 7

The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism.

UNIT III ADVANCED DYNAMIC ANALYSIS 7

Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, API calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching

UNIT IV MALWARE FUNCTIONALITY 5

Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection

UNIT V ANDROID MALWARE ANALYSIS 5

Android Malware Analysis: Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis, Signature-based Android Malware Detection, Case studies.

30 PERIODS

List of Experiments

1. Experimentation on Initial Infection Vectors and Malware Discovery
2. Implementation on Sandboxing Malware and Gathering Information from Runtime Analysis
3. Implementation on Portable Executable (PE32) File Format
4. Implementation on Executable Metadata and Executable Packers
5. Experimentation on Malware Self - Defense, Compression, and Obfuscation Techniques
6. Experimentation on Malware behaviour analysis
7. Experimentation on analyzing Malicious Microsoft Office and Adobe PDF Documents Experimentation on Mobile malware analysis
8. Experimentation on Packing and Unpacking of malware
9. Experimentation on Rootkit AntiForensics and Covert Channels
10. Experimentation on Modern Rootkit Analysis
11. Experimentation on Malware traffic analysis

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the fundamentals of malware analysis, including basic concepts, tools, and techniques.
CO2: Apply static analysis techniques to examine malware structure, file formats, and code behavior.
CO3: Apply dynamic analysis techniques to monitor and analyze malware execution and system interactions.
CO4: Analyze advanced malware analysis methods including reverse engineering, debugging, and disassembly.
CO5: Analyze different malware functionalities such as persistence, privilege escalation, and process injection techniques.
CO6: Apply static and dynamic analysis techniques for Android malware and understand its architecture and application lifecycle.

Suggested Activities:
- Hands-on Lab
- Tool Practice
- Case Study
- Mini Project

Textbooks:
1. Michael Sikorski and Andrew Honig, "Practical Malware Analysis" by No Starch Press, 2012, ISBN: 9781593272906
2. Bill Blunden, "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System", Second Edition, Jones & Bartlett Publishers, 2009

References:
1. Jamie Butler, Greg Hoglund, "Rootkits: Subverting the Windows Kernel", Addison-Wesley Professional, 2005
2. Bruce Dang, Alexandre Gazet, Elias Bachaalany, Sébastien Josse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", Wiley, 2014
3. Victor Marak, "Windows Malware Analysis Essentials", Packt Publishing, 2015
4. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis", CRC Press (Taylor & Francis Group), 2015

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	2	2	–
CO2	2	3	2	2	3	–	–	–	–	–	1	3	3	–
CO3	2	3	2	2	3	–	–	–	–	–	1	3	3	–
CO4	2	3	2	3	3	–	–	–	–	–	1	3	3	1
CO5	2	2	2	1	2	–	–	–	–	–	1	2	3	–
CO6	2	2	2	2	3	–	–	–	–	–	1	3	3	1
Avg.	**2.00**	**2.33**	**2.00**	**2.00**	**2.50**	**–**	**–**	**–**	**–**	**–**	**1.00**	**2.67**	**2.83**	**1.00**

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

PCS2432	**Cryptocurrency and Blockchain Technologies**	**PEC**	**L**	**T**	**P**	**C**

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

PCS2433	Robotic Process Automation and Intelligent Agents	PEC	L	T	P	C
			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

PCS2434	Augmented Reality/Virtual Reality	PEC	L	T	P	C
			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

PCS2435	**Game Development**	**PEC**	**L**	**T**	**P**	**C**
			2	**0**	**2**	**3**

Course Objectives:

- Understand 2D & 3D game development fundamentals
- Learn game design principles and mechanics
- Develop games using Pygame
- Explore game engines (Godot & Unity)
- Build a complete playable game

UNIT I GAME GRAPHICS AND FUNDAMENTALS 6

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

UNIT II GAME DESIGN PRINCIPLES 6

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

UNIT III GAME ENGINE DESIGN 6

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.

UNIT IV GAMING PLATFORMS AND FRAMEWORKS 6

Introduction to game development frameworks – Pygame architecture and features – Game development using Pygame– Overview of game engines – Godot engine architecture: scenes, nodes and scripting – Unity engine fundamentals: GameObjects, components and basic scripting – Mobile game development concepts – Single-player and multiplayer game overview – Comparison of game development platforms and tools.

UNIT V GAME DEVELOPMENT 6

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

30 PERIODS

LIST OF EXPERIMENTS:

1. Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI.
2. Write a program to implement a game loop and rendering mechanism using Pygame.
3. Write a program to implement player movement and input handling using Pygame.
4. Write a program to implement sprite-based animation in a game environment.
5. Write a program to implement collision detection between game objects.
6. Write a program to implement basic game logic with scoring and levels.
7. Write a program to implement simple game AI for enemy movement.
8. Develop a 2D interactive game using Pygame.
9. Implement a simple game scene using Godot engine.
10. Design a level with user interface elements using Godot.
11. Implement a simple interactive game using Unity.

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Comprehend the fundamental concepts of game development.
CO2: Apply game design principles in developing interactive applications.
CO3: Analyze the architecture and implement AI and interactive systems.
CO4: Develop interactive 2D games using Pygame
CO5: Design and develop game environments using modern game engines such as Godot and Unity.
CO6: Build a complete playable 2D and 3D interactive games.

Suggested Activities:

- Develop a simple 2D game prototype using Pygame demonstrating player interaction and game logic.
- Design a Game Design Document (GDD) for a proposed game including storyline, characters, and level structure.
- Create a basic interactive scene using a game engine such as Godot or Unity.

References:

1. David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, CRC Press,2006.
2. Jung Hyun Han, "3D Graphics for Game Programming", Chapman and Hall/CRC, 2011.
3. Al Sweigart, Making Games with Python & Pygame, CreateSpace Independent Publishing, 2012.
4. John P. Doran, *Unity Game Development Blueprints*, Packt Publishing, 2014.
5. Ryan Henson Creighton, Unity 3.x Game Development by Example Beginner's Guide**,** Packt 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	-
CO2	2	3	2	-	-	1	-	-	1	-	-	2	2	-
CO3	2	3	2	1	2	-	-	-	-	-	-	3	2	-
CO4	3	2	3	1	3	-	-	-	1	-	-	3	2	-
CO5	2	2	3	1	3	-	-	1	1	-	-	3	3	1
CO6	3	3	3	2	3	1	1	2	2	2	1	3	3	1
Avg.	**2.50**	**2.50**	**2.60**	**1.25**	**2.75**	**1.00**	**1.00**	**1.50**	**1.25**	**2.00**	**1.00**	**2.67**	**2.17**	**1.00**

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

PCS2436	**Low-Code/ No-Code Development**	**PEC**	**L**	**T**	**P**	**C**
			2	**0**	**2**	**3**

Course Objectives:

- To understand the fundamentals and concepts of low-code/no-code development platforms.
- To design and develop web and mobile applications using modern drag-and-drop platforms such as Bubble.io, Adalo, and Webflow.
- To automate workflows and integrate third-party services, including Firebase Authentication, Airtable, OpenAI API, Stripe, Twilio, and Google Maps API.

UNIT I INTRODUCTION TO LOW-CODE/NO-CODE DEVELOPMENT 6

Overview of Low-Code and No-Code Platforms – Concepts and Characteristics – Advantages and Limitations – Comparison with Traditional Development Approaches – Global Applicability and Industry Adoption of LCNC Platforms – Role of LCNC in Accelerating Digital Transformation and Technology Adoption – Use Cases and Applications – Understanding When to Use Low-Code/No-Code Solutions – Evaluation Criteria for Platform Selection – Introduction to Popular Platforms: Bubble.io, Webflow, Adalo and similar tools.

UNIT II BUILDING WEB AND MOBILE APPS WITH DRAG-AND-DROP TOOLS 6

UI/UX Design Principles – Design of User Interfaces and User Experience in No-Code Platforms – Development of Interactive Web Pages using Webflow and Bubble – Mobile Application Development using Adalo and Glide Platforms.

UNIT III AUTOMATING BUSINESS WORKFLOWS 6

Introduction to Workflow Automation Tools – Connecting Services using Zapier and Make (Integromat) – Automating Processes using Google Apps Script and n8n.

UNIT IV INTEGRATING APIS AND EXTERNAL SERVICES 6

Connecting External APIs without Coding – Integration of AI-based Features using OpenAI API – Payment Gateway Integration using Stripe and Razorpay.

UNIT V DEPLOYING AND MANAGING NO-CODE APPLICATIONS 6

Hosting and Publishing Applications on Various Platforms – Security Considerations in No-Code Applications – Scaling Low-Code/No-Code Solutions for Enterprise Applications.

30 PERIODS

LIST OF EXPERIMENTS:

1. Create a simple landing page using Webflow.
2. Build a to-do list or note-taking app using Adalo or Glide.
3. Automating Workflows: Automate email responses using Zapier and Google Sheets.
4. Design workflow automation using n8n for data synchronization and notifications.
5. Use Airtable as a backend for a no-code web app.
6. Use OpenAI API to add chatbot functionality to a Bubble app.
7. Implement Stripe or Razorpay in a no-code online store.
8. Publish a no-code app on Firebase or a custom domain.

30 PERIODS
TOTAL PERIODS: 60

Course Outcomes:

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

CO1: Explain the concepts, characteristics, advantages, and limitations of low-code/no-code development platforms.

CO2: Analyze the suitability of low-code/no-code solutions for different use cases and select appropriate platforms based on requirements.

CO3: Design user interfaces and develop interactive web and mobile applications using drag-and-drop tools such as Webflow, Bubble, Adalo, and Glide.

CO4: Apply workflow automation techniques using tools like Zapier, Make (Integromat), Google Apps Script, and n8n to streamline business processes.

CO5: Integrate external APIs and third-party services, including AI-based features and payment gateways, into no-code applications.

CO6: Deploy, manage, and scale no-code applications while addressing security considerations for real-world enterprise needs.

Suggested Activities:

- Case study on selecting suitable platforms for applications
- Seminar / Presentation on emerging trends in no-code platforms
- Literature review of recent tools and technologies
- Quiz / Debate on no-code vs traditional development

Textbooks:

1. Griffiths, R., Low-Code Application Development with Power Apps, Packt Publishing, 2020.
2. Harrington, P., Bubble.io: Build Web Apps Without Code, Independently Published, 2021.
3. Microsoft Press, Microsoft Power Platform Fundamentals (PL-900), Microsoft Press, 2021.
4. Adkin, D., The No-Code Playbook: Build Scalable Software Without Coding, Adalo, 2022.
5. Ries, E., The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Business, 2011.

Web References:

1. https://manual.bubble.io
2. https://university.webflow.com
3. https://zapier.com/help
4. https://www.make.com/en/help
5. https://platform.openai.com/docs
6. https://stripe.com/docs
7. https://developers.google.com/apps-script guide.

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	3	2	–	2	1	–	–	–	–	3	2	3	–
CO3	3	2	3	2	3	–	–	–	1	–	2	3	3	1
CO4	3	3	2	3	3	1	–	–	–	–	3	3	3	1
CO5	3	3	2	3	3	1	1	–	1	–	3	3	3	1
CO6	3	3	3	3	3	2	2	2	2	2	3	3	3	2
Avg.	**3.00**	**2.67**	**2.40**	**2.75**	**2.67**	**1.25**	**1.50**	**2.00**	**1.33**	**2.00**	**2.67**	**2.67**	**2.83**	**1.25**

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

PCS2437 Quantum Computing PEC L T P C

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

PCS2438	Metaverse	PEC	L	T	P	C
			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

PCS2439	Green Computing	PEC	L	T	P	C
			3	0	0	3

Course Objectives:

- To learn the fundamentals of Green Computing.
- To analyze the Green computing Grid Framework.

- To understand the issues related with Green compliance.
- To study and develop various case studies.

UNIT I FUNDAMENTALS 9

Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

UNIT II GREEN ASSETS AND MODELING 9

Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.

UNIT III GRID FRAMEWORK 9

Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework.

UNIT IV GREEN COMPLIANCE 9

Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future

UNIT V CASE STUDIES 9

The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

Periods: 45 PERIODS

Course Outcomes:

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

CO1: Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.

CO2: Analyze Green IT strategies, policies, and environmental metrics to evaluate sustainable business practices

CO3: Apply green asset and modeling techniques to design environmentally sustainable IT infrastructures.

CO4: Analyze virtualization technologies, green data centers and grid frameworks to improve energy efficiency in IT systems.

CO5: Apply Green IT compliance standards, protocols, and transformation strategies in organizational contexts.

CO6: Analyze real-world case studies to evaluate the effectiveness of Green IT strategies across different sectors.

Suggested Activities:

- Carbon Footprint Assessment Activity
- Case Study Analysis
- Virtualization Lab Activity
- Group Discussion/debate
- E-Waste Management Activity

Textbooks:

1. Bhuvan Unhelkar, "Green IT Strategies and Applications-Using Environmental Intelligence", CRC Press, June 2014.
2. Woody Leonhard, Katherine Murray, "Green Home computing for dummies", John Wiley & Sons, 2012.

References:

1. Alin Gales, Michael Schaefer, Mike Ebbers, "Green Data Center: steps for the Journey", Shroff/IBM rebook, 2011.
2. John Lamb, "The Greening of IT", Pearson Education, 2009.
3. Jason Harris, "Green Computing and Green IT- Best Practices on regulations & industry", Lulu.com, 2008
4. Carl Speshocky, "Empowering Green Initiatives with IT", John Wiley & Sons, 2010.
5. Wu Chun Feng (editor), "The Green computing book : Tackling Energy Efficiency at Large Scale ", CRC Press, 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	2	2	1	-	1	3	2	-	-	-	1	2	2	-
CO2	2	3	2	1	2	3	2	-	1	-	1	2	3	-
CO3	3	2	3	2	3	2	1	-	-	-	1	3	3	-
CO4	3	3	2	2	3	2	1	-	-	-	1	3	3	-
CO5	2	2	2	1	2	3	3	-	-	-	1	2	3	-
CO6	2	3	2	2	2	3	2	-	1	-	2	2	2	-
Avg.	**2.3**	**2.5**	**2**	**1.6**	**2.17**	**2.67**	**1.8**	**-**	**1**	**-**	**1.17**	**2.3**	**2.67**	**-**

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

PCS2440	**Knowledge Engineering**	**PEC**	**L**	**T**	**P**	**C**
			2	**0**	**2**	**3**

Course Objectives:

- To understand the basics of Knowledge Engineering
- To discuss methodologies and modeling for Agent Design and Development
- To design and develop ontologies.
- To apply reasoning with ontologies and rules.
- To understand learning and rule learning.
- To apply rule learning techniques for problem solving.

UNIT I REASONING UNDER UNCERTAINTY 6

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability –

Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering.

UNIT II METHODOLOGY AND MODELLING 6

Conventional Design and Development – Development tools and Reusable Ontologies – Graph based Modelling – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios

UNIT III ONTOLOGIES – DESIGN AND DEVELOPMENT 6

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

UNIT IV REASONIING WITH ONTOLOGIES AND RULES 6

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

UNIT V LEARNING AND RULE LEARNING 6

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.

Periods: 30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Perform operations with Evidence Based Reasoning.
2. Perform Evidence based Analysis.
3. Perform operations on Probability Based Reasoning.
4. Perform Believability Analysis.
5. Implement Rule Learning and refinement.
6. Perform analysis based on learned patterns.
7. Construction of Ontology for a given domain.

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the basics of Knowledge Engineering
CO2: Apply methodologies and modelling for Agent Design and Development.
CO3: Design and develop ontologies
CO4: Apply reasoning with ontologies and rules.
CO5: Explain fundamental concepts of machine learning
CO6: Apply rule learning techniques and perform hypothesis generation for problem solving

Suggested Activities:

- Group Discussion like generalization vs specialization with examples.
- Mini Project e.g. Builds a simple rule-based classifier.
- Think-Pair-Share - Students can explain abductive reasoning with examples.
- Flipped classroom on certain topics like Rule Learning etc.

Textbooks:

1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016.

References:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 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	1	1	1	1	1	-	1	2	1	2	1	1	1
CO2	3	2	3	2	2	-	-	2	1	2	1	3	3	1
CO3	2	2	3	2	2	-	-	3	2	2	2	3	2	3
CO4	2	2	3	1	1	-	-	2	2	2	2	2	1	1
CO5	2	2	3	1	1	-	-	2	1	1	1	2	1	1
CO6	3	3	2	3	2	1	1	1	1	1	3	2	3	3
Avg.	**2.5**	**2**	**2.5**	**1.6**	**1.5**	**1**	**1**	**1.8**	**1.5**	**1.5**	**1.8**	**2.1**	**1.8**	**1.6**

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

PCS2441	**Soft Computing**	**PEC**	**L**	**T**	**P**	**C**
			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: Total Periods: 30

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: 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

PCS2442	**Neural Networks and Deep Learning**	**PEC**	**L**	**T**	**P**	**C**
			2	**0**	**2**	**3**

Course Objectives:

- To understand the basics in deep neural networks
- T understand the basics of associative memory and unsupervised learning networks
- To apply CNN architectures of deep neural networks
- To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
- To apply autoencoders and generative models for suitable applications.

UNIT I INTRODUCTION 6

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: Biological neuron -An Introduction Evolution of Neural Networks- Important Terminologies of ANNs, Learning rules: Hebbian, Perceptron, Competitive learning rules- Linear & Non-Linear Activation functions -Supervised Learning Network - basic Supervised Learning Neural Network models: McCulloch Pitts, Perceptron, Adaline, Madaline, RBF

UNIT II ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS 6

Hebbian & Outer Product Rule -Training Algorithms for Pattern Association-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Adaptive Resonance Theory Network

UNIT III THIRD-GENERATION NEURAL NETWORKS 6

Spiking Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation

UNIT IV DEEP FEEDFORWARD NETWORKS 6

History of Deep Learning- Gradient Learning – Chain Rule and Backpropagation – overfitting, underfitting, Bias and Variance, Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets

UNIT V RECURRENT NEURAL NETWORKS 6

Introduction – Recurrent Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders

Total Periods: 30 PERIODS

LAB EXPERIMENTS: **Total Periods:** 30 PERIODS

1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron, in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement Hopfield, SOM, ART in TensorFlow/Keras
6. Implement an Image Classifier using CNN in TensorFlow/Keras.
7. Improve the Deep learning model by fine tuning hyper parameters.
8. Implement a Transfer Learning concept in Image Classification.
9. Implement Transfer Learning Using a Pre-trained Model in Keras.
10. Perform Sentiment Analysis using RNN.
11. Implement an LSTM based Autoencoder in TensorFlow/Keras.
12. Image generation using GAN.

TOTAL: 60 PERIODS

Course Outcomes:

CO1: Apply Artificial Neural Network models to solve simple real-world classification and prediction problems
CO2: Understand the basics of associative memory and unsupervised learning networks.
CO3: Apply CNN and its variants for suitable applications.
CO4: Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
CO5: Understanding the basics of Recurrent Neural Network
CO6: Apply autoencoders and generative models for suitable applications.

Textbooks:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.

References:

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly, 2018.
2. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.

4. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6. Deep Learning with Python, François Chollet, Manning Shelter Island,2017.
7. S Rajasekaran, G A Vijayalakshmi Pai, "Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications", PHI Learning, 2017.
8. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9. James A Freeman, David M S Kapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.

Activity:

- Research Paper Review - Review a recent IEEE paper and identify novelty, methodology, strengths, and limitations.
- Poster Presentation
- Model Comparison Activity - Compare CNN, RNN, LSTM, GRU, and Transformers using evaluation criteria.
- Paper completion
- Kahoot Competition

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	0	3	-	-	-	3	-	3	2	2	3
CO2	2	1	0	0	1	-	-	-	3	-	3	0	2	2
CO3	2	3	3	3	3	-	-	-	3	-	3	2	3	3
CO4	2	3	3	3	3	-	-	-	3	-	3	2	3	3
CO5	2	2	0	1	3	-	-	-	3	-	3	2	2	2
CO6	2	3	3	3	3	-	-	-	3	-	3	2	3	3
Avg.	**2**	**2.5**	**1.8**	**1.7**	**2.7**	**-**	**-**	**-**	**3**	**-**	**3**	**1.7**	**2.5**	**2.7**

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

PCS2443	**Pattern Recognition Techniques**	**PEC**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives:

- To understand the fundamentals of Pattern recognition
- To impart knowledge on various clustering techniques
- To study about feature extraction and selection
- To explore different classification models
- To understand Fuzzy Pattern Classifiers and application

UNIT I PATTERN CLASSIFIER 9

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Non-Parametric techniques, Perceptron Algorithm-LMSE Algorithm-Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT II CLUSTERING 9

Clustering Concept – Hierarchical Clustering Procedures – Partitional Clustering, k- means algorithm – Clustering of Large Data Sets – EM Algorithm – Grid Based Clustering– Density Based Clustering.

UNIT III FEATURE EXTRACTION AND SELECTION 9

Entropy Minimization – KL Transforms – Regression-Linear, Non-linear and Logistic, Prediction, Feature Selection through Functions Approximation – Binary Feature Selection – Dimensionality Reduction Techniques – Principal Component Analysis.

UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE 9

State Machines – Hidden Markov Models: Maximum Likelihood for the HMM, Forward-Backward Algorithm, Sum and Product Algorithm for the HMM, Extensions of the Hidden Markov Model – Support Vector Machines: Maximum Margin Classifiers, Relevance Vector Machines.

UNIT V RECENT ADVANCES AND APPLICATIONS 9

Fuzzy Classification: Fuzzy Set Theory, Fuzzy and Crisp Classification, Fuzzy Clustering, Fuzzy Pattern Recognition-Application of PR in image segmentation, ECG signal classification, Fingerprint recognition, Case Study: Real-time Pattern Analysis Applications.

Periods: 45 PERIODS

Course Outcomes:

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

CO1: Provide basic knowledge about the fundamentals of pattern recognition and its applications.
CO2 Understand about unsupervised algorithms suitable for pattern classification.
CO3 Familiarize with the feature selection algorithms and methods of implementing them in applications.
CO4 Learn about the basis of algorithms used for training and testing the dataset.
CO5 Learn basic fuzzy system and neural network architectures,
CO6: Familiarize applications in pattern recognition, image processing, and computer vision.

Suggested Activities:

- Plot and analyze discriminant functions for 2-class problems
- Study clustering behaviour on large datasets
- Mini experiment: Change number of clusters and observe results
- Compare model performance with and without feature selection
- Calculate: Entropy and information gain for sample data
- Simulate a simple Hidden Markov Model (e.g., weather prediction)
- Visualize: Maximum margin hyperplane
- Perform fuzzy clustering (conceptual / simple coding)
- Case study on Fingerprint recognition

Textbooks:

1. Bishop, C. M., “Pattern Recognition and Machine Learning”, Springer, 2010.
2. Andrew Webb, “Statistical Pattern Recognition”, Arnold publishers, London, Second edition, 2002.

References:

1. Murthy, M. N., & Susheela Devi, V., “Pattern Recognition”, Springer, 2011.
2. Duda, R. O., Hart, P. E., & Stork, D. G., “Pattern Classification”, 2nd Edition, John Wiley & Sons, 2001.
3. Theodoridis, S., & Koutroumbas, K., “Pattern Recognition”, 4th Edition, Academic Press, 2008.

4. Friedman, M., & Kandel, A., “Introduction to Pattern Recognition: Statistical, Structural, Neural and Fuzzy Logic Approaches”, World Scientific Publishing Co. Ltd., 2020.
5. Beyerer, J., Richter, M., & Nagel, M., “Pattern Recognition”, Springer, 2018.
6. Dougherty, G., “Pattern Recognition and Classification”, Springer, 2013.
7. Singh, H., “Practical Machine Learning and Image Processing”, Apress, 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	1	-	-	-	-	-	-	-	2	1	-
CO2	3	2	2	2	1	-	-	-	-	-	-	2	2	-
CO3	3	3	2	2	2	-	-	-	-	-	-	3	2	1
CO4	3	3	2	2	2	-	-	-	-	-	-	3	2	1
CO5	2	2	2	2	2	1	-	-	1	1	-	3	3	2
CO6	2	2	3	2	2	1	-	-	2	2	1	3	3	2
Avg.	**2.7**	**2.3**	**2.0**	**1.8**	**1.5**	**0.3**	**-**	**-**	**0.5**	**0.5**	**0.2**	**2.7**	**2.2**	**1.0**

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

PCS2444	**Reinforcement Learning**	**PEC**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives:

- Introduce a range of topics related to Reinforcement Learning and probability concepts.
- Gain knowledge on the Markov Decision Process.
- Understand the Q-Learning and SARSA methods.
- Know about the Deep Learning in Reinforcement Learning.
- Gain knowledge on Policy Gradient Methods.

UNIT I BASICS OF REINFORCEMENT LEARNING 9

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

UNIT II MARKOV DECISION PROCESSES AND DYNAMIC PROGRAMMING 9

Overview of Markov Chain - Overview of Markov Decision Process – Model Reinforcement Learning Problem using MDP – Markov Process – Markov Chain – Markov Decision Process – Alternative Bellman Equations for value functions – Optimal policy and optimal value functions – Using Dynamic programming to solve RL problems – Policy Evaluation – Policy Improvement – Policy Iteration – Value Iteration.

UNIT III MONTE CARLO AND TEMPORAL DIFFERENCING 9

Monte Carlo Introduction – Policy Evaluation – Incremental Update – Exploration Vs Exploitation – Policy Improvement – Temporal Differencing Learning – TD Policy Evaluation – Epilon-Greedy policy – On policy Vs Off-policy – Q-Learning – SARSA Learning – Double Q-Learning – Applications of Q-Learning – Grid Problems - N-Step Bootstrapping.

UNIT IV VALUE FUNCTION APPROXIMATION 9

Linear value function approximation – Challenge of Large-scale MDP – Value Function approximations – Stochastic Gradient Descent – Linear value and non-linear value approximation – Deep neural nets – Naïve Deep-Q Learning – Experience Replay – DQN for Games – DQN with Double-Q learning – Prioritized experience Replay – Advantage Function and Duelling Network Architecture.

UNIT V ADVANCED DEEP REINFORCEMENT LEARNING 9

Policy Gradient Methods – Policy-Based methods – Policy Gradient – REINFORCE – Baseline – Actor Critic Methods -Problems with Continuous Action space – Problems with Standard Methods – Policy Performance Bounds – Proximal Policy Optimization -Latest Trends – Distributed Reinforcement Learning – Curiosity Driven Exploration – Random network Distillation – Planning with AlphaZero.

Periods: 45 PERIODS

Course Outcomes:

On completion of the course, the students will be able to
CO 1: Understand different terminologies of RL and Concepts of Probability.
CO 2: Illustrate the Markov Decision Process and Bellman Equation for learning.
CO 3: Apply dynamic programming techniques to the Markov decision process and Monte Carlo methods
CO 4: Implement Time difference learning for real-world problems
CO 5: Apply Approximation methods of learning and Q-learning technique
CO 6: Apply probabilistic concepts and reinforcement learning techniques to implement optimal decision-making models for solving real-world sequential problems

Suggested Activities:
- Model a real-world problem
- Build a simple Deep Q-Network (DQN) using Python libraries
- Mini Project: Build an RL-based solution

Textbooks:

1. Richard S.Sutton and Andrew G.Barto, Reinforcement learning: An introduction, Second Edition, MIT Press, 2019.
2. Michael Hu, The Art of Reinforcement Learning – Fundamentals, Mathematics and Implementations with Python, Apress, 2024.

References:

1. Sudharsan Ravichandiran, Deep Reinforcement Learning with Python, Second Edition, Packet Publishing, Birmingham, 2020.
2. Csaba Szepesvari, Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence & Machine Learning), Morgan & Claypool Publishers, 2010.
3. Laura Graesser and Wah Loon Keng, Foundations of Deep Reinforcement learning: theory and Practice in Python, Pearson India, New Delhi, 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	2	-	-	-	-	-	2	-	-	3

CO2	3	2	1	1	2	-	-	-	-	-	2	-	-	3
CO3	3	3	2	2	2	-	-	-	-	-	2	2	2	3
CO4	3	3	2	2	3	-	-	-	-	-	2	2	2	3
CO5	3	3	2	2	3	-	-	-	-	-	2	2	2	3
CO6	3	3	3	3	3	2	1	2	2	2	3	3	3	3
Avg.	**3**	**2.7**	**1.8**	**1.8**	**2.5**	**2**	**1**	**2**	**2**	**2**	**2.2**	**2.2**	**2.2**	**3**

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

PCS2445	**Cognitive Science**	**PEC**	**L**	**T**	**P**	**C**
			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-physical Relation – From Materialism to Mental Science – Logic and the Sciences 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 6

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 probability 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 6

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.

Total Periods: 30

PRACTICAL EXERCISES: Total Periods: 30

1. Demonstration of Mathematical functions using Web PPL.
2. Implementation of reasoning algorithms.
3. Developing an application system using generative model.
4. Developing an application using conditional inference learning model.
5. Application development using hierarchical model.

6. Application development using Mixture model.

Total Periods: 60

Course Outcomes:

On completion of the course, the students will be able to
CO1: Understand the underlying theory behind cognition.
CO2: Connect to the cognition elements computationally.
CO3: Implement mathematical functions through WebPPL.
CO4: Develop applications using cognitive inference model.
CO5: Develop applications using cognitive learning model.
CO6: Apply computational techniques and probabilistic programming to implement functional models of human cognitive processes

Suggested Activities

- Think–Pair–Share Sessions
- Study real-world cognitive phenomena
- Mini Coding Tasks
- Tool Exploration

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	2	-	-	-	1	-	-	-	-	2	-	1	2
CO2	3	2	2	1	1	-	-	-	-	-	2	1	2	2
CO3	3	2	2	2	3	-	-	-	-	-	2	2	2	2
CO4	3	3	3	3	3	1	-	1	1	1	3	3	3	3
CO5	3	3	3	3	3	1	-	1	1	1	3	3	3	3
CO6	3	3	3	3	3	2	1	2	2	2	3	3	3	3
Avg.	**3**	**2.5**	**2.2**	**2.2**	**2.2**	**1**	**1**	**1.3**	**1.3**	**1.3**	**2.5**	**2.4**	**2.3**	**2.5**

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

PCS2446	**Ethics and AI**	**PEC**	**L**	**T**	**P**	**C**
			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: Total Periods: 30

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: 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
CO3	2	3	1	1	3	-	-	2	1	1	2	3	2	2
CO4	3	1	3	3	2	-	-	2	2	3	1	2	1	3
CO5	3	1	1	3	3	-	-	2	3	3	3	1	3	3
CO6	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**