SYLLABUS

B.Tech.

Computer Science and Engineering

(Cyber Security)

Batch 2024 - 2028

SCHOOL OF COMPUTING

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA

HIMACHAL PRADESH

TABLE OF CONTENT

Institute Vision and Mission

Institute Vision:

To build a vibrant multicultural learning environment with value based academic principles and to achieve excellence in teaching and research and to contribute effectively and responsibly to the national and global community.

Institute Mission:

- M1: To provide quality education to students with practical orientation.
- M2: To collaborate with industries and research institutions to solve socially relevant problems.
- M3: To inspire students to become responsible citizens and competent professionals with ethical values.

School of Computing Vision and Mission

School of Computing Vision:

To become a center of excellence in emerging areas and train students to become professionals solving challenging societal problems.

School of Computing Mission:

- M1: To impart state-of-the-art knowledge in computer science and information technology with emphasis on practical knowledge and to promote specialization in emerging streams.
- M2: To participate in research and development in industries and research organizations.
- M3: To make the students aware of ethics and apply them in solving social problems.

B Tech. in CSE (CY) PEOs and their Mapping

Program Educational Objective (PEO):

- **PEO1 Career:** To ensure that the graduates will work in renowned industries/research organizations, pursue higher education, or become entrepreneurs.
- **PEO2 Professionalism:** To ensure that the graduates will apply professional ethics and demonstrate their ability to solve socially relevant problems in multidisciplinary contexts.
- **PEO3 Innovation:** To ensure that graduates will have the ability to create secure and innovative software products and technologies to ensure a secure cyberspace for all.

PEO to Mission Mapping:

Mission / PEO	**M1**	**M2**	**M3**
PEO1	3	3	1
PEO2	3	2	3
PEO3	2	2	3

PEO	**Mission**	**Mapping Level**	**Justification**
PEO1	M1	3	Mapped strongly as student state of the art knowledge is required for a successful career.
	M2	3	Mapped strongly as student participation in research and development is required for a successful career.
	M3	2	Mapped moderately as the students' needs to aware of ethics and apply them in social problems.
PEO2	M1	2	Mapped moderately as student state of the art and practical knowledge is required for a professionalism.
	M2	3	Mapped strongly as student participation state of the art knowledge is required for a successful career.
	M3	2	Mapped moderately as student participation state of the art knowledge is required for a successful career.
PEO3	M1	3	Mapped strongly as student state of the art knowledge is required for a life-long learning.
	M2	3	Mapped strongly as student participation in research and development is required for a life-long learning.
	M3	2	Mapped moderately as student participation state of the art knowledge is required for a life-long learning.

Program Specific Outcomes of B Tech. in CSE (CY)

Program Specific Outcome (PSO):

- **PSO1:** To identify and formulate computational problems and solve them by applying software engineering principles.
- **PSO2:** To identify and capitalize opportunities in the areas of Cyber Security and become a successful cyber expert.
- **PSO3:** To design secure innovative solutions using open-source technologies within the ambit of ethical and social norms.

PO/PSO to PEO Mapping

		PEO		
		PEO1 Career	**PEO2 Professionalism**	**PEO3 Innovation**
PO1	Engineering Knowledge	3	1	3
PO2	Problem Analysis	3	1	3
PO3	Design/Development of solutions	3	2	3
PO4	Conduct investigations of complex problems	3	1	3
PO5	Modern tool usage	3	2	3
PO6	The engineer and society	1	3	1
PO7	Environment and sustainability	1	2	3
PO8	Ethics	2	3	3
PO9	Individual and Teamwork	3	3	2
PO10	Communication	2	3	3
PO11	Project management and finance	1	2	2
PO12	Lifelong Learning	3	2	3
PSO1	To identify and formulate computational problems and solve them by applying software engineering principles	3	2	3
PSO2	To identify and capitalize opportunities in the areas of Cyber Security and become a successful cyber expert	2	3	2
PSO3	To design secure innovative solutions using open-source technologies within the ambit of ethical and social norms	1	2	3

Design of Curriculum

The B.Tech. Course Curriculum has been designed conforming to the recommendations of Senate and guidelines of AICTE/UGC, including NEP 2020.

CONFORMANCE TO NEP 2020

As per the approved ordinance of the institute.

Highlights of Curriculum

The students will study the curriculum with the following features:

- More Practical Oriented Teaching and Learning
- More hands-on Projects
- Stream Oriented Specialization
- Multi-Disciplinary Electives/Projects
- Relative Grading
- Soft Skill Enhancement
- Overall Personality Development
- Employable Graduates for Industries
- Excellent Placements
- NEP 2020 Compliance

Curriculum Components

S.No.	Category	Credits	Credits(%)
1.	Major (Core)	75	47
2.	Minor (Stream)	14	09
3.	Multi-disciplinary	19	12
4.	Ability Enhancement	09	05
5.	Skill Enhancement	16	10
6.	Valued Added Courses	08	05
7.	Project	19	12
8.	Honours/Online Optional Courses #	12	-
Total		160	100

Total credits for degree with Honors is 160+12 = 172.

Coding Scheme

Example

C	S	M	S	1	0	1
1	2	3	4	5	6	7

The 7 letter code represents the following:	
Letter 1 & 2:	Academic Unit such as IC (Institute Core), CS (Computer Science), EC (Electronics Communication), DS (Data Science), CY (Cyber Security), IT (Information Technology), etc.
Letter 3 & 4:	Curriculum Component such as MC (Major Core), VA (Value Added), etc.
Letter 5:	Year (level) of the course such as 1,2,3... etc.
Letter 6 & 7:	Course identification number such as 01, 02, etc.

Academic Unit	
Name	**Code**
Computer Science and Engineering	CS
Computer Science and Engineering (Cyber Security)	CY
Computer Science and Engineering (Data Science)	DS
Electronics and Communication Engineering	EC
Information Technology	IT
Institute Core	IC
School of Computing	SC
School of Electronics	SE

Curriculum Component	
Name	**Code**
Major (Core)	MC
Minor (Stream)	MS
Multi-disciplinary	MD
Ability Enhancement	AE
Skill Enhancement	SE
Value Added Courses	VA
Project	PR
Honours Online Courses	HC
Optional Online Courses	OC

B.Tech. CSE (Cyber Security) Credit Scheme

Major Core (MC) Courses (75 credits)

S. No.	Course Code	Course Name	Credits
1.	CSMC101	Basics of Programming in C	04
2.	CSMC102	Computer Workshop	02
3.	CSMC103	Data Structures and Algorithms	04
4.	CSMC201	Discrete Structures	04
5.	CSMC202	Computer Organization	04
6.	CSMC203	Design and Analysis of Algorithms	04
7.	CSMC204	Object Oriented Programming	04
8.	CSMC205	Operating Systems	04
9.	CSMC206	Database Management Systems	04
10.	CSMC207	Theory of Computation	04
11.	CSMC208	Computer Networks	04
12.	ECMC101	Electronics Workshop	02
13.	ECMC102	Basic Electrical and Electronics Engineering	04
14.	ECMC202	Digital Circuits and Systems	04
15.	ECMC213	Product Development Lab	01
16.	CYMC201	Introduction to Cryptography	04
17.	CYMC202	Fundamentals of Data Science	04
18.	CYMC203	Mobile Forensics and Security	04
19.	CYMC301	Blockchain and Cryptocurrencies	04
20.	CYMC302	Multimedia Security and Forensics	03
21.	CYMC303	Cyber Ethics, Privacy, and Legal Issues	03
Total			**75**

Minor Stream (MS) Courses / Open Elective # (14 credits)

S.No.	SoC		SoE		Credits
	Course Code	Course Name	Course Code	Course Name	
1.	SCMS301	Artificial Intelligence	SEMS301	VLSI Technology	03
2.	SCMS302	Soft Computing*	SEMS302	Speech Signal Processing*	04
3.	SCMS401	Deep Learning*	SEMS401	Introduction to IoT*	04
4.	SCMS402	Cyber Physical Systems	SEMS402	Biomedical Signal Processing	03
	SCMS403	Introduction to Federated Learning	SEMS403	Quantum Computing	
Total					14

*Includes Lab
#A faculty member may also offer a self-designed course as an open elective subject to the approval of the competent authority.

Multi-Disciplinary (MD) Courses (19 credits))

S.No.	Course Code	Course Name	Credits
1.	ICMD101	Introduction to Bioinformatics	03
2.	ICMD102	Engineering Chemistry	04
3.	ICMD103	Engineering Physics	04
4.	ICMD104	Engineering Mathematics-I	04
5.	ICMD105	Engineering Mathematics-II	04
Total			19

Ability Enhancement(AE) Courses (09 credits)

S.No.	Course Code	Course Name	Credits
1.	ICAE101	Communication Skills	04
2.	ICAE301	Professional Communication and Soft Skills	02
3.	ICAE302	Entrepreneurship and Start-ups	03
Total			09

Skill Enhancement (SE) / Program Elective (16 Credits)

S.No.	Course Code	Course Name	Credits
1.	CSSE301	Data Science	04
	CSSE302	Computer Graphics	
	CSSE303	Network Security	
2.	CSSE304	Machine Learning	04
	CSSE305	Image Processing	
	CSSE306	Principles of Information Security	
3.	CSSE307	Speech and Language Processing	04
	CSSE308	Computer Vision	
	CSSE309	Cloud Computing	
4.	CSSE401	Pattern Recognition and Applications	04
	CSSE402	Software Engineering and Maintenance	
	CSSE403	Cloud Security	
Total			16

Value Added (VA) Courses (08 credits)

S.No.	Course Code	Course Name	Credits
1.	ICVA101	Basic Environmental Science and Engineering	03
2.	ICVA102	Universal Human Values - I	01
3.	ICVA103	Universal Human Values - II	01
4.	ICVA104	Yoga and Sports	00
5.	ICVA105	Extra-Curricular Activities	00
6.	ICVA301	Professional Ethics	03
Total			08

Project (PR) (19 Credits)

S.No.	Course Code	Course Name	Credits
1.	ICPR301	Minor Project	04
1.	ICPR401	Major Project - I	05
2.	ICPR402	Major Project – II	10
Total			19

Honours/ Optional Online Courses (HC/OC)

S.No.	Course Code	Course Name	Credits
1.	ICHCXXX	Honours Online Courses (4 Courses)	12
2.	ICOCXXX	Optional Online Courses (4 Courses)	0-12*
***Based on number of courses and credits audited.**			

X in the curriculum depends on the course chosen from online sources.

SEMESTER-WISE CURRICULUM

L-T-P-C Notation

L-T-P-C ⇒ Lecture-Tutorial-Practical-Credit.

Credit structure of each course is given in L-T-P-C form (e.g., 2–1–0–3). The numbers corresponding to L, T and P denote the contact hours per week for Lecture, Tutorial and Practical respectively, and that of C denotes the total number of credits for that course in a semester.

SEMESTER I

S.No.	Code	Course Name	L	T	P	C
1.	CSMC101	Basics of Programming in C	3	0	2	4
2.	CSMC102	Computer Workshop	0	0	4	2
3.	ECMC102	Basic Electrical and Electronics Engineering	3	0	2	4
4.	ICMD101	Introduction to Bioinformatics	3	0	0	3
5.	ICMD102	Engineering Chemistry	3	0	2	4
6.	ICMD104	Engineering Mathematics-I	3	1	0	4
7.	ICVA102	Universal Human Values - I	0	0	2	1
8.	ICVA104	Yoga and Sports	0	0	4	0
Total			15	1	16	22

SEMESTER II

S.No.	Code	Course Name	L	T	P	C
1.	ECMC101	Electronics Workshop	0	0	4	2
2.	CSMC103	Data Structures and Algorithms	3	0	2	4
3.	ICMD103	Engineering Physics	3	0	2	4
4.	ICMD105	Engineering Mathematics-II	3	1	0	4
5.	ICAE101	Communication Skills	3	0	2	4
6.	ICVA101	Basic Environmental Science and Engineering	3	0	0	3
7.	ICVA103	Universal Human Values - II	0	0	2	1
8.	ICVA105	Extra- Curricular Activities	0	0	4	0
Total			15	1	16	22

SEMESTER III

S.No.	Code	Course Name	L	T	P	C
1.	CSMC201	Discrete Structures	3	1	0	4
2.	CSMC202	Computer Organization	3	1	0	4
3.	CSMC203	Design and Analysis of Algorithms	3	1	0	4
4.	CSMC204	Object Oriented Programming	3	0	2	4
5.	ECMC202	Digital Circuits and Systems	3	0	2	4
6.	ECMC213	Product Development Lab	0	0	2	1
7.	CYMC201	Introduction to Cryptography	3	0	2	4
Total			18	3	8	25

SEMESTER IV

S.No.	Code	Course Name	L	T	P	C
1.	CSMC205	Operating Systems	3	0	2	4
2.	CSMC206	Database Management Systems	3	0	2	4
3.	CSMC207	Theory of Computation	3	1	0	4
4.	CSMC208	Computer Networks	3	0	2	4
5.	CYMC202	Fundamentals of Data Science	3	0	2	4
6.	CYMC203	Mobile Forensics and Security	3	0	2	4
Total			18	1	10	24

SEMESTER V

S.No.	Code	Course Name	L	T	P	C
1.	CYMC301	Blockchain and Cryptocurrencies	3	0	2	4
2.	CYMC302	Multimedia Security and Forensics	3	0	0	3
3.	XXMS3XX	Open Elective-I	3	0	0	3
4.	CSSE3XX	Program Elective- I	3	0	2	4
5.	CSSE3XX	Program Elective- II	3	0	2	4
6.	ICVA301	Professional Ethics	3	0	0	3
7.	ICHC3XX	Honours Online Course- I*	X	X	X	3
	ICOC3XX	Optional Online Course- I*	X	X	X	0-3
Total			18	0	6	21

***NPTEL/SWAYAM/MOOCs/etc.**

SEMESTER VI

S.No.	Code	Course Name	L	T	P	C
1.	CYMC303	Cyber Ethics, Privacy, and Legal Issues	3	0	0	3
2.	XXMS3XX	Open Elective-II	3	0	2	4
3.	ICAE301	Professional Communication and Soft Skills	0	0	4	2
4.	ICAE302	Entrepreneurship and Start-ups	3	0	0	3
5.	CSSE3XX	Program Elective- III	3	0	2	4
6.	ICPR301	Minor Project	0	0	8	4
7.	ICHC3XX	Honours Online Course- II*	X	X	X	3
	ICOC3XX	Optional Online Course- II*	X	X	X	0-3
Total			15	0	12	20

***NPTEL/SWAYAM/MOOCs/etc.**

SEMESTER VII

S.No.	Code	Course Name	L	T	P	C
1.	XXMS4XX	Open Elective -III	3	0	2	4
2.	XXMS4XX	Open Elective -IV	3	0	0	3
3.	CSSE4XX	Program Elective-IV	3	0	2	4
4.	ICPR401	Major Project - I	0	0	10	5
5.	ICHC401	Honours Online Course- III*	X	X	X	3
	ICOC401	Optional Online Course- III*	X	X	X	0-3
Total			9	0	16	16

***NPTEL/SWAYAM/MOOCs/etc.**

SEMESTER VIII #

S.No.	Code	Course Name	L	T	P	C
1.	ICPR402	Major Project- II	0	0	20	10
2.	ICHC402	Honours Online Course- IV*	X	X	X	3
	ICOC402	Optional Online Course- IV*	X	X	X	0-3
Total			0	0	20	10

***NPTEL/SWAYAM/MOOCs/etc.**

Student may be allowed to go for industry internship as per the institute policy.

Summary									
Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credit	22	22	25	24	21	20	16	10	160

SEMESTER I

Course Code	CSMC101
Course Title	Basics of Programming in C
L T P C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To learn algorithmic problem-solving techniques.
- To learn the fundamentals of C programming.
- To compose programs in C using conditions, iterations and decompose a problem into functions.
- To construct programs in C using array, functions and pointers.
- To develop programs using advanced concepts like structures, file handling.

COURSE CONTENT

Unit-I Introduction to Computers and Problem Solving Tools
Evaluation of Computers, History of Computers, Computer Organization, Characteristics, Hardware and Software, Modes of operation, Types of programming languages, developing a program. Algorithms, Characteristics, Flowcharts, Principles of Structured and unstructured programming, Functional Languages, Sequential, selective structures, Repetitive structures, Bounded, Unbounded and Infinite iterations – Examples for each.

Unit-II Introduction to C Programming
C character set, Identifiers and Keywords, Data types, Constants, Variables, Declarations, Expressions, Statements, Symbolic constants, Operators, Library functions, Data input and output: Single character input and output, entering input data, writing output data, gets and puts functions, Control and Conditional statements, Modular Programming.

Unit-III Functions in C Programming
Defining a function, accessing a function, Function prototypes, passing arguments to a function, passing arrays to a function, Functions and Procedures, Examples, Parameter passing methods. Arrays, defining an array, processing an array, Multidimensional arrays.

Unit-IV Pointers and Memory Management
Introduction, Passing pointers to a function, Recursion. String Handling, Introduction to Strings, Sample Program, Standard String Library Functions, Array of String.

Unit-V Structures, Unions and File Handling
Structures and Unions, Declaring and Instantiating Structures, Structures as Parameter and Pointer to Structures, Enumerated Data Types, Union, Bit Fields File Processing. Concept of Files, File Opening in Various Modes and Closing of a File, reading from a File, Writing onto a file.

LIST OF EXPERIMENTS

1. Implementation of basics of C programming.
2. Implementation of concepts of conditional statements in C programming.
3. Implementation of concepts of control statements in C programming.
4. Implementation of concepts of array and pointers in C programming.
5. Implementation of concepts of functions in C programming.
6. Implementation of concepts of strings handling functions in C programming.
7. Implementation of concepts of structures and union in C programming.
8. Implementation of concepts of file handling in C programming.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the computer fundamentals and design an algorithm, flowchart, and pseudo-code for a given problem	K2
CO2	Explain the basics and different constructs used in C programming	K2
CO3	Apply the concepts of control structures, arrays, and pointers to implement various algorithms and practice the skill of algorithmic thinking	K3
CO4	Apply the concepts of functions and string handling using C programming	K3
CO5	Apply the concepts of structures, unions, and file handling in C programming	K3
CO6	Solve Real-world problems by utilizing different concepts in C programming.	K5

TEXT BOOKS

1. Deital Paul and Deital Harvey, “C How to Program”, Prentice Hall London, Eighth Edition, 2015.
2. Kernighan Brian W. and Ritchie Dennis M., “The C Programming Language”, Prentice Hall, Second Edition, 2012.
3. “Programming with C”, by Byron S Gottfried, Schaum’s Outlines, Second Edition, Tata McGraw-Hill, 2016.

REFERENCE BOOKS

1. Dromey R.G., “How to solve it by Computer”, Pearson Education, Fourth Reprint, 2007.
2. Y. Kanetkar, “Let us C”, BPB Publication.
3. Hanly J.R. and Koffman E.B., “Problem Solving and Program Design in C”, Pearson Education, Sixth Edition, 2009.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	1	3	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	1	3	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	3	3	-	-	-	-	-	-	-	-	2	-	-
Score	18	12	6	15	-	-	-	-	-	-	-	-	10	-	-
COM	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-

Course Code	ECMC101
Course Title	Electronics Workshop
L T P C	0-0-4-2
Course Type	MC

COURSE OBJECTIVES

- To familiarize students with basic electronic components.
- To teach them to interface various sensors and actuators with Arduino.
- To implement a real life application using Arduino

LIST OF EXPERIMENTS

1. Introduction to Arduino board and various sensors and actuators.
2. Interfacing of LED with Arduino.
3. Interfacing of Buzzer with Arduino.
4. Interfacing of Ultra-sonic sensor with Arduino.
5. Interfacing of LCD with Arduino.
6. Interfacing of Seven Segment display with Arduino.
7. Interfacing of DC Stepper motor with Arduino.
8. Arduino based Mini Project.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Acquire knowledge about basic circuits and Arduino module.	K2
CO2	To interface various sensors with Arduino.	K3
CO3	To interface various actuators with Arduino.	K3
CO4	To interface both sensors and actuators with Arduino.	K5
CO5	Make a project targeting some real life application.	K6

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	-	-	-	-	3	-	-	3	2	-	-
CO2	3	2	2	3	-	-	-	-	3	3	3	3	2	-	-
CO3	3	2	2	3	-	-	-	-	3	3	3	3	2	-	-
CO4	3	2	2	3	1	2	3	-	3	3	3	3	2	-	-
CO5	3	2	2	3	1	3	3	3	3	3	3	3	2	-	-
Score	15	10	10	15	2	5	6	3	15	12	12	15	10	-	-
COM	3	2	2	3	1	3	3	3	3	3	3	3	2	-	-

Course Code	ICMD103
Course Title	Engineering Physics
L T P C	3-0-2-4
Course Type	MD

COURSE OBJECTIVES

- To impart knowledge about the limitations of Newtonian Mechanics and alternate formalism of Lagrange and Hamilton and the concept of special relativity and its applications to physical sciences and engineering.
- To study the basic principles of quantum mechanics: Learn how to solve the Schrödinger's equation and its applications.
- To understand the basic framework of solid state physics.
- To apprise the students regarding the concepts of electromagnetic field theory and its applications in engineering.
- To recognize and classify the structures of optical fiber and types.

COURSE CONTENT

Unit-I Classical Mechanics

1. Review of Newtonian Mechanics in Rectilinear Coordinate System, Motion in Plane Polar Coordinates, Conservation Principles, Inertial and Non-inertial Frames, Rigid Body Dynamics. Introductory ideas about Lagrangian and Hamiltonian and their simple applications.
2. Special Theory of Relativity (STR) Michelson-Morley Experiment, Postulates of STR, Galilean Transformation, Lorentz Transformation, Simultaneity, Length Contraction, Time Dilation, Relativistic Addition of Velocities, Mass-Energy Equivalence, Energy- Momentum Relationships.

Unit-II Modern Physics

1. Basics of Quantum Physics: Origin of Quantum Theory, Planck's Quantum Theory, Black Body Radiation, Photoelectric Effect, Compton Effect, Wave-Particle Duality: De Broglie Wavelength, Group and Phase Velocity, Heisenberg's uncertainty Principle, Double Slit Experiment, Schrödinger Equation, Physical interpretation of Wave Function, Elementary Idea of Operators, Eigen-Value Problem, Solution of Schrödinger Equation for simple boundary value problems, Reflection and Transmission Coefficients, Tunneling, Particle in a three Dimensional Box, Degenerate States.

2. Quantum Statistics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics. Density of States. Applications of B-E statistics: LASER (Spontaneous and Stimulated Emissions & Absorption, Einstein's Coefficients, Population Inversion, LASER Systems: Ruby LASER, He-Ne LASER, Semiconductor LASER-applications), Bose-Einstein Condensation. Applications of F-D Statistics: Free Electron Model of electrons in metals. Concept of Fermi Energy. Elementary Ideas of Band Theory of Solids, Quantum Computing.

Unit-III Physics of Materials

1. Structure of Materials: Space Lattice and Unit Cells, Crystal System, Symmetry Operation, Miller Indices, Packing Fractions, Structure Determination using X-ray Diffraction, Bragg's Law.
2. Semiconductor: Direct and indirect band gap semiconductors, Electron and Hole concentrations, Doping n-type, p-type, temperature variation of carrier concentration, Fermi level, Zener Diode, Tunnel Diodes, Photodiodes, Light Emitting Diodes. Hall Effect, Superconductors.
3. Magnetic and Dielectric Properties of Materials: Origin of Magnetism, Dia, Para, Ferro, Anti-Ferro and Ferrimagnetism, Soft and Hard Magnetic Materials, Dielectric Properties.

Unit-IV Electromagnetic Field Theory

1. Electrostatics: Coulomb's Law, Gauss's Law, proof of Gauss's Law, Electrostatic Field in Matter: Dielectric Polarization, polarizability and susceptibility, Types of Polarization, Claussius-Mosotti Equation.
2. Magnetostatics: Lorentz Force, Equation of Continuity, Biot-Savart Law, Ampere's Law, Magnetostatic field in matter: Torques and forces on magnetic dipoles, Magnetization, Induction.
3. Electrodynamics: Maxwell's Equations, Propagation of EM Waves in Free Space.

Unit-V Fiber Optics

Fermat's principle and Snell's law-optical fiber – principle and construction – acceptance cone - numerical aperture – V-Number - types of fibers, Fabrication: Double Crucible Technique-fiber optic communication principle – fiber optic sensors.

LIST OF EXPERIMENTS

1. To find the moment of inertia of a given flywheel.
2. To find the value of charge carrier concentration and Hall coefficient.
3. To determine the value of Planck's constant.

4. To find the value of wavelength of a given light source using Michelson Interferometer.
5. To find the value of wavelength of a given light source using Newton's rings.
6. To verify the Biot-Savart Law using the circular coil carrying current.
7. To find the resonance frequency in a series LCR circuit.
8. To find the energy gap of a material of p-n junction.
9. To verify the de-Broglie relation using electron diffraction.
10. To determine the plateau and optimal operating voltage of a Geiger-Müller
11. To determine the wavelength of a given LASER source using Diffraction Grating.
12. To study the interaction of high energy photons with matter (Compton Effect).
13. To study the B-H hysteresis curve.
14. To determine the value of e/m ratio.
15. To determine the angle, and refractive index of the prism using a spectrometer.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Identify the role of virtual work, Lagrange's and Hamilton's approach to the mechanics and develop skills to impart practical knowledge and apply the knowledge of Special Theory of Relativity.	K3
CO2	Describe and analyze the dynamics of systems that move under the influence of given potential, and to make use of the basics of Quantum Mechanics.	K4
CO3	Apply principles to determine crystal structure, thermal behavior of solids, dielectric, electric and magnetic behavior of solids, and develop skills to impart practical knowledge.	K3
CO4	Apply the concepts related to Faraday‘s law, induced emf and Maxwell‘s equations.	K3
CO5	Demonstrate optical fiber communication link, structure, propagation and transmission properties of an optical fiber.	K3

TEXT BOOKS

1. Kleppner, D., and Kolenkow, R. J. “An Introduction to Mechanics”, Tata McGraw-Hill, New Delhi, 2000.
2. Griffiths, David J. “Introduction to Quantum Mechanics, 2nd edition”, Pearson Education Ltd, 2014.
3. Kittel, Charles “Introduction to Solid State Physics, 8th edition”, John Wiley & Sons, Inc, USA, 2005.
4. Griffiths, David J. “ Introduction to Electrodynamics, 3rd edition”, Prentice-Hall of India, 2005.
5. Kaye, Phillip, Laflamme, R. and Mosca M. “Introduction to Quantum Computing”, Oxford University Press, New York, 2007.
6. Ghatak, Ajoy, and Thyagarajan, K., “Introduction to fiber optics”, Cambridge University Press, 2000.

REFERENCE BOOKS

1. Goldstein, Herbert, Poole, Charles and Safko, John “Classical Mechanics, 2nd edition”, Narosa, 1985.
2. Puri, R. K. and Babbar V. K. “Solid State Physics”, S. Chand & Co. Pvt. Ltd, New Delhi, 2000.
3. Beiser, Arthur “Concepts of Modern Physics”, Tata McGraw-Hill, New Delhi, 1995.
4. Resnick, R. “Introduction to Special Relativity” John Wiley, Singapore, 2000.
5. Avadhanulu, M. N. and Kashirsagar, P. G. “A Text Book of Engineering Physics”, S. Chand & Co. Pvt. Ltd, New Delhi, 2008.
6. Ida, Nathan “Engineering Electromagnetics”, Springer, 2005.
7. Feynman, R. P., Leighton, R. B. and Sands, M.“The Feynman Lectures on Physics, Vol. I” Narosa Publishing House, 1998.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	2	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	-	2	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	3	-	-	-	-	-	-	-	2	-	-	2
CO4	2	-	-	2	-	-	-	-	-	-	-	-	-	-	2
CO5	2	-	-	2	-	-	-	-	-	-	-	-	-	-	2
Score	11	4	-	11	-	-	-	-	-	-	-	2	-	-	10
COM	3	2	-	3	-	-	-	-	-	-	-	2	-	-	2

Course Code	ICAE101
Course Title	Communication Skills
L T P C	3-0-2-4
Course Type	AE

COURSE OBJECTIVES

- To identify, rectify, and overcome mother tongue influence and sensitize usage of native English speech sounds, word accent, intonation and rhythm.
- To develop awareness about different forms of professional communication & social behaviour.
- To empower students with appropriate language usage for presentation delivery, interviews, group discussions and public speaking.

COURSE CONTENT

Unit-I The Process of Communication

1. Grammar Refresh: Synonyms and Antonyms, Homophones, Homonyms and Homographs, Tenses, Active Voice and Passive Voice, Idioms and Phrasal Verbs, Reported Speech.
2. Introduction to Communication, Communication Models, Noise/Barriers in Communication, Nonverbal Communication, Channels of communication, Technical Communication, Downward-Upward Communication, Internal-External Communication, Horizontal-Diagonal Communication, Written vs. oral Communication, Conversational problems of second language users, Difference between conversation and other speech events.
3. How to write Accurately, Briefly, clearly. Precis writing.
4. How to Read, Introduction to Comprehension Skills, Skills to improve Comprehension Skills.
5. Telephonic Communication, Templates for Telephonic Conversation, Do's and Don'ts of Telephonic Communication, Leaving a message.

Unit-II Job Applications and Interviews

1. Format of Resume and Cover Letter, how to make a great Resume, How to write a Covering Letter to Resume.
2. Preparing for an Interview, Self-Introduction in Interview, Select Questions and how to answer them, Mock Interview.

3. What is Group Discussion, how to ace you GD, Do's and Don'ts of GD, Mock GD.

Unit-III Managing Organizational Structure

1. Organizational Roles, Leadership and Management, Ad Hoc Committee, Roles and Responsibilities of Committee & its members.
2. Eustress & Distress, Regulating stress.
3. Simulated Conversation Template.
4. Drafting Formal/Corporate Emails.

Unit-IV Taking Notes and Preparing Minutes

1. Planning a Meeting, Roles of the members, Meeting Etiquettes, How to draft Notice of a Meeting, How to draft Agenda of a Meeting, How to draft Minutes of a Meeting.
2. Elements of Report Writing, Procedure & Guidelines, Types and Format.
3. Taking notes, Note-taking skill: essential components.

Unit-V Presentation Skills and Negotiation Skills

1. Parts of a Presentation Delivery, starting a Presentation Delivery, Introduction: Hooking the Audience, Body of a Presentation Delivery, structuring a Presentation Delivery, Conclusion of a Presentation, how to tackle Q & A form Audience, Podium Panic, Body Language, Do's and Don'ts of PD, Mock PD.
2. Types of Corporate Conversations, Negotiation, Mediation & Arbitration, Resolving arguments, Models of Negotiation Process, Types of Negotiation, Skills of a Negotiator, Steps of the Negotiation Process, Skills to improve Negotiation Process.

LIST OF EXPERIMENTS

1. Introduction to Phonetics, Phonetic alphabet.
2. Introduction to Speech Sounds: Vowels & Consonants, , Structure of Syllables & Stress
3. Extempore, Public Speaking.
4. Words and Phrasal Stress.

5. Mock Telephonic Conversation.
6. Resume and Presentation Skills.
7. Group Discussion.
8. Interview Skills.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Develop skills of comprehension, writing and speaking in professional English and learn strategies to enhance independent language learning.	K3
CO2	Use the appropriate template, language and body language for group discussions, interviews and public speaking.	K3
CO3	Explain and apply the nuances of English professional communication in an organisation.	K3
CO4	Plan and execute Meetings, and draft minutes, reports and relevant documents.	K3
CO5	Develop public speaking skills essential for presentation deliveries, negotiations and corporate communications.	K3

TEXT BOOKS

1. Rizvi, M. A., “Effective Technical Communication”, 2nd edition, McGraw Hill Education, 2017.
2. Mohan, K. and Banerji, M., “Developing Communication Skills”, 2nd edition, Laxmi Publications, 2009.

REFERENCE BOOKS

1. Bhatacharya, I., “An Approach to Communication Skills”, Dhanpat Rai & Co., 2007.
2. Evans, D., “Decision maker”, Cambridge University Press, 1997.
3. Thorpe, E., and Thorpe, S., “Objective English”, Pearson Education, New Delhi, 2007.
4. Fisher, D., “Communication in Organizations”, Jaico Publishing House, 2004.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3
Score	-	-	-	-	-	-	-	-	3	11	-	-	-	-	3
COM	-	-	-	-	-	-	-	-	3	3	-	-	-	-	3

Course Code	ICVA101
Course Title	Basic Environmental Science and Engineering
L T P C	3-0-0-3
Course Type	VA

COURSE OBJECTIVES

- Understand the environmental impact of various energy sources.
- Identify and analyze environmental problems and climate change.
- Impacts of environmental biodiversity in our daily life.
- Comprehend environmental impact assessment and sustainability drivers.
- Understand environmental laws and sustainable practices for environmental protection.

COURSE CONTENT

Unit-I Energy Sources and its Environmental Impact
Energy resources in India and their sustainability, basics of solar thermal energy, and wind turbines, different types of conventional power plants, energy demand scenario in India, introduction to energy sources such as fossil fuel, biomass, ocean, chemical and thermonuclear, advantages and disadvantages of conventional vs non-conventional power generation, environmental issues of various power plants, industrial and transport emissions- impacts.

Unit-II Environment, Pollution, and Climate Change
Introduction to the environment: physical environment, biotic environment, biotic and abiotic interactions, environmental pollution (water, air, soil, and noise): sources, effects, control, air quality standards, international standards for drinking water, greenhouse gases effect, acid rain, causes and effects of climate change, greenhouse gases and global warming, international agreements and policies.

Unit-III Impact of Organisms on the Environment
History (scientists and discoveries), classification and nomenclature of microorganisms, structural organization and multiplication of microbes, microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy, stains and staining techniques, microbial nutrition and growth, control of microorganisms.

Unit-IV Environmental Impact Assessment and Ecosystem Sustainability
Introduction to Environmental Impact Assessment (EIA), Steps in EIA, Methods of Impact prediction and assessment, Case studies of EIA, Structure, and function of ecosystems, biodiversity: its conservation and importance, Definition and principles of Sustainable development, indicators of sustainability, the role of engineering in sustainable development, Sustainable technologies and practices.

Unit-V Environmental Laws, Policies, and Applications
Overview of major environmental laws and regulations, National and international environmental policies, Role of government and non-governmental organizations, Case studies of environmental policies, aerobic wastewater treatment, Anaerobic wastewater treatment, Bioremediation of contaminated land and water, Bio fertilizers, Bio pesticides, Biosensors.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Classify the environmental impact of various energy sources.	K2
CO2	Analyze different types of pollution and the guidelines for their control in the context of public health.	K3
CO3	Classify microbes according to energy source and carbon source.	K2
CO4	Understand the Environmental Impact Assessment, Monitoring, and Policy Frameworks.	K4
CO5	Apply scientific solutions to preserve water and land from contamination.	K3

TEXT BOOKS

1. Khan, B.H., "Non-Conventional Energy Resources," 3rd Edition, The McGraw Hill Education, 2017.
2. Rai, G. D., "Non-conventional Energy Sources," 6th Edition, Khanna Publishers, 2018.
3. Balasubramanian D., Bryce, C.F.A., Jayaraman K., Green J., and Dharmalingam K., Concepts in Biotechnology, 6th Edition. Hyderabad: Universities Press, 2005.
4. Pelczar M.J., Chan E.C.S., Krieg N. R., Microbiology, 6th Edition. McGraw Hill, India, 2018.
5. Thakur I.S., Environmental Biotechnology: Basic Concepts and Applications, 2nd Edition, I.K. International Publishing House Pvt. Ltd., 2019.
6. Glasson, J., and Therivel, R. "Introduction to environmental impact assessment." Routledge, 2013.
7. Bodansky, D., and van Asselt, H. "The art and craft of international environmental law." Oxford University Press, 2024.
8. Pozzo, B. Private Law and Environmental Sustainability. In Routledge Handbook of Private Law and Sustainability (pp. 3-27). Routledge, 2024.

REFERENCE BOOKS

1. Sargsyan G., Bhatia M., Banerjee S.G., Raghunathan K., and Soni R., Unleashing the Potential of Renewable Energy in India, World Bank Report, 2011.

2. Everett, G., Boyle, S., Peake, and Ramag J., Energy Systems and Sustainability. Power for a sustainable future. 2nd Edition, Oxford University Press, 2011.

3. Wang L.K., Tay J.H., Tay S.T.L., and Hung Y.T. Environmental Bioengineering, 1st Edition, Humana Press, 2010.

4. Evans G.G., and Furlong J., Environmental Biotechnology: Theory and Application, 2nd Edition, Wiley, 2018.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	-	2	-	-	-	-	-	-	2	-
CO2	3	2	2	1	1	-	2	-	-	-	-	2	-	2	2
CO3	-	2	-	-	-	2	2	3	-	-	-	-	-	-	2
CO4	-	-	2	2	1	-	2	-	-	-	-	-	-	-	2
CO5	3	-	2	2	1	2	2	3	-	-	-	2	-	-	2
Score	9	6	6	5	3	4	10	6	-	-	-	4	-	4	8
COM	3	2	2	2	1	2	2	3	-	-	-	2	-	2	2

Course Code	ICMD104
Course Title	Engineering Mathematics-I
L T P C	3-1-0-4
Course Type	MD

COURSE OBJECTIVES

- To learn mathematical concepts and methods required for solving engineering problems.
- To acquire fundamental knowledge of linear algebra and calculus
- To understand fundamental concepts of mathematics such as convergence of series, continuity and differentiability of functions of two or more variables.
- To be equipped with knowledge of definite, indefinite integrals and multiple integrals and apply them in various engineering problems.

COURSE CONTENT

Unit-I Matrices
Matrices, Related matrices, Complex matrices, Rank of a matrix, Normal form of a matrix, Characteristic equation, Eigenvalues, Eigen vectors, Properties of Eigen values, Cayley- Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form, Consistency of a linear system of equations, Rouche's theorem, Solution of linear system of equations (homogeneous and non-homogeneous), Gauss Elimination and Gauss Jordan methods.

Unit-II Infinite Series
Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, Comparison test, D'A1embert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test, Alternating series and Leibnitz's rule, Power series, Taylor series, Radius and interval of convergence.

Unit-III Elementary calculus
Function of several variables, Limit, Continuity and Differentiability, Uniform continuity, Maxima and Minima, Mean value theorem, Partial Derivatives, Integration, Gauss's, Green's and Stokes' theorems.

Unit-IV Vector Spaces
Vector spaces, Sub Spaces, Linear Dependence and Independence of Vectors, Span, Bases and Dimensions, Direct Sum.

Unit-V Linear Transformations
Linear Transformations, Range Space and Rank, Null Space and Nullity, Matrix of Linear Transformations, Matrix Representation of a linear transformation, Change of bases.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Demonstrate qualitative problems based on matrix analysis such as rank, Eigen values, and Eigen vectors etc.	K3
CO2	Test the convergence of the series by approximating complicated functions appearing in different engineering models.	K4
CO3	Simplify the problems on differentiation of functions of two variables and know about the maximization and minimization of these functions.	K4
CO4	Make use of the concepts of vector analysis such as linear independence and dependence of vectors etc.	K3
CO5	Interpret the use of linear transformation in real world problems.	K2

TEXT BOOKS

1. Jain R.K., lyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Pub. House, Fifth Edition, 2016.
2. K. Hoffman and R. Kunze, “Linear Algebra ”, Prentice Hall, 2008.
3. G.Strang, “Linear Algebra and its Applications”, 4th Edition, Thomson, 2006.
4. Thomas, G. B., Finney, R. L., Weir, M. D., & Giordano, F. R. (2003). Thomas’ calculus. Reading: Addison-Wesley.

REFERENCE BOOKS

1. Wilfred Kaplan, “Advanced Calculus ”, Pearson, 2003.
2. Wylie, C.R. and Barrett, L.C., “Advanced Engineering Mathematics ”, 6th Edition, McGraw-Hill Inc.US, 1995.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	-	-	-	-	-	-	-	-	-	10	-	-
COM	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

Course Code	ICVA102
Course Title	Universal Human Values - I
L T P C	0-0-2-1
Course Type	VA

COURSE OBJECTIVES

- To understand the concept of Value Education and its significance in achieving continuous happiness and prosperity.
- To understand the concept of harmony in the human being, recognizing the co-existence of the Self and the Body.
- To understand the importance of harmony in the family and society, and the role of values such as trust and respect in human relationships.

COURSE CONTENT

Module 1 – Introduction to Value Education

- Understanding Value Education
- Self-exploration as the Process for Value Education
- Continuous Happiness and Prosperity – the Basic Human Aspirations and their Fulfilment
- Right Understanding, Relationship and Physical Facility
- Happiness and Prosperity – Current Scenario
- Method to Fulfil the Basic Human Aspirations

Module 2 – Harmony in the Human Being

- Understanding Human being as the Co-existence of the Self and the Body
- Distinguishing between the Needs of the Self and the Body
- The Body as an Instrument of the Self
- Understanding Harmony in the Self
- Harmony of the Self with the Body
- Programme to Ensure self-regulation and Health

Module 3 – Harmony in the Family and Society

- Harmony in the Family – the Basic Unit of Human Interaction
- 'Trust' – the Foundational Value in Relationship
- 'Respect' – as the Right Evaluation
- Values in Human-to-Human Relationship

COURSE OUTCOMES

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

CO	Description	Level
CO1	Define and explain the principles of Value Education and its role in fulfilling basic human aspirations.	K2
CO2	Explain the relationship between the Self and the Body and develop strategies for achieving harmony and self-regulation.	K3
CO3	Apply values such as trust, respect, and empathy to foster harmony in family and social relationships.	K3

REFERENCE BOOKS

1. R.R. Gaur; R. Asthana; G.P. Bagaria; "A foundation course in HUMAN VALUES and professional ethics", 2023, 3rd Edition, UHV Publications Printed by PHI.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-
CO3	-	-	-	-	-	-	-	3	2	1	-	3	-	-	-
Score	-	-	-	-	-	-	-	9	2	1	-	9	-	-	-
COM	-	-	-	-	-	-	-	3	2	1	-	3	-	-	-

Course Code	ICVA104
Course Title	Yoga and Sports
L T P C	0-0-4-0
Course Type	VA

COURSE OBJECTIVES

- Learning and practicing yoga bring the mind and body together and to lead a whole some, healthy and disease free life.
- To learn about the importance and basic techniques of fitness activities.
- To understand the discipline and coordination among the team.
- To know the basic strategies, rules and regulations of sports.
- To learn about the Self-confidence and self-worth.

COURSE CONTENT

Module 1: Yoga
Yoga: Yogic Postures (Tadasana, Vrksasana, Trikonasana, Virabhadrasana, Urdhva Mukha Svanasana, Savasana), Pranayama, Surya Namaskar, Medidation

Module 2: Physical Fitness
Physical Fitness: Gym and Athletics and Parade Marching Skills

Module 3: Indoor Games
Indoor Games: Any one game from Badminton, Table Tennis.

Module 4: Outdoor Games
Outdoor Games: Anyone game from Cricket, Volley Ball, Basket Ball, Kabaddi, Kho-Kho.

COURSE OUTCOMES

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

CO	Description
CO1	Students will exhibit a physically active lifestyle and will understand that physical activity provides opportunities for enjoyment, challenge and self-expression.
CO2	Students will achieve and maintain a health-enhancing level of physical fitness.
CO3	Improved understanding of discipline and coordination.
CO4	Improved knowledge of rules and strategies of particular games and sports.
CO5	Self-confidence and self-worth as they relate to physical education recreation programs.

SEMESTER II

Course Code	CSMC102
Course Title	Computer Workshop
L T P C	0-0-4-2
Course Type	MC

COURSE OBJECTIVES

- To impart the knowledge of various hardware components of a computer system.
- To provide the skill of assembling the computer system.
- To impart knowledge about the troubleshooting and fault finding the computers and the peripherals.
- To impart the knowledge and usage of various tools such as Power Point, Word Excel, MS Outlook and Latex.
- To learn the basic commands in Linux operating system.
- To learn the basics of computer networks and different networking devices.

LIST OF EXPERIMENTS

1. Introduction to Von-Neumann Architecture, study of hardware components
2. To study and demonstrate the working of Chip Set, BIOS chip, Capacitors, Inductors, Resistors, Hub and Switch, Repeater and Bridges, Router and NIC.
3. To assemble a PC.
4. Dual Booting (Warm Booting and cold booting)
5. Installation process of Windows, Linux operating system(Ubuntu)
6. Study of Device Drivers and Installation process of Device Drivers
7. Hardware Troubleshooting (Demonstration): Students have to be given a PC which does not boot due to improper assembly or defective peripherals. Identifying problem and fixing it for getting to working condition.
8. Software Troubleshooting (Demonstration): Students have to be given a malfunctioning CPU due to system software problems
9. Introduction to MS Word, MS Excel, Power Point Presentation, MS Outlook, Latex.
10. Exposure to Basic commands and system administration in Linux.
11. Introduction to Cyber Security.

CO	Description	Level
CO1	Describe various hardware components of a computer system.	K2
CO2	Identify existing configuration of the computer and peripherals and to troubleshoot common problems	K3
CO3	Make use of various Microsoft tools to solve the problems.	K3
CO4	Experiment with basic commands in Linux operating system.	K3
CO5	Explain the basics concepts related to computer networks and identify different networking devices.	K3

COURSE OUTCOMES

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

TEXT BOOKS

1. Mueller, Scott, ”Upgrading and Repairing PCs, 22nd Edition”, QUE, Pearson Education, 2015.
2. Meyers, Mike, “Introduction to PC Hardware and Troubleshooting”, Tata McGraw Hill, New Delhi, 2003.
3. Zacker, Craig and Rourke, John, “The complete reference: PC hardware, 1st Edition”, Tata McGraw Hill, New Delhi, 2001.

REFERENCE BOOKS

1. Govindarajulu, B., “IBM PC and Clones hardware troubleshooting and maintenance, 2nd Edition”, Tata McGraw-Hill, New Delhi, 2008.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	3	3	-	-	-	-	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Score	15	4	-	6	-	-	-	-	6	6	-	-	2	-	-
COM	3	2	-	3	-	-	-	-	3	3	-	-	2	-	-

Course Code	CSMC103
Course Title	Data Structures And Algorithms
L T P C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To impart the basic concepts of data structures and algorithms.
- To understand writing algorithms and step by step approach to solving problems with the help of fundamental data structures.
- To understand concepts about searching and sorting techniques.
- To be familiar with basic techniques of algorithm analysis.
- To learn and implement various data structures and algorithms.

COURSE CONTENT

Unit-I Complexity of algorithms and Algorithmic paradigms
Introduction to Algorithms, Introduction to Asymptotic notations and their significance, complexity analysis of algorithms, worst case and average case. Arrays and Recursion functions.

Unit-II Basic Data Structures
Stacks and Queues- Abstract data types, sequential and linked implementations, and applications of stacks and queues. Linked Lists- Abstract data type, sequential and linked representations, comparison of insertion, deletion, and search operations for sequential and linked lists, doubly linked lists, circular lists, skip lists, and applications of lists.

Unit-III Trees and Heaps
Trees- Abstract data type, sequential and linked implementations, tree traversal methods and algorithms, Binary trees. Search Trees- Binary search trees, search efficiency, insertion, and deletion operations, importance of balancing, AVL trees, searching, insertion, and deletions in AVL trees, 2-3 tree, B-tree, B+ Trees. Heaps- Heaps as priority queues, heap implementation, insertion and deletion operations, binary heaps.

Unit-IV Graphs
Definition, terminology, directed and undirected graphs, properties, implementation – adjacency matrix and adjacency linked representation, connectivity in graphs, graph traversal – breadth first and depth first, spanning trees, Graph algorithms: Depth First Search and Breadth First Search with applications, Minimum Spanning Trees and shortest paths.

Unit-V Basic algorithmic techniques
Sorting and Searching techniques with analysis, Greedy algorithms, divide and conquer for sorting problems, dynamic programming for longest common subsequence and Introduction to hashing.

LIST OF EXPERIMENTS

1. Implementation and Operations on Arrays.
2. Implementation of ADT of Stacks.
3. Implementation of Applications of Stacks.
4. Implementation of ADT of Queues.
5. Implementation of Applications of Queues.
6. Implementation of ADT of Lists.
7. Implementation of Applications of Lists.
8. Implementation of Binary Trees.
9. Implementation of Search Trees.
10. Implementation of Heaps.
11. Implementation of Applications of Heaps.
12. Implementation of algorithms of graphs.
13. Implementation of sorting algorithms.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the fundamentals of data structures and algorithms.	K2
CO2	Build data structures for a given problem.	K3
CO3	Illustrate applications and use of tree data structures.	K3
CO4	Compare algorithms for graph data structures.	K4
CO5	Compare the basic algorithmic techniques and choose a suitable one for a given problem.	K5

TEXT BOOKS

1. Skiena Steven S., “The Algorithm Design Manual”, Springer, 2nd edition, 2008.
2. Cormen, T., Lieserson, C., Rivest, R., and Stein, C., “Introductions to Algorithms”, Prentice-Hall India, 3rd edition, 2009

REFERENCE BOOKS

1. Dasgupta, Sanjoy, Papadimitriou, Christos H. and Vazirani, Umesh V. “Algorithms”, Tata McGraw-Hill, 2008.
2. Kruse, Tondo and Leung, “Data Structures and Program Design in C”, 2nd edition, Prentice-Hall, 1997.
3. Lipschutz, Seymour, “Data structures”, McGraw Hill revised first edition, 2014.
4. Skiena Steven S., “The Algorithm Design Manual”, Springer, 2nd edition, 2008.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	3	-	-	-	-	-	3	-	-	3	-	3
CO2	-	-	-	-	3	-	-	-	-	-	-	-	3	-	3
CO3	2	2	-	3	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	3	3	-	-	-	3	-	-	-	-	-	-
CO5	2	2	-	-	1	-	-	-	-	-	-	-	-	-	3
Score	8	8	-	9	8	-	-	-	3	3	-	-	6	-	9
COM	2	2	-	3	2	-	-	-	3	3	-	-	3	-	3

Course Code	ECMC102
Course Title	Basic Electrical and Electronics Engineering
L T P C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To learn the problem-solving techniques in RLC circuits and power measurements.
- To learn the fundamentals of alternating current and direct current.
- To study the characteristics and use of PN junction diode and Zener diode.
- To study the various configurations of NPN and PNP transistors and their applications.
- To understand the JFET characteristics and its use as an amplifier.

COURSE CONTENT

Unit-I Electrical Circuits
Dependent and independent voltage sources and current sources, charging factor, power factor, Kirchoff's Laws: KVL and KCL, Nodal and Mesh analysis, delta to wye and wye to delta transformations, Linear and non-linear devices, RL, RC & RLC circuits, sinusoids, ac fundamentals, power and energy, self and mutual inductances, and energy in coupled circuit, Q factor and bandwidth.

Unit-II Network Theorems
Source transformation, Superposition Theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem and Maximum power transfer theorem Compensation theorem, Tellegen's theorem, and their applications.

Unit-III Semiconductors Diodes
Basics of semiconductors, intrinsic and extrinsic semiconductors, basic operation of a p-n junction diode, DC load line analysis, Rectifier circuits, filters (L, C, LC, π), Zener diode and its characteristics, Zener diode as a voltage regulator.

Unit-IV Bipolar Junction Transistor (BJTs)
Simplified structure, operation of n-p-n and p-n-p transistors, BJT as an amplifier and as a switch, Input and Output Characteristics of CE, CB, and CC configurations, DC load line analysis, selection of operating point (Q-point), gain (α, β, and γ), biasing techniques: fixed, emitter, voltage divider, collector feedback etc.

Unit-V Field Effect Transistor
Structure and basic operation of JFET, types (n-channel and p-channel), drain and transfer characteristics, structure and basic operation of MOSFET, types (depletion and enhancement), Drain and Transfer Characteristics, Comparison of BJT and FET.

LIST OF EXPERIMENTS

1. To calibrate a given wattmeter by direct loading, verify ohm's law for BPLL element, calibrate a voltmeter & ammeter, calibrate a single-phase energy meter by direct loading.
2. To verify the Kirchoff's laws.
3. To verify network theorems, polarity test, voltage ratio test, open circuit test, short circuit test, load test on single phase transformer.
4. To study DSO, Function generator, Multimeter, and DC power supply.
5. To observe the V-I characteristics of PN Junction and Zener diode.
6. To study the half-wave and full-wave rectifier circuits without and with capacitor filter.
7. To observe the input and output characteristics of a transistor, DC biasing the transistor in common- emitter configuration and determine its operating point (i.e., various voltages and currents).
8. To draw the Transfer and Drain Characteristics of JFET.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Apply the various laws and methods to solve the electrical problems.	K2
CO2	Apply different network theorems to find the current and voltage in every branch of a given circuit.	K3
CO3	Explain various semiconductor diodes to develop an electronic circuitry.	K2
CO4	Develop different circuits using the BJT for various applications.	K3
CO5	Make use of different types of FETs for developing an amplifier.	K3

TEXT BOOKS

1. Bird, John. Electrical circuit theory and technology. 6th Edition, Routledge, 2017.
2. Charles, K.A. and Sadiku, N.O., "Fundamental of Electric Circuits", 6th Edition Tata Mc-Graw Hill, 2018.
3. Hayt, W. H. and Kemmerly, J., "Engineering Circuit Analysis", 8th Edition, McGraw Hill Education, 2013.
4. Boylestad, R. L. and Nashelsky, L., "Electronic Devices and Circuits theory", 10th Edition, Pearson Education, 2013.

REFERENCE BOOKS

1. Sudhakar, A. and Palli, S. S., “Circuits and Networks: Analysis and Synthesis”, McGraw-Hill Education, 2017.

2. Sedra and Smith K. C., ”Microelectronics Circuits”, 5th Edition, Oxford University, 2009.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	8	15	-	-	-	-	-	-	-	-	10	-	-
COM	3	2	2	3	-	-	-	-	-	-	-	-	2	-	-

Course Code	ICMD105
Course Title	Engineering Mathematics - II
L T P C	3-1-0-4
Course Type	MD

COURSE OBJECTIVES

- To understand probabilistic models that are employed in countless applications in all areas of science and engineering.
- To acquire knowledge of ordinary differential equations.
- To understand fundamental concepts of Laplace and Fourier transforms.
- To acquire knowledge of the basics of Fourier series and practical Harmonic analysis.

COURSE CONTENT

Unit-I Probability and Random Variable:
Axioms of probability, Conditional probability, Total probability, Baye's theorem, Random variable, Probability mass function, probability density function, properties, Moments, Moment generating function and their properties, Joint distributions, Marginal and conditional distribution, Covariance.

Unit-II Standard Distributions:
Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties, Central limit theorem.

Unit-III Ordinary Differential Equations:
Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories, Simultaneous linear first order equations), Linear differential equations with constant coefficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant coefficients (Cauchy's and Legendre's linear equations), Applications of linear differential equations in engineering.

Unit-IV Laplace Transform:
Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

Unit-V Fourier Series
Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.	K2
CO2	Classify the function of random variables based on Discrete and Continuous Distributions, which can describe the real phenomenon.	K2
CO3	Analyze and solve system of differential equations which arise in real world problems.	K3
CO4	Apply Laplace transform technique to solve boundary value problems.	K3
CO5	Developing an understanding of Fourier analysis and compare them with harmonic analysis.	K3

TEXT BOOKS

1. Boyce W.E., Diprima R.C., "Elementary differential equations and boundary value problems", Wiley, Tenth Edition.
2. Veerarajan, T., "Probability, Statistics and Random Processes", 3rd edition, Tata McGraw Hill Education Pvt. Ltd., 2017.

REFERENCE BOOKS

1. Ross S., "A First Course in Probability", Pearson Education, Tenth Edition, 2015.
2. Kreyszig, E., "Advanced Engineering Mathematics", Wiley, Tenth Edition, 2015.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
Score	15	10	-	6	-	-	-	-	-	-	-	-	10	-	-
COM	3	2	-	3	-	-	-	-	-	-	-	-	2	-	-

Course Code	ICMD101
Course Title	Introduction to Bioinformatics
L T P C	3-0-0-3
Course Type	MD

COURSE OBJECTIVES

- To learn the basics of molecular biotechnology for understanding the flow of information in the biological system.
- To get familiarized with the bioinformatics tools, biological databases, and resources.
- To know the applications of alignment algorithms for sequence studies.
- To comprehend the structure and evolutionary relatedness of bio-macromolecules using bioinformatics tools.
- To learn the bioinformatics applications in drug design and discovery.

COURSE CONTENT

Unit-I Basic concepts of Biotechnology
Basics of molecular biotechnology: Overview of cell structure, Biomolecules: structure and function, Molecular structure of genes and chromosomes, Nucleic acid: replication, transcription, splicing, genetic code, translation and their regulatory mechanisms, Non-coding and micro RNA, RNA interference, DNA damage and repair, Post-translation modification. Molecular and Analytical Tools: Gene Cloning and Vectors, PCR, DNA sequencing, Protein sequencing, Next-generation sequencing, Gene microarrays, Proteomics, Upstream and Downstream processing: Chromatography, Post-purification analysis methods.

Unit-II Biological Databases
Introduction to Bioinformatics and Computational Biology, Biological sequences, Classification of biological databases: Sequence databases, Structure databases, Genome specific databases, Special databases and applications: microarray, metabolic pathway, motif, and domain databases, Data file formats.

Unit-III Sequence Analysis
Sequence alignment: Homology vs Similarity, Similarity vs Identity, Types of sequence alignment: Pairwise and Multiple sequence alignment, Global alignment, Local alignment, Dotplot, alignment algorithms: Needleman-Wunsch and Smith-Waterman algorithm, Substitution matrices: PAM and BLOSUM, Multiple sequence alignment: Application of multiple alignments, Viewing and editing of MSA and Scoring function, Database similarity searching: Basic Local Alignment Search Tool (BLAST), FASTA, PHI BLAST, PSI BLAST.

Unit-IV Macromolecular structure and phylogenetic analyses
Gene prediction methods, Gene annotation: Structural and Functional gene annotation, Protein structure visualization, Prediction of protein secondary structure, Tertiary structure prediction:

Homology modeling, Threading, Ab-initio prediction, Validation of the predicted structure using Ramachandran plot, Steriochemical properties, Structure-structure alignment. Phylogenetic basics: Molecular clock theory, Ultrametric trees, Distance matrix methods: UPGMA, Neighbouring joining, Character based methods: Maximum Parsimony, Methods of evaluating phylogenetic methods: boot strapping, jackknifing.

Unit-V Bioinformatics approaches for drug discovery
Computer Aided Drug Design: Drug discovery process, Target identification and validation, lead optimization and validation, Computational ligand designing, Analog-Based drug design, Pharmacophores (3D database searching, conformation searches, deriving and using 3D Pharmacophore, Constrained systematic search, Genetic algorithm, Clique detection techniques, maximum likelihood method) and QSAR, Structure-based drug design: Docking, De Novo Drug Design (Fragment Placements, Connection Methods, Sequential Grow), Virtual screening.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Demonstrate understanding of the biological processes and decipher them using advanced biotechnological tools.	K2
CO2	Use and describe bioinformatics data and information resources.	K3
CO3	Apply computational based solutions for biological perspectives.	K3
CO4	Understand the macromolecules structure prediction methods and analyses the evolutionary relationship among the organisms.	K3
CO5	Apply computational based solutions for drug discovery.	K3

TEXT BOOKS

1. Rastogi S.C., Rastogi P., Mendiratta N., Bioinformatics Methods and Applications, Prentice Hall India, Fifth edition (2022)
2. Arthur Lesk, Introduction to Bioinformatics, Oxford University Press, Fifth edition (2019).
3. Attwood TK, and Parry-Smith, Introduction to Bioinformatics, Pearson Education India, 1st Edition (2007).

REFERENCE BOOKS

1. William J. Thieman and Michael A. Palladino, Introduction to Biotechnology, Pearson New International Edition India, Fourth Edition (2021).

2. David W. Mount, Bioinformatics: Sequence and Genome Analysis, Second Edition, CSHL Press US (2004).

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	2	2	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	2	-	-	-	-	-	2	-	2
CO4	-	-	2	-	1	2	2	-	-	-	-	-	2	-	2
CO5	-	-	-	-	-	-	-	2	-	-	-	-	2	-	2
Score	6	4	5	1	4	4	4	2	-	-	-	-	6	-	8
COM	3	2	2	1	2	2	2	2	-	-	-	-	2	-	2

Course Code	ICMD102
Course Title	Engineering Chemistry
L T P C	3-0-2-4
Course Type	MD

COURSE OBJECTIVES

- To learn about hard-soft water and solve problems based on hardness estimation.
- To comprehend the structure, properties, synthesis and applications of polymers.
- To investigate engineering materials such as fuels and lubricants.
- To acquire a thorough understanding of nanotechnology and practical applications in everyday contexts.
- To apply the electrochemical principles in batteries and semiconductor devices.
- To analyze the structure and properties of compounds using IR, UV, NMR, Thermal analysis and chromatography.
- To develop proficiency in conducting laboratory experiments, demonstrating safe and proper utilization of standard chemistry glassware and equipment.

COURSE CONTENT

Unit-I Water and its Treatment
Sources of water, Hard and Soft Water, Estimation of Hardness by EDTA Method, Softening of Water, Boiler Feed Water, Treatment Methods, Specifications for Drinking Water, BIS and WHO Standards, Desalination Processes- Reverse Osmosis and Electrodialysis.

Unit-II Polymer and Composites
Polymer: Introduction, Functionality and Classification of Polymers, Mechanism of Polymerization, Molecular Weight, Structure-Property Relationship, Moulding Techniques, Synthesis, Properties and Application of Commercially Important Polymers, Conducting Polymers. Composites: Introduction to Composites, Classification, Constituents, Advantages and applications of composites.

Unit-III Fuels and Lubricants
Fuels: Classification, Types of Coal, Determination of Calorific Value of Solid Fuels, Bomb Calorimeter, Theoretical Oxygen, Proximate and Ultimate Analysis of Coal, Manufacture of Metallurgical Coke, Flue Gas Analysis, Biofuels. Lubricants: Definition, Theories, Characteristics, Additives to Lubricants, Solid Lubricants.

Unit-IV Introduction to Nanochemistry
Nanotechnology, Concept of Nanochemistry, Synthesis, Characteristics and Applications of Carbon Nanostructures Graphene, Graphite, Fullerenes, Carbon Nanotubes, Nanowires, Nanor-

ods, Porous Nanostructures, Drawbacks and futuristic aspects of Nanotechnology, Green Chemistry, Nanosensors.

Unit-V Basics of Electrochemistry and its Applications
Electrochemical Cells: Introduction, Electrolytic and galvanic cells, electrochemical series, Nernst equation, cell EMF. Batteries: Types, Working principle and uses. Corrosion: Types, Passivity, Polarization, Over-potential and its significance. Factors affecting corrosion. Protection from corrosion. Semiconductor Electrochemistry: Fuel Cells, Hydrogen Cell, Clean energy conversion and storage devices.

Unit-VI Characterization Techniques
Introduction to Spectroscopy, UV-Visible Spectroscopy: Principle, Instrumentation and Application; IR Spectroscopy: Principle and Applications; NMR: Principle, Instrumentation, Applications Of NMR; Thermal Method: Instrumentation, Fundamental Principles and Applications of TGA, DTA and DSC; Introduction to Chromatographic Techniques.

LIST OF EXPERIMENTS

1. To determine the total hardness of the given hard water using EDTA titration method to estimate of total.
2. To determine the carbonate, non-carbonate and total hardness in the given water sample by EDTA method.
3. To determine the alkalinity of the given water sample by titrating it against 0.02 N H2SO4 solution.
4. To determine the strength of given solution of Mohr's salt.
5. To estimate amount of chlorine present in given sample of bleaching powder.
6. To determine the iron content in the given salt by using external indicator.
7. To estimate Dissolved oxygen (DO) level in the given water sample by Winkler's Method.
8. To determine the strength of an acid by pH – metric method.
9. To determine the strength of a mixture of acid solution (HCl and CH3COOH) by titrating against Sodium hydroxide solution conductometrically.
10. To identify the surface tension of an unknown liquid using Stalagmometer.
11. To identify the viscosity of an unknown liquid using Ostwald viscometer.
12. To separate the mixture of amino acids by thin layer chromatography.
13. To prepare urea formaldehyde resin.
14. To prepare polymer of Bakelite.

CO	Description	Level
CO1	Distinguish between hard/soft water and solve the day-to-day problems associated with it.	K3
CO2	Explain the properties, structure, synthesis and applications of Polymers in engineering fields.	K2
CO3	Identify the different engineering materials and explain its usefulness in technological advancement.	K3
CO4	Assess the real-world applications of nanotechnology in revolutionizing our surroundings.	K3
CO5	Interpret the operation of electrochemical systems in batteries and semiconductor devices and identify solutions to prevent corrosion.	K4
CO6	Analyse the structures of known and unknown compounds using different characterization techniques.	K4
CO7	Apply the concepts of Engineering Chemistry to real-world situations.	K3

COURSE OUTCOMES

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

TEXT BOOKS

1. Vairam, S., "Engineering Chemistry- A textbook of chemistry for engineers", Wiley India Pvt. Ltd., 2018.
2. Palanna, O. G., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd., 2017.
3. Dara, S. S. and Umare, S. S., "A Text book of Engineering Chemistry", S. Chand Publishing, 2011.

REFERENCE BOOKS

1. Poole, J.R, Charles, P., and Frank J. owens, "Introduction to nanotechnology", John Wiley and Sons, 2009.
2. Pavia, D.L., Lampman, G.M., Kriz, G.S., "Introduction to spectroscopy: a guide for students of organic chemistry", Philadelphia: W.B. Saunders Co., 1979.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	3	2	-	-	-	-	-	2	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	2	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	2	2	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO7	3	2	-	3	-	-	-	-	-	-	-	-	-	-	-
Score	21	14	-	3	-	7	4	-	-	-	-	-	6	-	2
COM	3	2	-	3	-	3	2	-	-	-	-	-	2	-	2

Course Code	ICVA103
Course Title	Universal Human Values - II
L T P C	0-0-2-1
Course Type	VA

COURSE OBJECTIVES

- To review and integrate key concepts from previous modules and explore the application of harmony principles in societal contexts.
- To understand the principles of harmony in nature and existence, recognizing interconnectedness, self-regulation, and mutual fulfillment.
- To explore the implications of a holistic understanding of harmony and existence on professional ethics, education, and human conduct.

COURSE CONTENT

Module-I Recap of UHVPE Part 1 and Harmony in the Society

1. Recap of Introduction to Value Education
2. Recap of Harmony in the Human Being
3. Recap of Harmony in the Family: Feeling of Trust
4. Recap of Harmony in the Family: Feeling of Respect and other Feelings
5. Understanding Harmony in the Society
6. Vision for the Universal Human Order

Module-II Harmony in the Nature (Existence)

1. Understanding Harmony in the Nature
2. Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
3. Realizing Existence as Co-existence at All Levels
4. The Holistic Perception of Harmony in Existence

Module-III Implications of the Holistic Understanding – a Look at Professional Ethics

1. Basis for Universal Human Values

2. Definitiveness of (Ethical) Human Conduct
3. Professional Ethics in the light of Right Understanding
4. A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
5. Holistic Technologies, Production Systems and Management Models-Typical Case Studies
6. Strategies for Transition towards Value-based Life and Profession

COURSE OUTCOMES

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

CO	Description	Level
CO1	Students will be able to analyze and apply harmony principles to promote a vision for the Universal Human Order and foster a more harmonious society.	K2
CO2	Students will be able to explain the holistic concept of harmony in existence, recognizing the co-existence and interdependence of all levels of nature.	K3
CO3	Students will be able to apply universal human values and principles of right understanding to develop strategies for transitioning towards value-based personal and professional practices.	K3

REFERENCE BOOKS

1. R.R. Gaur; R. Asthana; G.P. Bagaria; “A foundation course in HUMAN VALUES and professional ethics”, 2023, 3rd Edition, UHV Publications Printed by PHI.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	3	-	-	-
CO3	-	-	-	-	-	-	-	3	2	1	-	3	-	-	-
Score	-	-	-	-	-	-	-	9	2	1	-	4	-	-	-
COM	-	-	-	-	-	-	-	3	1	1	-	3	-	-	-

Course Code	ICVA105
Course Title	Extra-Curricular Activities
L T P C	0-0-4-0
Course Type	VA

COURSE OBJECTIVES

- To actively the students in the institute extracurricular activities.
- To encourage students in participating the club activities.
- To motivate students in registering the student clubs/societies.
- To make the students understand the importance of service.
- To inculcate self-confidence and self-worth into students.

Modules

Module I:
The students need to participate in at least one major event conducted by the institute and provide the certificate as the proof.

Module II:
The student need to participate in at least one club activity organised by the societies.

Module III:
The student need to register in at least one society after joining the institute.

Module IV:
The student need to actively participate in the government initiatives organised by the institute.

Module V:
The student need to attend at least one self-growth sessions like yoga, mental counselling, etc. organised by the institute.

COURSE OUTCOMES

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

CO	Description
CO1	Foster a connection between extracurricular participation and academic pursuit.
CO2	Develop problem-solving and critical thinking skills through strategic planning and execution by participating in various events in clubs and societies.
CO3	Develop intrinsic motivation and a passion for lifelong learning and participation in various club events, govt. initiatives organized by the Institute.
CO4	Enhance the ability to work effectively within a team, understanding roles, responsibilities, and the importance of cooperation.
CO5	Maintain a healthy level of physical and mental fitness.

SEMESTER III

Course Code	CSMC201
Course Title	Discrete Structures
Number of Credits (L-T-P-C)	3-1-0-4
Course Type	MC

COURSE OBJECTIVES

- To study the objects that have discrete as opposed to continuous values including the foundations of logic and algorithms.
- To study the concepts of sets and relations.
- To understand the functions and their applications.
- To learn the fundamentals of graph theory.
- To study and understand algebraic structures.

COURSE CONTENT

Unit-I Introduction to Preliminaries and Predicate Calculus
Basic concepts of discrete mathematics and related problems, propositions and predicates, disjunction and conjunction, tautologies and contradiction, laws of equivalence, rules of substitution and transitivity, normal forms, proof techniques, applications.

Unit-II Set Theory
Basic concepts, Venn Diagrams, set operations, power set, methods of proof for sets, Relations and ordering, Types of relations, Graph and matrix of a relation, properties of a relation and its application in computer science.

Unit-III Functions
Functions: definitions and notation, one to one, onto, one to one and onto, composition, identity and inverse, related results, Counting: Principle of Inclusion and Exclusion, Division and Euclidean Algorithm in Integers, Elements of Probability, Recurrence Relations, Application in computer science.

Unit-IV Graph Theory
Basic concepts of graph theory, multigraphs and weighted graphs, Bipartite graph, walk, path and circuits, Warshall's algorithm: shortest path, Eulerian paths and circuits, Hamiltonian paths and circuits, factors of a graph and planar graphs, Graph colorings, Graph isomorphism, Application of graph theory.

Unit-V Basics of Structures
Mathematical induction, Algebraic structures properties, Semi group, Monoid, Group and Sub group: examples and standard results, generators and evaluation of powers, cosets and Langrange's theorem, rings, integral domains, fields, Applications of algebric structures.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the basics of discrete mathematics, predicate calculus.	K3
CO2	Understand set theory and relations	K2
CO3	Understand and apply the concepts of functions and recurrence relation.	K3
CO4	Illustrate the concepts of graph theory.	K2
CO5	Explain different algebraic structures.	K3

TEXT BOOKS

1. Tremblay, J. P. and Manohar, R., *"Discrete Mathematical structures with applications to Computer Science"*, McGraw Hill, 2017.
2. Liu, C.L., *"Elements of Discrete Mathematics"*, McGraw Hill, 2012.
3. Nicodemi, O., *"Discrete Mathematics: A Bridge to Computer Science and Advanced Mathematics"*, West Publishing Co., 1999.

REFERENCE BOOKS

1. Scheinerman, Edward, *"Mathematics: A Discrete Introduction"*, Cengage, 3rd Edition, 2012.
2. Rosen, Kenneth H., *"Discrete Mathematics and Its Applications"*, McGraw Hill, 2012.
3. Graham, L. R., Donald, E. K. and Patashnik, O., *"Concrete Mathematics: A Foundation for Computer Science"*, Addison Wesley, 2nd Edition, 1994.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	-	-	-	-	-	-	-	3	3	2
CO2	2	3	2	3	3	-	-	-	3	3	3	3	3	3	3
CO3	2	-	3	-	-	-	-	-	-	-	-	-	3	3	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	3	3	-
CO5	2	3	-	3	-	-	-	-	-	-	-	-	3	3	-
Score	10	11	8	9	6	-	-	-	3	3	3	3	15	15	5
COM	2	3	3	3	3	-	-	-	3	3	3	3	3	3	3

Course Code	CSMC202
Course Title	Computer Organization
L-T-P-C	3-1-0-4
Course Type	MC

COURSE OBJECTIVES

- To learn the basics of Computer System Architecture.
- To understand the core concepts of Processor Design.
- To learn and demonstrate the basics of Computer Arithmetic and Control Design.
- To learn about the structure and organization of Memory in Computer Systems.
- To understand the concepts of Parallelism in Computer Systems.

COURSE CONTENT

Unit-I General System Architecture
Stored Program control concept (Von-Neumann architecture principle), Flynn's Classification of computers (SIMD, MISD, MIMD), Structure organization (CPU, Caches, Main memory, Secondary memory unit and I/O), Register Transfer Operation, Micro-operations, Addressing Modes, Operation instruction set (Arithmetic and logical, Data transfer, Control flow), Instruction set format, Instruction Set Architecture (Instruction set based classification of processor i.e., RISC, CISC, RISC vs CISC Comparison).

Unit-II Processor Design
Arithmetic and logic unit, Stack organization, CPU Architecture types, Accumulator Based-Register, Stack Memory, Register, Detailed data path of a typical register-based CPU, Fetch, Decode, and Execute Cycle.

Unit-III Computer Arithmetic and Control Design
Addition and Subtraction, Multiplication Algorithms (Booth's Multiplication Algorithm), Division Algorithm, Floating point arithmetic operations. Control Design: Microprogrammed and Hard-wired control options, Hard-wired design methods, State table method, Multiplier control, CPU control unit. Microprogrammed, Basic concepts, control Memory, Address Sequencing.

Unit-IV Memory Hierarchy and I/O Organization
Memory Hierarchy, need for Memory Hierarchy, locality of reference principle, cache memory, main and secondary, Memory parameters, access cycle time, cost per unit, concept of virtual memory. Programmed, Interrupt driven I/O, Direct Memory Access, Synchronous and asynchronous data transfer.

Unit-V Introduction to Parallelism
Goals of parallelism, Instruction level parallelism, pipelining, super scaling, Processor level parallelism, Multiprocessor system overview.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the concepts of Computer Architecture such as Principles, Instructions Set, Addressing Modes, etc.	K2
CO2	Outline the principles of Processor design.	K2
CO3	Explain and demonstrate the various approaches followed in performing Computer Arithmetic.	K3
CO4	Interpret the organization and working of various memories in Computer Systems.	K2
CO5	Explain the relevance of Parallelism in Computer Systems.	K2

TEXT BOOKS

1. Mano M. *" Computer architecture and Organization"*, Third Edition, Pearson, 2017.
2. Hayes J.P, *"Computer architecture and Organization"*, Third Edition, McGraw Hill, 2017.
3. Stallings, W., *"Computer Organization and Architecture"*, Eleventh Edition, Pearson Publication, 2022.

REFERENCE BOOKS

1. Hennessy, John. L and Patterson, David A, *"Computer Architecture – A Quantitative Approach"*, Morgan Kaufmann, 6th Edition, 2018.
2. Hamacher, C., Vranesic, Z. and Zaky, S., *"Computer Orgnization"*, McGraw Hill Education, 5th Edition, 2011.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	3	3	-	-	-	3	3	-	-	-	-	3
CO4	2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Score	11	-	-	10	3	-	-	-	3	3	-	-	-	-	3
COM	3	-	-	3	3	-	-	-	3	3	-	-	-	-	3

Course Code	CSMC203
Course Title	Design and Analysis of Algorithms
Number of Credit (L-T-P-C)	3-1-0-4
Course Type	MC

COURSE OBJECTIVES

- To design algorithms for a given problem.
- To write simple and rigorous proof of the correctness of algorithms.
- To understand the asymptotic performance of algorithms.
- To apply important algorithmic design paradigms for solving real world problems.
- To understand several complexity classes.

COURSE CONTENT

Unit-I Algorithm Design paradigms
Motivation, concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Structure of divide-and-conquer algorithms: sets and disjoint sets, Union and Find algorithms, quick sort, Finding the maximum and minimum, Quick Sort, Merge sort, Heap and heap sort.

Unit-II Greedy Algorithms
Optimal storage on tapes, Knapsack problem, Job sequencing with deadlines, Minimum Spanning trees: Prim's algorithm and Kruskal's algorithm, Huffman codes.

Unit-III Dynamic programming
Overview, difference between dynamic programming and divide and conquer, Matrix chain multiplication, Traveling salesman Problem, longest Common sequence, 0/1 knapsack.

Unit-IV Backtracking
Queen Problem, Sum of subsets, graph coloring, Hamiltonian cycles. Branch and bound: LC searching Bounding, FIFO branch and bound, LC branch and bound application: 0/1 Knapsack problem, Traveling Salesman Problem.

Unit-V Computational Complexity
Complexity measures, Polynomial Vs non-polynomial time complexity, NP-hard and NP-complete classes, examples.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the fundamentals of algorithms and design efficient algorithms for real world problems.	K6
CO2	Construct greedy paradigm for a given problem.	K3
CO3	Illustrate dynamic programming concepts.	K2
CO4	Design backtracking algorithms for real world problems.	K6
CO5	Compare complexity classes for a given problem	K5

TEXT BOOKS

1. E. Horowitz, S. Sahni and Rajasekaran, *"Fundamentals of Computer Algorithms"*, Universities Press, 2008.
2. Cormen, Thomas H., et al. *"Introduction to algorithms"*. MIT press, 2022.
3. Skiena Steven S., *"The Algorithm Design Manual"*, Springer, 2nd edition, 2008.

REFERENCE BOOKS

1. A.V. Aho, J.E. Hopcroft and J.D. Ullman, *"The Design and Analysis of Computer Algorithms"*, Addison Wesley, 2009.
2. Sedgewick, Robert, and Kevin Wayne. Algorithms. Addison-wesley professional, 2011.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	-	-	-	-	-	-	-	3	-	-
CO2	3	2	1	2	1	-	-	-	-	-	-	-	3	-	3
CO3	3	3	3	3	1	-	-	-	-	-	-	-	2	-	-
CO4	3	3	1	2	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	-	-	-	3
Score	15	13	9	13	9	-	-	-	-	-	-	-	8	-	6
COM	3	3	2	3	2	-	-	-	-	-	-	-	3	-	3

Course Code	CSMC204
Course Title	Object Oriented Programming
L-T-P-C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To learn algorithmic problem-solving techniques.
- To learn the fundamentals of object-oriented programming.
- To compose programs in C++ using conditions, iterations and decompose a problem into function.
- To design, write, compile, test and execute programs using high level language.
- To work with files and the Standard Template Library (STL).

COURSE CONTENT

Unit-I Introduction to Object Oriented Programming
Basic concepts of OOP, Benefits of OOP, Introduction to object-oriented design and development, Design steps, Design example, Object oriented languages, Comparison of structured and object-oriented programming languages. Arrays, Pointers and Functions: Arrays, Storage of arrays in memory, Initializing Arrays, Multi-Dimensional Arrays, Pointers, accessing array elements through pointers, passing pointers as function arguments, Arrays of pointers, Pointers to pointers, Functions, Arguments, Inline functions, Function Overloading Polymorphism.

Unit-II Classes and Objects
Data types, operators, expressions, control structures, arrays, strings, Classes and objects, access specifiers, constructors, destructors, operator overloading, type conversion. Storage classes: Fixed vs Automatic declaration, Scope, Global variables, register specifier, Dynamic memory allocation.

Unit-III Inheritance
Inheritance, single Inheritance, Multiple Inheritance, Multi-level inheritance, hierarchical inheritance, hybrid inheritance, Virtual functions and Polymorphism. Exception Handling: List of exceptions, catching exception, handling exception.

Unit-IV Streams and Files
Opening and closing a file, File pointers and their manipulations, Sequential Input and output operations, multi-file programs, Random Access, command line argument, string class, Date class, Array class, List class, Queue class, User defined class, Generic Class.

Unit-V Standard Template Library
Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, Container Classes, General Theory of Operation, Vectors.

LIST OF EXPERIMENTS

1. Implementation of array and pointers.
2. Implementation of functions.
3. Implementation of function overloading.
4. Implementation of classes and objects.
5. Implementation of functions in classes.
6. Implementation of operator overloading.
7. Implementation of different types of inheritance.
8. Implementation of Streams.
9. Implementation of various operations on files.
10. Implementation of exception handling.
11. Implementation of STL.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the basics of object-oriented programming and develop programs solving basic programming concepts.	K3
CO2	Experiment with classes, objects and different techniques for solving problems.	K3
CO3	Evaluate the best inheritance method and apply exception handling.	K5
CO4	Make use of operations on files.	K3
CO5	Develop the standard template library for user applications.	K3

TEXT BOOKS

1. Bjarne Stroustrup, *"The C++ programming Language"*, 4th Edition, Addison Wesley, 2022
2. Behrouz A. Forouzan and Richard F. Gilberg *"C++ Programming: An Object-Oriented Approach"* 1st Edition, 2022.
3. Dietel, Paul J. and Dietel, Harvey M., *"C++ for Programmers"*, Prentice Hall, 10th Edition, 2016.

REFERENCE BOOKS

1. E. Balagurusamy, *"Object Oriented programming with C++"*, Tata McGraw Hill, 8th Edition 2020.
2. Reema Thareza *"Object Oriented Programming with C++"*, Revised 1st Edition, Gamma Publications, 2020.
3. Booch, *"Object Oriented Analysis and Design with Applications"*, 3rd Edition, Addison Wesley, 2009.
4. Lafore, Robert, *"Object Oriented Programming in Turbo C++"*, Galgotia Publications 2001.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	3	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Score	10	12	-	-	3	-	-	-	-	-	-	-	9	-	-
COM	2	3	-	-	3	-	-	-	-	-	-	-	3	-	-

Course Code	ECMC202
Course Title	Digital Circuits and Systems
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To describe the basic principles of digital circuits and solve logic expressions and circuits using Boolean laws and K-map.
- To impart knowledge for the design and implementation of combinational logic circuits.
- To impart knowledge for the design and implementation of sequential logic circuits.
- Classify and comprehend the working principle of logic family and data converters.
- To learn the basics of Verilog HDL for system modeling.

COURSE CONTENT

Unit-I Number System And Logic Gates
Introduction to various number systems and their Conversion. Binary Arithmetic (Addition, Subtraction, Multiplication and Division), BCD codes, Excess-3 code, Gray code, Hamming code, Error Detection and Correction. Basic Logic Operations, Basic Identities, Algebraic Laws, Useful Boolean Identities, Canonical Logic Forms, Algebraic Reductions, Complete Logic Sets, Karnaugh Maps.

Unit-II Combinational Logic Networks
Concept of a Digital Component, BCD Validity Detector, Binary Adders, Subtractors, Multiplexers, Demultiplexers, Line Decoders and Encoders, Binary Multiplication, Binary Comparators.

Unit-III Sequential Logic Circuits
Concept of a Sequential Network, Latches, Clock and Synchronization, Flip-Flops, Design of Synchronous & Asynchronous Sequential circuits. Shift registers: Principle of 4-bit shift registers. Shifting principle, Timing Diagram, SISO, SIPO, PISO and PIPO registers.

Unit-IV Introduction to State Machines and PLDs
Algorithmic State Machine, Finite State Machine: Mealy and Moore Machine, Sequence Detector, Vending Machine; Introduction to PLDs, PROM and its types, PAL, and PLA.

Unit-V First Concepts In Verilog HDL
Defining Modules in Verilog HDL; Gate, Data Flow and (Behavioral) Structural Modelling, Learning Verilog HDL. CMOS Logic Circuits: NOT Function in CMOS, Complex Logic Gates in CMOS.

LIST OF EXPERIMENTS

1. Introduction of Digital Logic Gates: Investigate logic behavior of NOT, AND, OR, NAND, NOR, EX-OR, EX-NOR gates.
2. Gate-level minimization: Two-level and multi-level implementation of Boolean functions.
3. Combinational Circuits design assemble and test: adders and subtractors.
4. Code Converter: BCD to Excess-3 code converter, gray code to binary converter, binary to gray code converter.
5. Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number of Gates.
6. Design of multiplexers and de-multiplexers.
7. Design of encoders and decoders.
8. Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce an 8-bit product.
9. Parallel adder and accumulator: design, implement and test.
10. Flip-Flop: assemble, test and investigate operation of S-R, D & J-K flip-flops.
11. Counters: Design, assemble and test various Asynchronous and Synchronous binary counter with parallel load.
12. Shift Registers: Design and investigate the operation of all types of shift registers with parallel load.
13. Design of Combinational circuits using the Verilog HDL module.
14. Design of Sequential circuits using the Verilog HDL module.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.	K2
CO2	Ability to understand, analyze, and design various combinational and sequential circuits.	K3
CO3	Ability to identify basic requirements for a design application and propose a cost-effective solution.	K3
CO4	Ability to understand different types of logic families and data converters.	K4
CO5	To develop skills to build a Verilog HDL for system Modeling.	K2

TEXT BOOKS

1. Thomas L. Floyd. *"Digital Fundamentals"*, 11th Edition, Pearson International Education, 2017.
2. Mano, M. M. and Ciletti, M. D. *"Digital Design: With an Introduction to the Verilog HDL"*, 5th Edition, Pearson Education, 2013.
3. Mano, M. M. and Ciletti, M. D. *"Digital Design"*, 4^{th} Edition, Pearson Education, 2006.

REFERENCE BOOKS

1. Palnitkar, S. " *"Verilog HDL: A Guide to Digital Design and Synthesis"*," Prentice Hall, 1996.
2. Perry, D. L. & quot; *"VHDL: Programming by Example"*, 4th Edition ", McGraw-Hill, 2002.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	2	-	-	-	-	3	-	3	-	-	2
CO2	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
CO3	3	3	-	3	2	-	-	-	-	3	-	3	3	-	2
CO4	3	2	2	3	2	2	3	3	2	3	-	3	-	-	2
CO5	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
Score	15	11	2	15	10	2	3	3	2	15	-	15	9	-	10
COM	3	3	2	3	2	2	3	3	2	3	-	3	3	-	2

Course Code	CYMC201
Course Title	Introduction to Cryptography
L T P C	3-0-2-0
Course Type	MC

COURSE OBJECTIVES

- To learn the relevant mathematical concepts and apply them in cryptography.
- To analyze the design of the state-of-the-art symmetric cryptosystems and assess their strengths and weaknesses.
- To learn the design principles of asymmetric cryptography.
- To learn modern asymmetric cipher design using elliptic curves.
- To apply the knowledge of cryptography to solve real-world problems.

COURSE CONTENT

Unit-I Introduction
Introduction to cryptography, security attacks, mechanism and services, cryptosystems and basic cryptographic tools: secret-key, public-key, block and stream ciphers, hybrid cryptography; classical ciphers, cryptanalysis of classical ciphers; principles of modern cryptography, formal definitions, proofs of security, provable security and real-world security, Shannon's theory, one-time pad, limitations of perfect secrecy.

Unit-II Symmetric Encryption
Principle of symmetric cryptography, stream and block ciphers, Feistel and non-Feistel structure, DES, Triple-DES, defining computationally secure encryption, semantic security, constructing secure encryption schemes, AES, Modes of Operation, Differential and Linear Cryptanalysis, cryptographic hash functions: properties, MD5, SHA family.

Unit-III Asymmetric Encryption
Principle of asymmetric cryptography, Number theory, Euclidean algorithm, Chinese remainder theorem, Diffie-Hellman algorithm, RSA cryptosystem, probabilistic primality testing, attacks on RSA, DSA.

Unit-IV Elliptic Curve Cryptosystems
Elliptic curves over real numbers, elliptic curves over finite field, elliptic curve-based Diffie-Hellman, elliptic curve-based El-Gamal cryptosystem, and elliptic curve-based DSA.

Unit-V Advanced Topics
Pairing-based cryptography, Identity-based encryption, Attribute-based encryption, Homomorphic encryption, Zero-Knowledge Proofs.

LIST OF EXPERIMENTS

1. Modular Arithmetic and Matrix Operations.
2. Classical Ciphers – Additive, Multiplicative, Caesar (Affine), Hill, Playfair, etc.
3. Cryptanalysis of Classical Ciphers.
4. Stream Ciphers (Feedback Registers).
5. DES and Triple DES.
6. AES.
7. Modes of Operation.
8. Euclidean and Extended Euclidean Algorithm, Primality Testing.
9. Diffie Hellman (DH).
10. RSA.
11. ElGamal.
12. ECC-Based DH and ElGamal.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the fundamentals of cryptography and relevant mathematical ideas.	K3
CO2	Understand formal security definitions, assumptions, and the concepts of symmetric cryptography and cryptographic hashing.	K2
CO3	Explain public key cryptographic algorithms and their applications.	K4
CO4	Explain elliptic curve-based cryptosystems.	K2
CO5	Understand applications of cryptography.	K2

TEXT BOOKS

1. J. Katz and Y. Lindell, “Introduction to Modern Cryptography (2nd ed.),” Chapman Hall/CRC.
2. D. R. Stinson and M. B. Paterson, “Cryptography Theory and Practice (4th ed.),” CRC Press.

REFERENCE BOOKS

1. W. Stallings, "Cryptography and Network Security: Principles and Practice (7th ed.)," Pearson.

2. D. Boneh and V. Shoup, "A graduate course in applied cryptography", `https://toc.cryptobook.us/book.pdf`.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	3	3	3	-	-	-	-	-	-	2	3	2	-
CO3	3	2	-	3	-	2	-	-	-	-	-	-	2	-	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	3	3	3	2	2	-	-	-	-	2	3	2	-
Score	11	12	9	9	3	-	-	-	-	-	-	4	-	9	8
COM	3	3	3	3	3	-	-	-	-	-	-	2	-	3	2

SEMESTER IV

Course Code	CSMC205
Course Title	Operating Systems
L-T-P-C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To introduce the major concepts and components of Operating Systems.
- To understand the concepts of process synchronization in Operating Systems.
- To enrich the knowledge in managing and optimizing memory.
- To explore the file system organization and its implementation.
- To understand the principles and mechanisms of distributed systems and its synchronization techniques.

COURSE CONTENT

Unit-I Introduction
Operating Systems, Definition, Types, Functions, Abstract view of OS, System Structures, System Calls, Virtual Machines, Process Concepts, Threads, Multithreading.

Unit-II Process Management
Process Scheduling, Process Co-ordination, Synchronization, Semaphores, Monitors Hardware Synchronization, Deadlocks, Methods for Handling Deadlocks.

Unit-III Memory Management
Strategies, Contiguous and Non-Contiguous allocation, Virtual memory Management, Demand Paging, Page Placement and Replacement Policies.

Unit-IV File System
Basic concepts, File System design and Implementation, Case Study: Linux File Systems, Mass Storage Structure, Disk Scheduling, Disk Management, I/O Systems, System Protection and Security.

Unit-V Distributed System
Introduction, Distributed operating systems, Distributed file systems, Distributed Synchronization.

LIST OF EXPERIMENTS

1. Implementation of different system calls of UNIX operating system.
2. Implementation of I/O system calls of UNIX OS.

3. Implementation different CPU scheduling algorithms to find turnaround time and waiting time.
4. Simulation of multi-level queue scheduling algorithm.
5. Implementation of I/O system calls of UNIX operating system a) Process Creation b) Executing a command c) Sleep command d) Sleep command using getpid e) Signal handling using kill k) Wait command
6. Implementation of following file allocation strategies. a) Sequential b) Indexed c) Linked
7. Simulation of MVT and MFT memory management techniques.
8. Simulation of the contiguous memory allocation for Worst-fit, Best-fit, First-fit technique.
9. Implementation of different file organization techniques.
10. Implementation of Deadlock avoidance algorithm.
11. Implementation of different disk scheduling algorithms.
12. Implementation of different page replacement algorithms.
13. Implementation of producer-consumer problem using semaphores.
14. Implementation of different system calls of UNIX operating system.
15. Implementation of I/O system calls of UNIX OS.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Illustrate functions of Operating Systems.	K2
CO2	Analyse and Compare performances for different CPU scheduling algorithms, synchronization approaches, deadlock management techniques.	K4
CO3	Analyse different memory management and device management approaches for better data access.	K4
CO4	Make use of various file-system designs and identify the implementation issues.	K3
CO5	Analyse the design issues of distributed operating systems, and identify the limitations of traditional Operating systems and motivations for advancements.	K4

TEXT BOOKS

1. Galvin, Silberschatz and Gagne, *"Operating System Concepts"*, 10th edition, John Wiley and Sons, 2018.
2. Stallings, William, *"Operating Systems –Internals and Design Principles"*, 8th Edition, Pearson Publications, 2014.
3. Godbole, Achyuts , *"Operating Systems"* , Third Edition, McGraw Hill, 2017.

REFERENCE BOOKS

1. Tanenbaum, Andrew, *"Modern Operating Systems"*, 5th Edition, Pearson Publications, 2022.
2. Greg Tomsho *"Guide to Operating System"* 6th Edition, Cengage Publication, 2020.
3. Harris, J.Archer, *"Operating System"* 1st Edition, McGraw Hill, 2020.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	-	1	-	-	-	-	-	-	-	2	-	2
CO2	3	3	3	3	1	2	-	3	-	-	-	3	3	2	2
CO3	3	3	-	3	1	2	-	3	-	-	-	3	3	2	2
CO4	3	3	3	-	1	-	-	-	-	-	-	3	2	2	2
CO5	3	2	2	-	1	2	-	-	-	-	-	3	3	2	2
Score	15	13	11	6	5	6	-	6	-	-	-	12	13	8	10
COM	3	3	3	3	1	2	-	3	-	-	-	3	3	2	3

Course Code	CSMC206
Course Title	Database Management Systems
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To learn data models, conceptualize and depict a database system using ER diagram.
- To learn relational data modeling and query languages algebra for defining, querying, and managing relational databases.
- To understand dependency theory and normalization techniques for efficient designing of relational databases.
- To understand the fundamental concepts of transaction processing techniques.
- To understand the internal storage structures in a physical DB design.

COURSE CONTENT

Unit-I Introduction
Purpose of Database System, views of data, data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model, conceptual data modeling, motivation, entities, entity types, attributes, relationships, relationship types, E/R diagram notation, examples.

Unit-II Relational Model
Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL.

Unit-III Database Design
Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF.

Unit-IV Transaction Management
Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Unit-V Storage and File Management
Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

LIST OF EXPERIMENTS

1. Introduction to SQL and installation of SQL server/oracle.
2. Data Definition Language (DDL) commands in RDBMS.
3. Data Manipulation Language (DML) and Data Control Language (DCL).
4. High level language extensions with cursors.
5. Data types and create a database and write the program to carry out the following operation.
6. Create tables department and employee with required constraints.
7. Working with null values, matching the pattern from the table.
8. Aggregate functions: grouping the result of a query.
9. Set operators, Nested Queries, Joins and Sequences.
10. Views, indexes, database security and privileges: Grant and Revoke commands, Commit and Rollback commands.
11. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing Non-SQL parameters.
12. Triggers and Cursor Management in PL/SQL.
13. Procedures and Functions
14. Automatic Backup of Files and Recovery of Files.
15. As a designer identify the views that may have to be supported and create views.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the fundamentals of DBMS and build conceptual models of real-world problems.	K3
CO2	Design database schema for real world problems and construct complex SQL queries.	K6
CO3	Develop a database using normalization for real world applications.	K6
CO4	Illustrate transaction processing, concurrency control and recovery techniques.	K2
CO5	Analyze file structures and indexing techniques and select the suitable one for a given application.	K5

TEXT BOOKS

1. Silberschatz A., Korth, Henry F., and Sudharshan, S., *"Database System Concepts, 5th Edition"*, Tata McGraw Hill, 2016.
2. Elmasri, Ramez and Navathe, Shamkant B., *"Fundamentals of Database Systems 7th Edition"*, Pearson, 2015.

REFERENCE BOOKS

1. Date C. J, Kannan, A. and Swamynathan, S., *"An Introduction to Database Systems, 8th edition"*, Pearson Education, 2012.
2. Ramakrishnan, Raghu, and Johannes Gehrke. *"Database management systems" Third edition."* (2003).
3. Smirnova, Sveta, and Alkin Tezuysal. *"MySQL Cookbook"*. O'Reilly Media, Inc., 2022.
4. Rockoff, Larry. *"The language of SQL"*. Addison-Wesley Professional, 2021

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	2	-	-	-	3	3	-	-	3	-	-
CO3	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	-	3	-	-	-	-	-	-	-	-	2	-	-
Score	15	12	6	9	4	-	-	-	3	3	-	-	9	-	-
COM	3	3	3	3	2	-	-	-	3	3	-	-	3	-	-

Course Code	CSMC207
Course Title	Theory of Computation
L-T-P-C	3-1-0-4
Course Type	MC

COURSE OBJECTIVES

- To give an overview of the theoretical foundations of computer science from the perspective of formal languages.
- To illustrate finite state machines to solve problems in computing.
- To explain the hierarchy of problems arising in the computer sciences.
- To familiarize Regular grammars, context frees grammar.
- To learn and understand context sensitive languages and various model of Turing machines

COURSE CONTENT

Unit-I FINITE AUTOMATA (FA)
Introduction: Alphabets, Strings and Languages, Automata and Grammars, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.

Unit-II REGULAR EXPRESSIONS (RE)
Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions-Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. REGULAR GRAMMARS: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.

Unit-III CONTEXT FREE GRAMMER (CFG)
Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL.

Unit-IV PUSHDOWN AUTOMATA
Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA. Turing Machines (TM) Formal definition and behavior, Languages of a TM, TM as accept and TM as a computer of integer

functions, Types of TMs.

Unit-V RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES (REL)
Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCP), undecidability of PCP.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the fundamentals of automata theory and build finite state machines for real world problems.	K2
CO2	Construct a deterministic finite state machines for the given regular expression.	K3
CO3	Illustrate context free grammar and context free languages.	K2
CO4	Design a push down automata for real world problems.	K3
CO5	Compare various Turing machine models.	K4

TEXT BOOKS

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), *"Introduction to Automata Theory Languages and Computation"* , Third Edition, Pearson Education, India.
2. Michael Sipser, *"Introduction to the Theory of Computation"*, 3rd Edition,2014.
3. Peter Linz, *" An Introduction to Formal Languages and Automata"* 4th Edition 28 June, 2017.

REFERENCE BOOKS

1. K. L. P Mishra, N. Chandrashekaran (2003), *"Theory of Computer Science-Automata Languages and Computation"*, 2nd edition, Prentice Hall of India, India.
2. A. M. Natarajan, P. Balasubramani, *"Theory of Computation"*, New Age International, 2003.
3. Vivek Kulkarni, *"Introduction to the Theory of Computation"*, First published August 31, 2013.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	-	-	-	-	-	3	-	-	3	-	3
CO2	2	2	-	-	3	-	-	-	-	-	-	-	3	-	3
CO3	2	2	-	3	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	3	3	-	-	-	3	-	-	-	-	-	-
CO5	2	3	-	-	1	-	-	-	-	-	-	-	-	-	3
Score	10	11	1	9	8	-	-	-	3	3	-	-	6	-	9
COM	2	3	1	3	2	-	-	-	3	3	-	-	3	-	3

Course Code	CSMC208
Course Title	Computer Networks
L-T-P-C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To understand the concept of layering and various data communication techniques.
- To learn the basic MAC protocols in Computer Networks.
- To learn and implement the addressing schemes and routing protocols for a given scenario in Computer Networks.
- To learn the role and working of TCP and UDP protocols.
- To understand various application layer protocols.

COURSE CONTENT

Unit-I Layered Network Architecture
ISO-OSI Model, TCP/IP, Data Communication Techniques: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Data Modems, Multiplexing Techniques, Frequency Division, Multiplexing Hierarchies, Transmission Media, Error Detection: Parity Check Codes, Cyclic Redundancy Codes.

Unit-II Data Link Protocols
Stop and Wait protocols, Noise free and Noisy Channels, Performance and Efficiency, Sliding Window protocols, MAC Sublayer: The Channel Allocation Problem, Carrier Sense multiple Access Protocols, Collision Free Protocols, FDDI protocol, Distributed Queue Dual Bus (DQDB) protocol, Virtual LAN.

Unit-III Network Layer protocols
Design Issues: Virtual Circuits and Datagrams, Routing Algorithms, Optimality principle, Shortest path routing Algorithms, Flooding and Broadcasting, Distance Vector Routing, Link State Routing, Flow Based Routing, Multicast Routing, Flow and Congestion Control: General Principles, Congestion control in datagram subnets, Choke Packets, Load Shedding, Jitter Control, RSVP. Interworking: Bridges, Routers and Gateways, IP packet, IP routing

Unit-IV Transport Layer Protocols
Design Issues, Quality of Services, Introduction to sockets, Connection Management: Addressing, Connection Establishment and Releases, Use of Timers, Flow Control and Buffering, Multiplexing, The internet Transport Protocols: User Datagram protocol UDP/TCP Layering, Segment Format, Checks Sum, Timeout Connection Management.

Unit-V Session Layer protocol
Dialog Management, Synchronization, OSI Session primitives, Connection Establishment. Introduction to network management: Remote Monitoring Techniques: polling, Traps performance management, Class of service, Quality of service, Security Management, Firewalls.

LIST OF EXPERIMENTS

1. Study different types of ethernet cables and practically implement the cross-wired cable and straight through cable using clamping tools.
2. Configure IP addresses for Networking Devices: End Device, Hub, Switch, Bridge, Repeaters, Gateway, and Routers. Debug and troubleshoot the network issues using basic commands such as ipconfig, ipconfig/all, nslookup, tracert, netstat along with various configuration modes (i.e., user, privilege, and global).
3. Configure wired, wireless, and virtual local area networks and transfer files among the devices.
4. Simulate how a DHCP server assigns IP addresses dynamically to LAN clients.
5. Configure and test DNS server and client in a LAN.
6. Simulate MAC Layer Protocols (CSMA/CD and CSMA/CA) using NS-3 and measure delay, collisions, packet delivery ratio, and throughput.
7. Configure different network topologies: bus, star, mesh, ring, tree, and hybrid.
8. Configure FTP protocol for a LAN. Upload and download the files between devices in a network.
9. Implement the ARP and RARP protocols.
10. Create a client-server application programming model using TCP/UDP protocols.
11. Configure and test the operations of OSPF, BGP, and RIP routing protocols.
12. Implement and analyze HTTP communication between web client and server.
13. Demonstrate email communication using SMTP protocol.
14. Simulate a firewall to permit or deny traffic in a network.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the role of various layers of ISO/OSI model and various data communication techniques.	K2
CO2	Explain the basic MAC protocols and various design issues in Computer Networks.	K2
CO3	Implement a suitable IP addressing scheme, subnetting/VLAN and routing protocol implementation for a given scenario.	K4
CO4	Explain the role and working of TCP and UDP protocols.	K3
CO5	Experiment with various Application Layer protocols and build an application using the same.	K4

TEXT BOOKS

1. Forouzan, A., *"Data Communication and Networking"*, Fourth Edition, McGraw Hill, International Edition, 2017.
2. Tanenbaum, S., *"Computer Networks"* , Fifth Edition, Prentice Hall, India, 2013.

REFERENCE BOOKS

1. Olifer, Natalia and Olifer Victor, *"Computer Network: Principles, Technologies and Protocols for network design"*, Wiley India Publication, 2006.
2. Kurose, James F. and Ross, Keith W., *"Computer Networking: A Top-Down Approach"*, Pearson Education, Sixth edition (30 June 2017).
3. West J, White CM. *"Data communications & computer networks: A business user's approach"*. Cengage; 2023 June 5.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	3	3	-	-	-	3	3	-	-	-	-	3
CO4	2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	3	3	-	-	3	-	-
Score	11	-	-	7	3	-	-	-	6	6	-	-	3	-	3
COM	3	-	-	3	3	-	-	-	3	3	-	-	3	-	3

Course Code	CYMC202
Course Title	Fundamentals of Data Science
L T P C	3-0-2-4
Course Type	PC

COURSE OBJECTIVES

- To introduce the field of data science and its broad range of applications.
- To equip with practical skills in data manipulation, cleaning, and analysis.
- To provide a foundation in statistical methods and their applications in data science.
- To introduce basic machine learning concepts and algorithms.
- To develop the ability to apply data science techniques to real-world problems.

COURSE CONTENT

UNIT-I INTRODUCTION TO DATA SCIENCE
Overview of Data Science: Definition, Key Components, Data Science Process, and Applications. Statistical Modelling: Introduction, Types of statistical modeling. Probability Distributions: Common Probability Distributions, Fitting a Model, and Tools for Data Science.

UNIT-II DATA MANIPULATION
Introduction to Python for Data Science, Data Types and Structures, Data Cleaning and Preparation, Libraries: Pandas, NumPy. Importance of Data Visualization: Tools and Libraries: Matplotlib, Seaborn. Creating and Interpreting Visualizations.

UNIT-III STATISTICAL ANALYSIS
Statistical Analysis: Mean, Median, Mode, Standard deviation. Probability Distributions: Normal, Binomial Distribution, Poisson, Exponential, Uniform, Chi-Square Distribution. Statistical Tests: t-tests, chi-square tests. Inferential Statistics: Hypothesis Testing, Confidence Intervals

UNIT-IV INTRODCUTION TO MACHINE LEARNING
Basics of Machine Learning: Types, Tools and Libraries, and Applications. Performance Evaluation Metrics, Regression Metrics, Model Training And Evaluation, Regression Algorithms, Classification Algorithms, Clustering Algorithms, Dimensionality Reduction.

UNIT-V BASICS OF ENTERPRISE REPORTING
Evolution of Data Science Practices, Case Studies from Different Industries, Overview of Popular Data Science Tools and Libraries, Emerging Technologies and Trends, Data Science Workflows and Best Practices, Future Challenges and Opportunities.

LIST OF EXPERIMENTS

1. Familiarize with python programming, Jupyter Notebooks, and Basic Libraries.
2. Learn data manipulation and preprocessing using Pandas.
3. Create visualizations to understand and present data using Matplotlib
4. Create visualizations to understand and present data using Seaborn.
5. Perform EDA to uncover patterns and insights.
6. Conduct statistical tests and analyses using SciPy.
7. Implement and evaluate regression models.
8. Implement and evaluate classification models.
9. Implement clustering algorithms for pattern recognition.
10. Evaluate basic machine learning models using various performance metrices.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Interpret the role of data science in various industries and familiar with basic concepts	K2
CO2	Inspect the suitable techniques and tools for handling and visualizing data.	K4
CO3	Apply statistical methods to analyze data, perform hypothesis testing, and interpret results.	K3
CO4	Implement basic machine learning models and evaluate their performance.	K5
CO5	Solve real-world problems using data science techniques and tools.	K6

TEXT BOOKS

1. VanderPlas, J. (2016). Python data science handbook: Essential Tools for Working with Data. O'Reilly Media.
2. McKinney, W. (2017). Python for data analysis: Data Wrangling with Pandas, NumPy, and IPython. O'Reilly Media.
3. Hastie, T., Tibshirani, R., Friedman, J. (2009). The Elements of Statistical Learning: Data mining, inference, and prediction. Springer.

4. Healy, K. (2018). Data visualization: A Practical Introduction. Princeton University Press.

REFERENCE BOOKS

1. Murphy, K. P. (2012). Machine learning: A probabilistic perspective. MIT Press.
2. M. L. (2019). Statistical methods for machine learning: Discovering better models for prediction and inference. Chapman and Hall/CRC.
3. Bruce, P. C., Bruce, A. (2020). Practical statistics for data scientists: 50 essential concepts. O'Reilly Media.
4. Murtagh, F. (2014). Introduction to data science: Data analysis and prediction algorithms with Python. Springer.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	3	1	1	-	1	1	-	-	-
CO2	3	3	2	-	-	2	-	1	2	1	-	2	-	-	-
CO3	3	2	2	1	1	1	1	1	2	2	-	1	-	-	-
CO4	2	1	2	2	3	1	2	1	-	3	-	1	-	-	-
CO5	2	1	2	1	2	1	1	2	-	1	-	1	-	-	-
Score	13	9	10	5	7	5	7	6	5	7	1	6	-	-	-
COM	3	3	2	2	3	2	3	2	2	3	1	2	-	-	-

Course Code	CYMC203
Course Title	Mobile Forensics and Security
L T P C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- Develop a strong foundation in the principles and practices of digital forensics, with a focus on mobile devices.
- Acquire hands-on experience in mobile device acquisition, analysis, and reporting.
- Understand the legal and ethical implications of mobile forensics investigations.
- Analyze mobile device architecture and operating systems to identify potential vulnerabilities.
- Apply forensic tools and techniques to extract and examine digital evidence from mobile devices and develop strategies for preventing, detecting, and responding to mobile security threats.

COURSE CONTENT

UNIT-I INTRODUCTION TO MOBILE FORENSICS
Overview of mobile forensics, Legal and ethical considerations, Mobile device architecture and operating systems, Mobile device data types and storage, Understanding logical and physical memory

UNIT-II MOBILE DEVICE ACQUISITION
Types of mobile device acquisition (logical, physical, file system), Acquisition tools and techniques, Chip-off acquisition, Data recovery methods, Challenges and best practices in mobile device acquisition.

UNIT-III MOBILE DEVICE ANALYSIS
Data extraction and analysis tools, Examination of call logs, text messages, contacts, emails, and other data types, Digital media analysis (photos, videos, audio), Application data analysis, Cloud-based data analysis.

UNIT-IV MOBILE DEVICE SECURITY
Mobile device vulnerabilities and threats, Mobile malware and its impact, Mobile device security best practices, Incident response and digital forensics, Mobile Network Security, Mobile network architecture and protocols, Cellular network security vulnerabilities, SIM card security, Mobile payment security, Wi-Fi security.

UNIT-V ADVANCED TOPICS IN MOBILE FORENSICS
Mobile device forensics in criminal investigations, Mobile device forensics in civil litigation, Emerging trends in mobile forensics, Advanced data analysis techniques (e.g., data mining,

machine learning), Mobile device forensics case studies.

LIST OF EXPERIMENTS

1. Calculate descriptive statistics, create visualizations, and interpret data distribution for a given dataset.
2. Simulate random events, compare experimental and theoretical probabilities, and explore probability distributions.
3. Conduct hypothesis tests to make inferences about population parameters based on sample data.
4. Build and evaluate simple linear regression models to predict a dependent variable based on an independent variable.
5. . Develop multiple linear regression models to predict a dependent variable using multiple independent variables.
6. Calculate correlation coefficients and visualize relationships between variables using scatter plots.
7. Design and compare different visualizations for the same dataset to assess their effectiveness.
8. Create interactive visualizations using suitable tools and evaluate their usability for data exploration.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Demonstrate a comprehensive understanding of mobile device architecture, operating systems, and data storage mechanisms.	K3
CO2	Apply forensic tools and techniques to acquire, preserve, analyze, and report digital evidence from mobile devices.	K3
CO3	Analyze mobile device data to identify relevant information for investigations, including call logs, text messages, contacts, and multimedia content.	K2
CO4	Evaluate the legal and ethical implications of mobile forensics investigations and adhere to professional standards.	K4
CO5	Implement effective mobile security measures to protect against threats	K4

TEXT BOOKS

1. Digital Forensic: The Fascinating World of Digital Evidences by Nilakshi Jain, Dhananjay R. Kalbande, Wiley Publications, 2016.
2. Mobile Forensic Investigations by Lee Reiber, McGraw Hill Publisher, 2nd Edition, 2020.
3. Cyber Forensics by Dejey, Oxford University Press Publications, 1 st Edition, 2018.

REFERENCE BOOKS

1. Practical Digital Forensics: Forensic Lab Setup, Evidence Analysis, and Structured Investigation Across Windows, Mobile, Browser, HDD, and Memory by Dr. Akashdeep Bhardwaj and Keshav Kaushik, Apress Publisher, 2023
2. Guide to Computer Forensics and Investigations by Christopher Steuart, Bill Nelson, and Amelia Phillips, Cengage Publisher, 4th Edition, 2013.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	1	-	3	1	1	-	1	1	-	-	-
CO2	3	3	2	-	-	2	-	1	2	1	-	2	-	-	-
CO3	3	2	2	1	1	1	1	1	2	2	-	1	-	-	-
CO4	2	1	2	2	3	1	2	1	-	3	-	1	-	-	-
CO5	2	1	2	1	2	1	1	2	-	1	-	1	-	-	-
Score	13	9	10	5	7	5	7	6	5	7	1	6	-	-	-
COM	3	3	2	2	3	2	3	2	2	3	1	2	-	-	-

Course Code	ECMC213
Course Title	Product Development Lab
Number of Credits (L-T-P-C)	0-0-2-1
Course Type	MC

COURSE OBJECTIVES

- To introduce students to PCB design tools and techniques.
- To familiarize students with the process of converting a schematic design into a physical prototype.
- To enhance students' understanding of CAD tools and their role in prototyping.
- To enable students to integrate and test basic electronic components using prototyping techniques.
- To develop the practical skills on designing the real-world circuits.

COURSE CONTENT

Module-I Introduction to PCB Design
Overview of PCB design, types of PCBs, applications, materials used, and design considerations. Introduction to PCB design software.

Module-II Schematic Design
Exploration of the PCB design software: Symbols and footprints, component library management. Design and simulation of basic circuits.

Module-III PCB Layout Design
PCB stack-up, routing strategies, grounding techniques, component placement, and design rules. Designing single-layer and double-layer PCBs, performing ERC (Electrical Rule Check) and DRC (Design Rule Check).

Module-IV PCB Fabrication and Assembly
PCB manufacturing process, CAM files (Gerber files), via types, solder mask, silkscreen, soldering techniques, and safety. Generating Gerber files, preparing PCB for fabrication, printing and etching PCB prototypes, Hand soldering components, placing and soldering surface mount components, and assembling the PCB

Module-V Testing and Troubleshooting
Testing procedures for continuity, voltage, and functionality; debugging and troubleshooting techniques. Functional testing of the PCB; identifying and correcting issues

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand and utilize PCB design software to create schematics and PCB layouts	K1
CO2	Design a PCB using CAD tools and prepare necessary documentation.	K4
CO3	Fabricate a PCB prototype by implementing design-for-manufacturing principles.	K5
CO4	Assemble and solder components on a PCB and perform functional testing.	K3
CO5	Identify and troubleshoot design and assembly errors effectively	K2

TEXT BOOKS

1. Khandpur, Raghbir Singh. ”Printed Circuit Boards Design, Fabrication, and Assembly.” (2006).
2. Mitzner, Kraig. Complete PCB design using OrCAD Capture and PCB editor. Newnes, 2009.

REFERENCE BOOKS

1. DWilson, Peter. The circuit designer’s companion. Newnes, 2017.
2. Eppinger, Steven D., and Karl Ulrich. ”Product design and development.”, 1995.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	1	-	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	2	-	-	-	-	-	-	-	-	-	2
CO3	-	2	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	1	3	2	-	-	-	-	2	-	-	-	-	-	-
CO5	1	2	2	1	-	-	-	-	1	-	-	1	-	-	-
Score	5	11	8	3	3	-	-	-	3	-	-	2	-	-	2
COM	2	3	2	2	2	-	-	-	2	-	-	1	-	-	2

SEMESTER V

Course Code	CYMC301
Course Title	Blockchain and Cryptocurrencies
L T P C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- Develop a strong foundation in ethical principles and their application to technology.
- Understand the legal framework governing cyberspace, including copyright, trademark, and privacy laws.
- Analyze the impact of technology on society, including issues such as digital divide, surveillance, and censorship.
- Evaluate ethical dilemmas related to emerging technologies, such as artificial intelligence, biotechnology, and virtual reality.
- Cultivate critical and analytical abilities to navigate complex ethical and legal digital dilemmas.

COURSE CONTENT

UNIT-I Introduction
Introduction to Blockchain and Digital currency, Evolution, Blockchain as Public ledger, Structure of a Block, Transactions, Merkel trees, Peer-to-Peer Networks, Timestamp, Double Spend Problem, Decentralization Applications, Characteristics, Benefits and Challenges.

UNIT-II Cryptography and Distributed Computing for Blockchain
Hash functions, Public Key Cryptosystems, Digital Signature, Zero-Knowledge Proof, k-Anonymity, Centralizations vs. Decentralization, Distributed Consensus, Consensus without Identity, Incentives and Proof of Work, Tamper Proof Ledger, Mining and Currency Supply.

UNIT-III Bitcoin Cryptocurrency
Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network, Limitations & Improvements, Cryptocurrency as an Asset Class, Risk and Return to Cryptocurrency, Portfolio Theory, Asset Allocation with Cryptocurrency, Mining Cryptocurrencies, Crypto Classifications, DAO, Private Blockchains.

UNIT-IV Ethereum and Hyperledger
Ethereum, Ethereum Virtual Machine (EVM) and Tron Virtual Machine (TVM), Trustlessness and Immutability of Blockchain, Proof of Work (PoW) and Proof of Stake (PoS), Wallets for Ethereum, Solidity, Hyperledger, Corda, Hyperledger Fabric, Hyperledger Composer, Permissioned vs. Permissionless Blockchain.

UNIT-V Use Cases and Applications
Ways to store and use Bitcoin, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets, Building the Blockchain, Crypto Finance, Blockchain in Gaming, FinTech, Banking, Supply Chain, Healthcare, Real-Estate, Judiciary, IoT, Insurance, Government and Regulation.

LIST OF EXPERIMENTS

1. Implementing Hash Algorithm SHA3.
2. Creation of Merkle Trees.
3. Creation of Block.
4. Implementing Blockchain.
5. Creation of ERC20 Token.
6. Blockchain in Merkle Tree.
7. Mining using Blockchain.
8. Peer-to-Peer using Blockchain.
9. Cryptocurrency Wallet.
10. Setting up programming environment (Solidity, Ethereum accounts, Reactjs, etc.).
11. Contract Creation.
12. Multipage frontend for Contract management.

COURSE OUTCOMES

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

CO	Description	Level
CO1	To learn about the design principles of Blockchain.	K2
CO2	To understand the role of cryptography and distributed computing in Blockchain.	K3
CO3	To be able to analyze bitcoin transactions, scripts, and network.	K4
CO4	To be able to design decentralized applications that relies on cryptocurrencies.	K6
CO5	To evaluate security, privacy, and efficiency of a given Blockchain use case.	K2

TEXT BOOKS

1. A. M. Antonopoulos, “Mastering Bitcoin: Programming the Open Blockchain,” Shroff/O’Reilly, 2017.

2. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction,” Princeton University Press, 2016.

REFERENCE BOOKS

1. R. Wattenhofer, “Blockchain Science: Distributed Ledger Technology,” Independently Published, ISBN-10: 1793471738, 2019.

2. E. Elrom, “The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects,” Apress, 2019.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	-	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-		-	2	-
CO5	3	3	3	3	3	3	-	-	-	-	-	-	-	2	-
Score	15	15	12	10	9	3	-	-	-	-	-	-	-	4	-
COM	3	3	3	3	3	3	-	-	-	-	-	-	-	2	-

Course Code	CYMC302
Course Title	Multimedia Security and Forensics
L T P C	3-0-0-3
Course Type	MC

COURSE OBJECTIVES

- To learn the fundamental concepts of multimedia security, including digital watermarking and steganography.
- To understand cryptographic techniques applied in securing multimedia content.
- To explore techniques for detecting, analyzing, and preventing digital media forgeries.
- To study various forensic methodologies for audio, video, and image analysis.
- To gain practical experience in multimedia forensics tools and frameworks.

COURSE CONTENT

UNIT-I Introduction to Multimedia Security
Introduction to Multimedia (Image, Audio, Video, Text) and its formats, Security threats and vulnerabilities in multimedia systems, Principles of multimedia encryption: Symmetric and Asymmetric Encryption, Overview of cryptographic techniques in multimedia (AES, DES, RSA)., Compression and its impact on security: JPEG, MPEG encryption challenges.

UNIT-II Digital Watermarking and Steganography
Introduction to digital watermarking: Techniques and applications, Types of watermarks: Visible, Invisible, Robust, Fragile, Steganography: Concepts, types (LSB, DCT-based), and use cases, Steganalysis: Detecting hidden information in multimedia, Reversible watermark-ing and its applications in secure data recovery.

UNIT-III Image and Video Forensics
Fundamentals of image forensics: Types of image forgeries (copy-move, splicing),Video forensics: Detection of tampered frames, forgery localization, Camera and sensor forensics: Identifying source cameras based on image properties, Deep Learning-based approaches for image and video forgery detection, Forensic tools for image and video forgery detection.

UNIT-IV Audio Forensics
Introduction to audio forensics: Types of audio tampering, Detection of splicing and re-recording in audio files, Speaker verification and recognition, Machine learning and AI-based audio forgery detection, Forensic tools for analyzing audio integrity.

UNIT-V Legal Aspects and Digital Forensic Frameworks
Legal frameworks and compliance in multimedia forensics, Evidence collection and preservation in multimedia forensics, Chain of custody and admissibility of digital evidence in court, Blockchain applications in multimedia security: Ensuring media authenticity, Introduction to

forensic tools: Autopsy, FTK Imager, X-Ways, Case studies on real-world mul-timedia forensics investigation.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the core concepts of multimedia security and privacy.	K2
CO2	Apply cryptographic techniques to secure multimedia data.	K3
CO3	Implement and evaluate steganography and digital watermarking techniques.	K4
CO4	Analyze multimedia content for forgeries using forensic methods.	K4
CO5	Use digital forensic tools to conduct security audits on multimedia content.	K5

TEXT BOOKS

1. Multimedia Security: Watermarking, Steganography, and Forensics (1st Edition) by Chun-Shien Lu, Publisher: CRC Press, 2019.
2. Digital Image Forensics: There Is More to a Picture than Meets the Eye by Husrev Taha Sencar and Nasir Memon, Publisher: Springer, 2022.

REFERENCE BOOKS

1. Handbook of Multimedia Forensics and Security by Aboul Ella Hassanien and Mohamed Elhoseny, Publisher: Springer, 2020.
2. Steganography in Digital Media: Principles, Algorithms, and Applications by Jessica Fridrich, Publisher: Cambridge University Press, 2017.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-		-	2	-
CO5	3	3	3	3	3	3	-	-	-	-	-	-	-	2	-
Score	15	13	12	10	9	3	-	-	-	-	-	-	-	4	-
COM	3	3	3	3	3	3	-	-	-	-	-	-	-	2	-

Course Code	SCMS301
Course Title	Artificial Intelligence
Number of Credits(L-T-P-C)	3-0-0-3
Course Type	MS

COURSE OBJECTIVES

- To learn the basics of Artificial Intelligence.
- To be able to mathematically represent knowledge.
- To learn the methods of solving problems in Artificial Intelligence.
- To learn various game playing and planning techniques.
- To learn semantic analysis and its application in NLP.

COURSE CONTENT

Unit-I Introduction to AI
Control strategies, Search strategies, Production system characteristics, Specialized production system, Problem-solving methods, Problem graphs, Matching, Indexing, and Heuristic functions, Hill Climbing, Depth-first and Breadth-first, satisfaction, Related algorithms, Measure of performance and analysis of search algorithms.

Unit-II Knowledge Representation
Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other Logic-Structured representation of knowledge.

Unit-III Reasoning
Production-based system, Frame-based system. Inference: Backward chaining, forward chaining, Rule value approach, Fuzzy reasoning, Certainty factors, Bayesian Theory, Bayesian Network, Dempster-Shafer theory.

Unit-IV Game Playing and Planning
Overview, Min-Max search procedure, Alpha-beta cut-offs, Iterative Deepening, Components of planning system, goal stack planning, non-linear planning, hierarchal planning and other planning techniques, reactive systems.

Unit-V Understanding and NLP
Introduction to Understanding, Understanding as constraint satisfaction, Introduction to NLP, Syntactic and Semantic analysis, Statistical NLP, and Spell Checking.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Learn the basic concepts of artificial intelligence.	K2
CO2	Learn the knowledge using predicate calculus.	K2
CO3	Identify problems that are amenably solved by AI methods.	K3
CO4	Apply various game-playing techniques in artificial intelligence.	K3
CO5	Understand semantic information in NLP applications.	K3

TEXT BOOKS

1. Rich, Elaine, Kevin Knight, and Shivashankar B. Nair. *"Artificial intelligence"* . (2010).
2. Winston, Patrick Henry. *"Artificial intelligence"*. Addison-Wesley Longman Publishing Co., Inc., 1992.

REFERENCE BOOKS

1. Kheemani, Deepak, *"A First Course in Artificial Intelligence"*, McGraw Hill Education, First Edition, 2017.
2. Floridi L. *"The ethics of artificial intelligence: Principles, challenges, and opportunities"*.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
Score	15	8	-	-	-	-	-	-	-	-	-	-	8	-	-
COM	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

Course Code	SEMS301
Course Title	VLSI Technology
Number of Credits(L-T-P-C)	3-0-0-3
Course Type	MS

COURSE OBJECTIVES

- To learn about clean room and safety requirements for VLSI Technology.
- To learn different fabrication and characterization techniques.
- To learn and understand Oxidation and Lithography.
- To learn and understand Chemical Vapour Deposition techniques
- To learn and understand basic concepts of Nano-science and Nanotechnology.

COURSE CONTENT

Unit-I Environment for VLSI Technology
Clean room and safety requirements. Wafer cleaning processes and wet chemical etching techniques.

Unit-II Impurity Incorporation
Solid State diffusion modeling and technology; Ion Implantation modeling, technology and damage annealing; characterization of Impurity profiles.

Unit-III Oxidation and Lithography
Kinetics of Silicon dioxide growth both for thick, thin and ultrathin films. Oxidation Technologies in VLSI and ULSI; Characterization of oxide films; High k and low k dielectrics for ULSI. Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI; Mask generation.

Unit-IV Chemical Vapour Deposition Techniques
CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; Epitaxial growth of silicon; modeling and technology.

Unit-V Introduction to Nanotechnology
Basic principles of Nanoscience and Nanotechnology, Background of nanotechnology, types of nano-technology and nano-machines, top down and bottom up techniques, atomic manipulation-nanodots, semi-conductor quantum dots, self-assembly monolayers, Simple details of characterization tools- SEM, TEM, STM, AFM.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand material processing techniques and Pattern Transfer process.	K2
CO2	Evaluate different fabrication and characterization techniques.	K3
CO3	Demonstrates the concept behind thin film deposition, and characterization techniques.	K3
CO4	Compare metal contact formation, interconnect, bonding and packaging.	K3
CO5	Infer the overall landscape and characteristics of nanoscience and nanotechnology.	K2

TEXT BOOKS

1. S. M. Sze (Ed), *"VLSI Technology"*, 2nd Edition, McGraw-Hill, 2017.
2. Datta, S., *"Lessons from Nanoelectronics: A New Perspective on Transport"*, 2nd Edition, World Scientific, 2018.

REFERENCE BOOKS

1. C.Y. Chang and S.M. Sze (Ed), *"ULSI Technology"*, McGraw-Hill Companies Inc.
2. S. K. Gandhi, *"VLSI fabrication Principles"*, John Wiley Inc.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	-	2
CO2	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2
Score	15	10	13	13	-	-	-	-	-	-	-	-	-	-	10
COM	3	2	3	3	-	-	-	-	-	-	-	-	-	-	2

Course Code	CSSE301
Course Title	Data Science
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To introduce data science fundamentals, lifecycle, applications, and essential Python tools.
- To build skills in data handling, cleaning, and preprocessing using Python libraries.
- To perform EDA and create visualizations with Matplotlib, Seaborn, and Plotly.
- To understand key statistical concepts and apply hypothesis testing methods.
- To apply data wrangling techniques, address ethical issues, and deploy basic data apps.

COURSE CONTENT

Unit-I Introduction to Data Science
Introduction, Lifecycle, Applications, Setting up python environment: Anaconda, Jupyter Notebooks, Python basics: data types, control statements, functions, modules, Essentials libraries: Numpy for numerical computing, Pandas for data manipulation (Series, DataFrames, groupby, merge, reshape).

Unit-II Data Handling and Manipulation
Data Handling: Working with pandas, Series and DataFrames, Reading/writing files: CSV, Excel, JSON, Data Selection, Indexing, and Filtering, Data cleaning and preprocessing handling missing data, duplicates, and outliers, Grouping, Merging, Concatenating, and Reshaping datasets, Exploratory Data Analysis (EDA): Univariate analysis, bi-variate analysis, multivariate analysis, panda-profiling.

Unit-III Data Visualization and Reporting
Introduction, Importance, descriptive statistics, distribution analysis, Data Visualization using python libraries: matplotlib, seaborn, and plotly, Plot types: line, bar, histogram, box, scatter, heatmap, pairplots.

Unit-IV Statistical Analysis
Statistical Analysis: Mean, Median, Mode, Standard deviation. Probability mass functions Cumulative distribution functions, Probability density functions, Probability Distributions: Normal, Binomial Distribution, Poisson, Exponential, Uniform, Chi-Square Distribution. Statistical Tests: t-tests, chi-square tests. Hypothesis testing, p-values, correlation, and ANOVA, Outlier detection: Z-score, IQR, boxplots.

Unit-V Data wrangling and Ethics
Data transformation: encoding, binning, scaling, formatting, Feature extraction and text processing (e.g., cleaning structured/unstructured data), working with time-series and date-time data, Data ethics: bias, fairness, privacy, and data protection laws, Introduction to model/data app deployment with Flask or Streamlit (without ML), Version control using Git and GitHub.

LIST OF EXPERIMENTS

1. Load and inspect datasets from various formats (CSV, Excel, JSON); handle missing values and data types for initial preprocessing.
2. Perform descriptive statistical analysis to explore distributions, detect outliers, and identify trends and patterns in the data.
3. Group datasets based on categorical attributes and compute aggregate statistics such as mean, sum, count, and percentage.
4. Combine datasets using merge and join operations; reshape data using pivot tables and melt/unmelt techniques.
5. Create various visualizations including bar charts, histograms, scatter plots, box plots, and heatmaps to uncover hidden insights.
6. Design and build interactive dashboards for dynamic data visualization and real-time filtering of datasets.
7. Compute key statistical measures (mean, variance, correlation, skewness, etc.) and conduct initial data diagnostics.
8. Apply formal statistical tests to validate assumptions and draw inferences from population samples.
9. Parse date-time formats, perform resampling, and visualize trends, seasonality, and time-based patterns using line plots and rolling averages.
10. Develop and deploy a basic web application that enables users to interact with, explore, and visualize data.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand and apply the basic concepts of data science, Python programming, and use of libraries such as NumPy and Pandas for data manipulation.	K2
CO2	Perform data preprocessing tasks like handling missing values, filtering, grouping, merging, and transforming datasets to prepare data for analysis.	K3
CO3	Conduct exploratory data analysis and visualize patterns and trends using appropriate Python visualization libraries and techniques.	K3
CO4	Apply statistical techniques including distributions, hypothesis testing, and correlation analysis to infer insights from data.	K4
CO5	Implement data wrangling methods, handle text and time-series data, understand ethical implications in data usage, and deploy simple data applications using Flask or Streamlit.	K4

TEXT BOOKS

1. Cady, Field. The data science handbook. John Wiley & Sons, 2024.
2. Grus, Joel. Data science from scratch: first principles with python. O'Reilly Media, 2019.

REFERENCE BOOKS

1. VanderPlas, Jake. Python data science handbook: Essential tools for working with data. " O'Reilly Media, Inc.", 2016.
2. Prakash, Kolla Bhanu, ed. Data science handbook: a practical approach. John Wiley & Sons, 2022.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-
CO2	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-
CO3	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-
CO4	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-
CO5	3	3	3	3	1	-	-	-	-	-	-	-	2	3	-
Score	15	11	15	15	5	-	-	-	-	-	-	-	10	15	-
COM	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-

Course Code	CSSE302
Course Title	Computer Graphics
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To understand the basics of various inputs and output computer graphics hardware devices.
- To understand the concepts of basic graphics primitives and rendering techniques.
- To learn 2D transformations techniques and viewing operations.
- To model and transform 3D objects using appropriate mathematical tools.
- To understand the advanced rendering techniques and color models.

COURSE CONTENT

Unit-I Basics of Computer Graphics
Applications of computer graphics, Display devices, Random and Raster scan systems, working of CRT, Graphics interactive input devices.

Unit-II Graphics Primitive
Points, lines, Circles as primitives, Scan conversion algorithms for primitives, Fill area scanline polygon filling, Inside-outside test, Boundary and flood-fill, character generation methods, Anti-aliasing.

Unit-III 2D Transformation and Viewing
Transformations, Matrix representation, Homogeneous coordinates, Composite transformations, Reflection and shearing, Viewing pipeline and coordinates system, Window-to-viewport transformation, Clipping including point clipping, Line clipping, polygon clipping, Text Clipping.

Unit-IV 3D Concepts and Object Representation
3D display methods, polygon surfaces, Tables, Cubic spline interpolation methods, Bezier curves and surfaces, B-spline curves and surfaces. 3D transformation, Viewing pipeline and coordinates, Parallel and perspective projection.

Unit-V Advanced Topics
Visible surface detection concepts, Back-face detection, Painter's Algorithm, depth buffer Algorithm, Area subdivision method, Illumination, light sources, illumination methods, Color models: Properties of light, XYZ, RGB, YIQ and CMY color models.

LIST OF EXPERIMENTS

1. Digital Differential Analyzer Algorithm.

2. Bresenham's Line Drawing Algorithm.
3. Midpoint Circle Generation Algorithm.
4. Ellipse Generation Algorithm.
5. Creating various types of texts and fonts.
6. Creating two dimensional objects.
7. Two Dimensional Transformations.
8. Coloring the Pictures.
9. Three Dimensional Transformations.
10. Curve Generation.
11. Simple Animations using transformations.
12. Key Frame Animation.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Demonstrate understanding of the basics of Computer Graphics.	K2
CO2	Implement algorithms for basic graphics primitives and rendering techniques.	K3
CO3	Apply 2D transformation techniques and viewing operations using matrix and coordinate system concepts.	K3
CO4	Develop and manipulate 3D object representations and apply appropriate transformations and projection methods.	K4
CO5	Analyze and evaluate advanced rendering techniques.	K5

TEXT BOOKS

1. Rogers D. F. and Adams J. A., "Mathematical elements for Computer Graphics", McGraw-Hill International Education, Second Edition, 2017.
2. Donald D Hearn, M. Pauline Baker, "Computer Graphics, C version", Pearson Education, 2nd Edition, 1997.
3. Hearn D., Baker M. P and Carithers Warren, "Computer Graphics with OpenGL", Pearson Education, Fourth Edition, 2011.

REFERENCE BOOKS

1. Hill F. S. Jr. and Kelley Stephen M. “Computer Graphics using OpenGL”, Pearson Education, Third Edition, 2006.

2. Foley J. D., Van Dam A., Feiner S. K. and Hughes J. F.,“Computer Graphics: Principles and Practice”, Second Edition in C, Addison-Wesley, 2004.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	3	3	-	-	-	3	3	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	2	3	3	-	-	-	-	-	-	-	-	-	-
Score	15	15	13	14	14	-	-	-	3	3	-	-	9	9	6
COM	3	3	3	3	3	-	-	-	3	3	-	-	3	3	3

Course Code	CSSE303
Course Title	Network Security
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To infer the various types of attacks and services related to network layer protocol.
- To discuss how to apply authentication techniques to safeguard the data transfer.
- To inspect the security requirements and standards for IP and web-based systems.
- To understand the design principles of authentication protocols.
- To investigate the security issues involved in wireless networks.

COURSE CONTENT

Unit-I Overview of Network Security
Security services, attacks, Security Issues in TCP/IP suite, Sniffing, spoofing, buffer overflow, ARP poisoning, ICMP Exploits, DNS security, IP address spoofing, IP fragment attack, routing exploits, UDP exploits, TCP exploits.

Unit-II Digital Signatures and Authentication
Requirements, Authentication functions, Message Authentication Codes, Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD, HMAC Digital Signatures.

Unit-III Internet Protocol and Security Standards
IP Security Overview and Architecture, Authentication Header, Encapsulating Security Payload, Secure E-mail and S/MIME, Domain Keys Identified Mail, Secure Socket Layers (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security.

Unit-IV Internet Authentication and Applications
Kerberos, X.509, Public Key Infrastructure.

Unit-V Wireless Network Security
Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Firewall security.

LIST OF EXPERIMENTS

1. Packet Sniffing using Wireshark.
2. Setting up a Firewall.
3. Port Scanning using Nmap.

4. MAC Spoofing and Detection.
5. DNS Spoofing and Poisoning.
6. ARP Spoofing.
7. Creating and Testing a VPN.
8. Brute Force Attacks with Hydra or Medusa.
9. Intrusion Detection System Setup.
10. Building a Honeypot System.
11. Simulating DoS and DDoS attacks.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Identify the various security services and attacks in network layer.	K3
CO2	determine appropriate mechanisms to verify the integrity of the message.	K5
CO3	Relate how existing standards help to enable digital acceleration in network modernization.	K2
CO4	Analyze the need for automated tools for protecting files and other information stored on the networked system.	K4
CO5	Construct security solutions for a given wireless application or system.	K6

TEXT BOOKS

1. Stallings William and Brown Lowrie, "Computer Security: Principles and Practice", Pearson, Fourth Edition, 2018.
2. Stamp Mark, "Information Security: Principles and Practices", Wiley Publication, Second Edition, 2011.
3. Stallings W., "Cryptography and Network Security: Principles and Practice", 7th edition, Pearson, 2017.

REFERENCE BOOKS

1. Kahate Atul, "Cryptography and Network Security", Tata McGraw-Hill, Third Edition, 2013.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	-	2	2	-	-	-	-	-	-	-	-	-	3	-	-
Score	2	6	4	-	-	-	-	-	-	-	-	-	3	6	-
COM	2	2	2	-	-	-	-	-	-	-	-	-	3	2	-

Course Code	CSSE304
Course Title	Machine Learning
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To understand core machine learning concepts, workflows, and model evaluation using Python.
- To develop skills in regression and classification with a focus on model tuning and performance.
- To apply clustering, dimensionality reduction, and anomaly detection on unlabeled data.
- To gain proficiency in reinforcement learning for dynamic decision-making.
- To explore advanced topics like NLP, deep learning, ensembles, deployment, and ethics.

COURSE CONTENT

Unit-I Introduction to Machine Learning
Introduction to Machine Learning, Motivation and Applications of Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Semi-Supervised, Reinforcement Learning, Machine-learning workflow: data collection, data pre-processing, model training, evaluation, and deployment, cross-validation, bias-variance tradeoff, Python libraries: numpy, pandas, matplotlib, scikit-learn.

Unit-II Supervised Learning
Regression: Introduction, Linear regression, Polynomial regression, least squares estimation, evaluation metrics for regression, regularization techniques: Ridge, Lasso Regression. Classification: Introduction, Logistic Regression, Decision Trees, k-Nearest Neighbor, and Support Vector Machine (SVM), Hyperparameter Tuning, Evaluation Metrics for classification: Accuracy, Precision, Recall, F1-score, ROC Curve, and Confusion Matrix.

Unit-III Unsupervised Learning
Clustering: Introduction, K-Means Clustering, Hierarchical Clustering, Density-Based Clustering: DBSCAN, Dimensionality reduction: Introduction, Principal Component Analysis (PCA), t-Distributed Stochastic Neighbor Embedding (t-SNE), Association Rule Learning: Introduction, Apriori Algorithm, Anomaly Detection.

Unit-IV Reinforcement Learning
Introduction to Reinforcement Learning, Markov Decision Processes (MDPs), Dynamic Programming: Policy Iteration, Value Iteration, Monte Carlo Methods: On-Policy and Off-Policy Learning, Temporal Difference Learning: Q-Learning, SARSA, Deep Reinforcement Learning: Deep Q-Networks (DQN), Policy Gradient Methods, Exploration vs. Exploitation Dilemma,

Function Approximation in Reinforcement Learning, Multi-Armed Bandit Problems.

Unit-V Advancements in Machine Learning
Introduction to Natural Language Processing (NLP), Time Series Analysis, and deep learning. Ensemble methods: bagging, boosting, and stacking, Model deployment: Flask, Docker, Machine learning ethics and bias.

LIST OF EXPERIMENTS

1. Exploring and performing Data Preprocessing and Exploratory Data Analysis using Python on a given dataset.
2. Implementing Outlier Detection using Z-Score, IQR Methods, and Boxplots methods and Visualize them using the matplotlib or seaborn libraries
3. Implementation of Linear and Polynomial Regression with Evaluation metrics on a given dataset.
4. Classification using Logistic Regression, KNN, Naive Bays, and Decision Tree on a given dataset.
5. Implementing the Regularization Techniques such as Ridge and Lasso Regression on a given dataset.
6. Implementing the Clustering algorithms such using K-Means, Hierarchical, and DBSCAN Algorithms on a given dataset.
7. Implementing the Dimensionality Reduction using PCA and t-SNE on a given dataset.
8. Implementation of Q-Learning/DQN in Grid World Environment.
9. Implementing the Ensemble Methods such as Random Forest, AdaBoost, and XGBoost on a given dataset.
10. Implementing the Voting and Stacking ensemble classifiers/regressor on a given dataset.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Able to understand ML workflows, algorithms, and Python libraries for data processing and model evaluation.	K2
CO2	Able to apply regression and classification including regularization and hyperparameter tuning.	K3
CO3	Able to acquire skills in clustering, dimensionality reduction, and anomaly detection.	K3
CO4	Able to grasp principles and methods for dynamic decision-making.	K4
CO5	Able to explore the advancements in machine learning like NLP, deep learning, ensemble methods, deployment, and ethical considerations.	K3

TEXT BOOKS

1. Tom, Mitchell, *"Machine Learning"*, McGraw-Hill, 2017.
2. Burkov, Andriy, *"The hundred-page machine learning book"*, Vol. 1, Quebec City, QC, Canada: Andriy Burkov, 2019.

REFERENCE BOOKS

1. Ethem, Alpaydin, *"Introduction to Machine Learning"*, PHI, 2005.
2. James, David, *"Introduction to Machine Learning with Python: A Guide for Beginners in Data Science"*, CreateSpace Independent Publishing Platform, 2018.
3. Géron, Aurélien, *"Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow"*, O'Reilly Media, Inc., 2022.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-
CO2	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-
CO3	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-
CO4	3	2	3	3	1	-	-	-	-	-	-	-	2	3	-
CO5	3	3	3	3	1	-	-	-	-	-	-	-	2	3	-
Score	15	11	15	15	5	-	-	-	-	-	-	-	10	15	-
COM	3	3	3	3	1	-	-	-	-	-	-	-	2	3	-

Course Code	CSSE305
Course Title	Image Processing and Computer Vision
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To learn the basics of image processing.
- To get familiarized with various routinely used digital image processing tools and techniques.
- To get familiarized with various routinely used computer vision tools and techniques.
- To understand the role of computer vision applications in our daily life.
- To learn the frameworks and additional tools for development of computer vision applications aiming at improved user experience.

COURSE CONTENT

Unit-I Image Formation
Transformations in 2D, Transformations in 3D, Composition of transformations in 2D and 3D, homogeneous coordinates in 2D and 3D, Lens distortions, Pinhole camera, need for pinhole, geometry of perspective projection through, pinhole camera, Camera calibration, Photometric image formation.

Unit-II Image Alignment and Image Processing
Motion models and degrees of freedom; non-parametric image alignment, Control point based image alignment using least squares, SIFT algorithm, Forward and reverse image warping bilinear and nearest neighbor interpolation, Point Operators, Linear Filtering, Neighborhood Operators, Fourier Transforms, Pyramids and wavelet, Geometric Transformations.

Unit-III RECOGNITION, FEATURE DETECTION AND MATCHING
Instance recognition, Image classification, Object detection, Semantic segmentation, Video understanding, Vision and language, Points and patches, Edges and contours, Contour tracking, Lines and vanishing points, Segmentation.

Unit-IV Motion and Optical Flow
Motion as a cue to an inference of 3D structure from images, Motion factorization algorithm by Tomasi and Kanade, SVD: concept of SVD as a weighted summation of rank-one matrices, Dealing with the aperture problem: regularization. Horn and Shunck method: algorithm using discrete formulation, Jacobi's method for matrix inversion, Lucas-Kanade algorithm for optical flow.

Unit-V Depth Estimation
Epipolar geometry, Sparse correspondence, Dense correspondence, Local methods, Global optimization, Deep neural networks, Multi-view stereo, Monocular depth estimation, Overview of 3D construction.

LIST OF EXPERIMENTS

1. Developing, creating and displaying Gray Scale Images.
2. Implementing the Histogram Equalization.
3. Implementing design techniques of Non-linear Filtering.
4. Determination of Edge detection using Operators.
5. Understand how pre-trained models can classify images and evaluate their performance.
6. Implement object detection and evaluate its performance on various objects.
7. Build a facial recognition system to identify or verify individuals.
8. Compute and visualize optical flow between consecutive video frames.
9. Extract text from images using OCR technology.
10. Estimate camera movement (translation and rotation) based on optical flow.
11. Estimate the depth of objects in a scene using stereo image pairs.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Demonstrate understanding of the fundamentals of digital image processing.	K2
CO2	Develop understanding and underlying techniques of Image transformations and filtering.	K3
CO3	Develop understanding and underlying techniques of Image alignment and Image Processing.	K3
CO4	Develop an understanding of techniques used to recover structure and motion from image sequences	K3
CO5	Develop an understanding of optical flow techniques used for describing image motion.	K3

TEXT BOOKS

1. Richard S., *"Computer Vision: Algorithms and Applications"*, Springer, 2022.
2. Arcangelo Distante , Cosimo Distante, *"Handbook of Image Processing and Computer Vision"* Springer, 2020.
3. Forsyth and Ponce, *"Computer Vision: A Modern Approach"*, 2nd Edition, Pearson Education, 2015.

REFERENCE BOOKS

1. Emanuele T. and Alessandro V, *"Introductory Techniques for 3D Computer Vision"*, Prentice Hall, 1998.
2. Manas Kamal Bhuyan, *"Computer Vision and Image Processing: Fundamentals and Applications"*, 2019.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	2	2	-	-	-	-	-	-	2	2	-
CO2	2	3	3	3	3	2	-	-	-	-	-	-	-	-	-
CO3	2	2	3	3	2	2	-	-	-	-	-	-	2	-	2
CO4	2	3	3	3	3	2	2	-	-	-	-	-	2	2	2
CO5	2	2	2	1	1	-	-	3	-	-	-	-	-	-	-
Score	10	12	13	12	11	8	2	3	-	-	-	-	6	4	4
COM	2	3	3	3	3	2	2	3	-	-	-	-	2	2	2

Course Code	CSSE306
Course Title	Principles of Information Security
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To learn the basics of information security.
- To be able to analytically understand the threats to information.
- To learn the methods of solving problems in security in information science.
- To learn various security tools and techniques to protect data.
- To learn and implement applications of information security.

COURSE CONTENT

Unit-I Introduction
Basics of finite fields. Private and Public key cryptography, existing cryptosystems and their security, Cryptanalysis of existing systems, Zero knowledge protocols, One way functions. Advanced protocols for different applications, e.g. echeque, ecash etc. Network and System level security issues, Threats and Attacks, Deviations in Quality of Service, Forces of Nature, Human Error or Failure, Information Extortion, Sabotage or Vandalism, Software Attacks, Technical Hardware Failures or Errors, Technical Software Failures or Errorsm, Theft.

Unit-II Planning and Risk Management
Introduction, Information Security Planning and Governance, Information Security Policy, Standards, and Practices, Information Security Blueprint, Security Education, Training, and Awareness Program, Continuity Strategies, Risk Identification, Risk Assessment, Risk Control, Quantitative Versus Qualitative Risk Management Practices, Recommended Risk Control Practices.

Unit-III Security Technology and Cryptography
Introduction, Intrusion Detection and Prevention Systems, Honeypots, Honeynets, and Padded Cell Systems, Scanning and Analysis Tools, Foundations of Cryptology, Cipher Methods, Cryptographic Algorithms, Cryptographic Tools, Protocols for Secure Communications.

Unit-IV Implementing Information Security
Introduction, Information Security Project Management, Technical Aspects of Implementation, Nontechnical Aspects of Implementation, Information Systems Security Certification and Accreditation, Positioning and Staffing the Security Function, Credentials for Information Security Professionals.

Unit-V Security Maintenance

Security Considerations for Temporary Employees, Consultants, and Other Workers, Security Management Maintenance Models, Digital Forensics.

LIST OF EXPERIMENTS

1. Implement finite fields.
2. Implement finite groups.
3. Implement Ceaser Cipher.
4. Implement Affine Cipher with equation c = 3x + 12.
5. Implement Playfair Cipher with key entered by user.
6. Implement polyalphabetic Cipher.
7. Implement Hill Cipher.
8. Implement Rail fence technique.
9. Implement Simple Columner Transposition technique.
10. Implement network security protocols.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand fundamentals of security of data and information.	K2
CO2	Understand the tools and techniques to plan the security systems.	K2
CO3	Analyze key secure technologies and cryptography techniques.	K3
CO4	Implement several protocols and techniques for information security.	K4
CO5	Apply information security techniques to solve problems across different industries.	K4

TEXT BOOKS

1. Whitman, M. E., & Mattord, H. J., *"Principles of information security"*, 2004.
2. Stamp, M.,*"Information security: principles and practice"*, John Wiley & Sons, 2011.

REFERENCE BOOKS

1. Chitadze, N., *"Basic principles of information and cyber security*", In Analyzing New Forms of Social Disorders in Modern Virtual Environments (pp. 193-223), IGI Global, 2023.
2. Edition, F., *"Principles of Information Security"*, 2012.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Score	15	4	-	-	6	-	-	-	-	-	-	9	-	-	-
COM	3	2	-	-	3	-	-	-	-	-	-	3	-	-	-

Course Code	ICAE301
Course Title	Professional Communication and Soft Skills
L T P C	3-0-0-3
Course Type	AE

COURSE OBJECTIVES

- To promote theoretical understanding and professional/personal practice of effective and ethical human communication between and within a broad range of contexts and communities.
- To develop awareness about different forms of professional communication and social behavior in a team and as a team.
- To hone the employability related communication skills of the students by empowering them with appropriate language usage for presentation delivery, interviews, and public speaking.
- To deal professionally through the art of negotiation.
- To instill confidence to speak in public and do group discussions.

COURSE CONTENT

Unit-I Introduction to Soft Skills and Professional Ethics
Aspects of Soft Skills: Effective Communication Skills, Personality Development, Importance of Professional Ethics.

Unit-II Team Building
Understanding nature of team: Mapping personal and professional goals of team members, Working effectively in a team through building relations and interpersonal communication. What is negotiation, Ways of negotiating, Understanding the power of language and non-verbal communication.

Unit-III Meetings and Presentation
How to call a meeting, how to organize a meeting, how to design the agenda and prepare minutes of the meeting. Researching for a presentation, structure of presentation, verbs often required, language focus, importance of body language in presentation, preparing an outline of a presentation, ending the presentation.

Unit-IV Stress Management and Time Management
Kinds of stress, Identifying the right reasons of stress, how to handle the pressure, Techniques to cope with the stressful situation at a workplace, Goal setting, Understand the importance of time and how to prepare the time line.
Unit-V Group Discussion and Public Speaking
Nature of discussion, Ways to form and present the arguments, public speaking skills and being successful in it.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Develop awareness about personality development, social behavior and professional ethics.	K3
CO2	Understand and recognize the importance of interpersonal skills and team dynamics, and strengthen individual expression in collaborative peer activities.	K3
CO3	Apply concepts of negotiation to a workplace situation and effectively plan a negotiation using appropriate verbal and nonverbal cues.	K3
CO4	Plan and execute Meetings, and draft minutes, reports and relevant documents.	K3
CO5	Develop coherence, cohesion and competence essential for presentation deliveries.	K3

TEXT BOOKS

1. Rizvi, M. A., *"Effective Technical Communication"* , 2nd edition, McGraw Hill Education, 2017.
2. Mohan, K. and Banerji, M., *"Developing Communication Skills"* , 2nd edition, Laxmi Publications, 2009.
3. Markel, M and Selber, S.A., *"Technical Communication"*, 12th Edition, Macmillan Learning, 2018.

REFERENCE BOOKS

1. Dale, C., *"How to Win Friends and Influence People"*, New York: Simon and Schuster, 1998.
2. Coleman, D., *"Emotional Intelligence"*. Bantam Book, 2006.
3. Thorpe, E., and Thorpe, S., *"Objective English"*, Pearson Education, New Delhi, 2007.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Score	-	-	-	-	-	-	-	3	6	6	-	-	-	-	3
COM	-	-	-	-	-	-	-	3	3	3	-	-	-	-	3

Course Code	ICVA301
Course Title	Professional Ethics
Number of Credits (L-T-P-C)	3-0-0-3
Course Type	VA

COURSE OBJECTIVES

- To enable the students to create on awareness on Engineering Ethics and Human Values, to instil Moral and Social Values and loyalty and to appreciate the rights of others.
- To develop and prompt the accountability and responsibility being engineering professional.
- To enable students to identify and analyze ethical dilemmas in their professional lives and make informed, principled decisions.
- To guide students in adhering to professional codes of conduct and industry standards, ensuring that their behavior positively reflects on their profession and organization.
- To cultivate an appreciation for diverse perspectives, cultures, and practices, ensuring respectful and equitable treatment of all individuals in a professional setting.

COURSE CONTENT

Unit-I Human Values
Morals, values and Ethics, Integrity , Work ethic , Service learning ,Civic virtue , Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self, confidence, Character, Spirituality, Introduction to Yoga and meditation for professional excellence and stress management.

Unit-II Engineering Ethics
Senses of 'Engineering Ethics' , Variety of moral issues , Types of inquiry , Moral dilemmas , Moral Autonomy , Kohlberg's theory , Gilligan's theory , Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories.

Unit-III Engineering As Social Experimentation
Engineering as Experimentation, Engineers as responsible Experimenters, Codes of Ethics, A Balanced Outlook on Law.

Unit-IV Safety, Responsibilities And Rights
Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Importance of Plagiarism, Discrimination

Unit-V Global Issues
Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Distinguish between ethical and non-ethical situations.	K4
CO2	Practice moral judgment effectively handling the conditions of dilemma.	K3
CO3	Develop cognitive skills in solving social problems and apply the code of ethics to social experimentation.	K3
CO4	Apply risk and safety measures in various engineering fields.	K3
CO5	Explain corporate social responsibility and understand the concern for ethical contribution for the global society.	K2

TEXT BOOKS

1. Govindarajan M., Natarajan S., Senthilkumar V.S., *"Engineering Ethics"*, Prentice Hall of India, 2013.
2. Martin Mike W., Schinzinger Roland, *"Ethics in engineering"*, Tata Mc Graw Hill, 4th Editin,2005.

REFERENCE BOOKS

1. Ferrell, O. C., Fraedrich, J., & Ferrell, L. (2005). *"Business ethics: Ethical decision making and cases"*, 13th ed., Cengage Learning.
2. Singer, P., & Singer, F. A. (2008). *"Ethics for the real world: Creating a personal code to guide decisions in work and life"*, Harvard Business Review Press.
3. Brenkert, G. G. (2004). *"Corporate integrity and accountability"*, SAGE Publications.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3
CO4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Score	-	-	-	-	-	2	2	9	-	-	-	-	-	-	3
COM	-	-	-	-	-	2	2	3	-	-	-	-	-	-	3

Course Code	ICHC301
Course Title	Honours Online Course- I*
Number of Credits (L-T-P-C)	X-X-X-3
Course Type	HC

This is an optional course for the students who want to opt for B.Tech. (Honours). The Students must adhere the guidelines mentioned in the applicable UG Ordinance. The students can choose online courses from NPTEL or SWAYAM or MOOCs. They should undergo the online course completely, submit assignments, projects, etc., and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

Course Code	ICOC301
Course Title	Optional Online Course- I*
Number of Credits (L-T-P-C)	X-X-X-(0-3)
Course Type	OC

The Students can opt for Optional Online Course along with their normal courses. The students can choose online courses from NPTEL/SWAYAM/MOOCs. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

SEMESTER VI

Course Code	CYMC303
Course Title	Cyber Ethics, Privacy, and Legal Issues
L T P C	3-0-0-3
Course Type	MC

COURSE OBJECTIVES

- Develop a strong foundation in ethical principles and their application to technology.
- Understand the legal framework governing cyberspace, including copyright, trademark, and privacy laws.
- Analyze the impact of technology on society, including issues such as digital divide, surveillance, and censorship.
- Evaluate ethical dilemmas related to emerging technologies, such as artificial intelligence, biotechnology, and virtual reality.
- Cultivate critical and analytical abilities to navigate complex ethical and legal digital dilemmas.

COURSE CONTENT

UNIT-I INTRODUCTION TO CYBER ETHICS
Definition and scope of cyber ethics, Ethical theories and frameworks, Ethical issues in computer science and information technology, Professional ethics for IT professionals, Ethical responsibilities of IT professionals, Codes of conduct and professional standards, Conflicts of interest and ethical dilemmas, Whistleblowing and ethical disclosure

UNIT-II PRIVACY AND DATA PROTECTION
Concept of privacy and its evolution, Privacy laws and regulations (e.g., GDPR, CCPA), Data protection and security, Surveillance, privacy Online tracking and behavioural advertising, Data security concepts (confidentiality, integrity, availability), Risk assessment and management, Privacy-enhancing technologies

UNIT-III INTELLECTUAL PROPERTY RIGHTS
Copyright, trademark, and patent law, Digital rights management, Software piracy and counterfeiting, Open source software and licensing, Patents, Nature and characteristics of patents, Patentability criteria, Patent application process, Rights and obligations of a patentee, Patent infringement and remedies

UNIT-IV CYBERCRIME AND DIGITAL FORENSICS
Types of cybercrime (e.g., hacking, phishing, identity theft), Cybercrime investigations and digital forensics, Cybersecurity measures and best practices, Critical infrastructure protection, Computer Forensics, Computer hardware and software fundamentals, Operating system internals (Windows, Linux, macOS), File systems (FAT, NTFS, ext2/3/4), Disk imaging and data

recovery techniques.

UNIT-V EMERGING ETHICAL ISSUES
Legal and ethical issues in digital forensics, Expert witness testimony, Artificial intelligence and ethics, Social media and privacy, Internet censorship and freedom of speech, Digital divide and accessibility.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Demonstrate a comprehensive understanding of ethical principles and their application to the digital realm.	K3
CO2	Analyze the legal and regulatory frameworks governing cyberspace, including privacy, intellectual property, and cybercrime.	K4
CO3	Evaluate the social and ethical implications of emerging technologies and their impact on individuals and society.	K3
CO4	Develop critical thinking and problem-solving skills to address complex ethical dilemmas in the digital age.	K3
CO5	Communicate effectively about complex ethical and legal issues related to technology to diverse audiences.	K2

TEXT BOOKS

1. Ethics and Technology: Controversies, Questions, and Strategies for Ethical Computing by Herman T. Tavani, Wiley Publications, 4th Edition, 2013.
2. The Art of Computer Forensics: Investigating Computer Crime by Brian Carrier Addison, Wesley Professional Publisher, 2004.

REFERENCE BOOKS

1. Privacy is Power: Why and How to Protect Your Personal Information by Carissa Véliz, Bantam Press Publisher, 2020.
2. Digital Forensics with Kali Linux by B.S. Cherry, Packt Publishing, 3rd Edition, 2022.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-		-	2	-
CO5	3	3	3	3	3	3	-	-	-	-	-	-	-	2	-
Score	15	13	12	10	9	3	-	-	-	-	-	-	-	4	-
COM	3	3	3	3	3	3	-	-	-	-	-	-	-	2	-

Course Code	SCMS302
Course Title	Soft Computing
L T P C	3-0-2-4
Course Type	MS

COURSE OBJECTIVES

- To understand the concepts of soft computing techniques.
- To understand the concepts of evolutionary computation.
- To impart adequate knowledge about Neural Networks.
- To understand the general principles of Fuzzy Logic Controllers.
- To apply soft computing algorithms for solving complex problems.

COURSE CONTENT

Unit-I INTRODUCTION TO SOFT COMPUTING
Soft computing vs. Hard computing, Applications of soft Computing, Various types of Soft Computing techniques, Neuron Nerve structure and Synapse, McCulloch Pitts neuron model, Perceptron model, Neural network Architecture, Applications

Unit-II EVOLUTIONARY COMPUTATION
Historical Development of EC, Genetic programming- Evolutionary Strategies, features of Evolutionary computation, Advantages and Applications of Evolutionary Computation, Basic concept of Genetic algorithm, Genetic Operators, Comparison of Genetic Algorithm with Other Optimization Techniques, Advantages, Applications and Limitations of Genetic Algorithm.

Unit-III MULTI-LAYER PERCEPTRON
Types of Neural Network, Advantages and Drawbacks, Applications of Single layer and multilayer feed forward networks, back propagation learning methods, effect of learning rule coefficient.

Unit-IV INTRODUCTION TO FUZZY LOGIC
Fuzzy Logic, Applications, Fuzzy set and classical set, membership functions, fuzzy terminologies: Linguistic terms, Support, core, normality, cross over, fuzzy singleton, alpha cut, strong alpha cut, fuzzy set operations (Union, Intersection, Complement, Algebraic product, Algebraic sum, Algebraic Difference, Multiplication of fuzzy sets by a crisp number, Power of Fuzzy Set, Bounded Sum, Bounded Difference, Cartesian Product, Equal Fuzzy Sets

Unit-V EMERGING TRENDS
Particle Swarm Optimization, Applications, Fuzzy control Systems, Applications, Fuzzy controller, Fuzzy Inference System, Mamdani Approach, Defuzzification; Center of sum method, Advantages, Drawbacks, Applications, Clustering methods, Fuzzy Classification, Clustering and pattern recognition

LIST OF EXPERIMENTS

1. Explore Pandas Library for Data Summarization
2. Demonstrate the basic concept of Perceptron using Python.
3. Demonstrate the use case of different transfer functions (Binary Step, Sigmoid, Relu, Tanh, Softmax) in Artificial Neural Network using Python.
4. Demonstrate the use of Perceptron for deploying Logic Gate: AND, OR, NOR, NAND, XOR
5. Demonstrate the solution of XOR GATE (Non-Linearly Separable Problem) using ANN.
6. Demonstrate Multi-Layer Perceptron Backpropagation using Python.
7. Implement the concept of Fuzzy Logic.
8. Demonstrate basic fuzzy operations using Python (Union, Intersection, Complement)
9. Demonstrate generation of fuzzy values using three different membership functions.
10. Demonstrate Genetic Algorithm using Python.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Experiment with various soft computing techniques and analyse the performance of neural network model using various evaluation metrics.	K4
CO2	Explain evolutionary computation and apply it for solving optimization problems.	K3
CO3	Experiment with genetic algorithm and apply genetic operators in various applications.	K3
CO4	Explain fuzzy systems and contrast fuzzification and defuzzification techniques.	K2
CO5	Classify and compare various soft computing methods.	K2

TEXT BOOKS

1. Deepa, S.N. and Sivanandam, S.N., *"Principles of Soft Computing, 2 nd Edition"*, Wiley India, 2011.
2. Tom, Mitchell, *"Machine Learning"*, McGraw-Hill, 2017.
3. Zimmermann H. J. *"Fuzzy set theory and its Applications"* Springer international edition, 2011.

REFERENCE BOOKS

1. Timothy, J. Ross, *"Fuzzy Logic with Engineering Applications, 3 rd Edition"*, Wiley India, 2010.

2. Shai, Shalev-Shwartz, Shai, Ben-David, *"Understanding Machine Learning from Theory to Algorithms"*, Cambridge University Press, 2014.

3. Malik H, Iqbal A, Yadav AK. *"Soft computing in condition monitoring and diagnostics of electrical and mechanical systems"*. Berlin/Heidelberg, Germany: Springer; 2020.

4. Lesot M, Marsala C. *"Fuzzy Approaches for Soft Computing and Approximate Reasoning: Theories and Applications"*. Switzerland: Springer. 2020.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO2	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Score	10	4	-	-	6	-	-	-	-	-	-	9	-	-	-
COM	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-

Course Code	SEMS302
Course Title	Speech Signal Processing
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	MS

COURSE OBJECTIVES

- To learn the basic concepts of articulatory and acoustic phonetics.
- To study different techniques for speech analysis.
- To impart knowledge on speech modelling techniques and their implementation issues.
- To study various speech recognition techniques.
- To learn different speech synthesis techniques and their applications.

COURSE CONTENT

Unit-I Basic Concepts of Speech
Fundamentals of Speech; Articulatory phonetics: production and classification of speech sounds; Acoustic phonetics: acoustics of speech production; Review of Digital Signal Processing; Short Time Fourier Transform (STFT); LPC Methods.

Unit-II Speech Analysis
Introduction to Speech Analysis, Understanding about feature extraction and pattern comparison techniques, Speech distortion measures, mathematical and perceptual, log–spectral distance, Cepstral distances, weighted cepstral distances and filtering, Likelihood distortions, spectral distortion using a warped frequency scale, LPC, PLP and MFCC coefficients, Time alignment and normalization: dynamic time warping, Multiple time: alignment paths.

Unit-III Speech Modelling
Introduction to Speech Modelling, Understanding Hidden Markov Models (HMMs), Markov Process, HMMS-2 evaluation, Optimal state sequence: viterbi search, Baum-Welch parameter re-estimation, Implementation issues.

Unit-IV Speech Recognition
Introduction to Speech Recognition, Architecture of a large vocabulary continuous speech recognition system, Acoustics and language models, N-gram language model, Context dependent sub-word units, Applications and present status.

Unit-V Speech Synthesis
Introduction to Speech Synthesis, Understanding the basics of Text-to-speech synthesis (TTS), Concatenative and waveform synthesis methods, Sub-word units for TTS, Understanding about intelligibility and naturalness, Role of prosody, Applications and present status.

LIST OF EXPERIMENTS

1. Introduction to MATLAB on Speech Signal Processing.
2. Speech acquisition and recording using MATLAB.
3. Analysis of Different Sounds (Phonemes) using MATLAB.
4. Implement of Short Term Time Domain Processing of Speech using MATLAB.
5. Implementation of Linear Predictive Coding (LPC) methods in MATLAB.
6. Fundamental frequency estimation in Speech signal using MATLAB.
7. Format synthesis MFCC extraction from Speech signal using MATLAB.
8. Cepstral Analysis of Speech Signal in MATLAB.
9. LPCC extraction from Speech signal using MATLAB.
10. Implementation of HMM models for Speech Modelling in MATLAB.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain fundamentals of speech processing and classify different speech sounds.	K2
CO2	Apply feature extraction and pattern comparison techniques of speech processing.	K3
CO3	Apply hidden markov model for optimal state sequence search and welch parameter re-estimation.	K3
CO4	Analyze architecture of a large vocabulary continuous speech recognition system.	K4
CO5	Compare and select methods for waveform and text-to-speech synthesis.	K5

TEXT BOOKS

1. Rabiner, L. and Schafer, R., *"Theory and Applications of Digital Speech Processing"*, 1st edition, Pearson Education, 2010.
2. Rabiner, L. R., Juang, B. H., and Yegnararayana, B., *"Fundamentals of Speech Recognition"*, 1st edition, Pearson Education, 2008

REFERENCE BOOKS

1. Jurafsky, D. and Martin, J. H., *"Speech and Language Processing"*, 2nd edition, Pearson Education, 2013.

2. Quatieri, Thomas F. *"Discrete-time speech signal processing: principles and practice"*, Pearson Education India, 2002.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	2	3	3	3	3	2	-	-	-	3	2	3	-	2	-
CO3	2	2	3	3	1	-	-	-	-	3	-	3	-	-	-
CO4	2	2	2	3	2	-	-	-	-	3	-	3	-	-	-
CO5	2	3	3	3	3	-	-	-	3	3	-	3	3	2	3
Score	10	12	11	12	9	2	-	-	3	15	2	15	3	4	3
COM	2	3	3	3	3	2	-	-	3	3	2	3	3	2	3

Course Code	ICAE302
Course Title	Entrepreneurship and Start-ups
L T P C	3-0-0-3
Course Type	AE

COURSE OBJECTIVES

- To impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.
- To develop and strengthen motivation and leadership skills in students.
- To make them understand the classification of MSMEs in India and exposing to new business trends for startups.
- To provide the understanding for various financial resources and sustaining the business enterprise.
- To update students with various govt. schemes for the support of sick units and strategies for business growth.

COURSE CONTENT

Unit-I Entrepreneurship
Concept of Entrepreneurship – Entrepreneurial skills, Characteristics of an Entrepreneur, Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur, Barriers to Entrepreneurship, Risks to an Entrepreneur. Process in Entrepreneurship, Macroeconomic environment - Influence of macroeconomic conditions on Entrepreneurship.

Unit-II Motivation and Leadership
Psychology theories of entrepreneurship – McClelland's Theory of motivation, Rotter's Locus of Control Theory, Action Regulation Theory, Stress Management, Leading mission-driven organizations – Developing Mission, Vision, and Goals statements of the organizations, Developing competitive advantage, Generic competitive strategy, Building Motivated Team. Entrepreneurship Development Programs – Need, Objectives.

Unit-III MSME and Types of New Age Business
MSME – Definition, Classification – Characteristics, Role and Importance of MSMEs in Indian Economy, Ownership Structures, Types of new age business - FinTech, EdTech, Healthcare, AgriTech, Robotics, and Digital Transformation, Emerging markets for Entrepreneurs-Cybersecurity and cloud computing, Tax management, Real Estate, supply chain and logistics. Formulation of Project report – Need, Objectives, and Components of a Project Report, Techno-Economic, Market, and Financial Feasibility Assessment of a project.

Unit-IV Financing and Business Stability
Methods of Financing to Startups, Funding Strategies, Different types of Funding – Sources of

Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Scaling up and stabilization of a business, strategies for scaling business. Data Analytics to advantage – Advantages of Data Analytics.

Unit-V Support to Entrepreneurs
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand the entrepreneurial mind-set and what it takes to create value.	K2
CO2	Develop motivation and leadership to start one's own business.	K3
CO3	Analyse the business enterprises in order to identify business opportunities in trending new age businesses.	K4
CO4	Learn to secure financial backing and sustain business growth.	K1
CO5	Evaluates the effectiveness of different entrepreneurial strategies.	K5

TEXT BOOKS

1. Khanka. S.S., *"Entrepreneurial Development"* S.Chand & Co. Ltd.,Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, *"Entrepreneurship – Theory, Process and Practice"*, 9th Edition, Cengage Learning 2014.
3. *"Innovation and Entrepreneurship"* by Peter F. Drucker
4. *"The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses"* by Eric Ries

REFERENCE BOOKS

1. *"Small Business Management: Launching and Growing Entrepreneurial Ventures"* by Justin G. Longenecker, J. William Petty, and Leslie E. Palich.
2. *"Entrepreneurship Development and Small Business Enterprises"* by Poornima M. Charantimath.

3. *"Entrepreneurship and Startup"* by Institute of Cost Accountants of India, Kolkata.
4. *"Disciplined Entrepreneurship: 24 Steps to a Successful Startup"* by Bill Aulet

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	3	-	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	3	-	-	2
CO3	-	-	-	-	-	-	2	-	-	-	-	3	-	-	3
CO4	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-
Score	-	-	-	-	-	-	2	3	3	-	6	15	-	-	5
COM	-	-	-	-	-	-	2	3	3	-	3	3	-	-	2

Course Code	CSSE307
Course Title	Speech and Language Processing
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To master the fundamentals of symbolic methods in language processing tasks, such as natural language parsing
- To be competent with fundamental concepts for natural language processing and automatic speech recognition, such as "hidden Markov models"
- To be competent with fundamental concepts in text-to-speech synthesis, such as concatenative synthesis and text analysis
- To be familiar with statistical machine translation framework for Automatic Speech Recognition ASR).
- To be familiar with methods of constructing speech recognition and synthesis systems.

COURSE CONTENT

Unit-I Introduction to Speech and Language Processing
Mechanics of Speech: Speech Production Mechanism, Nature of Speech Signal, Discrete-Time Modeling of Speech Production, Representation of Speech Signals, Classification of Speech Sounds, Phones, Phonemes, Phonetics, IPA and Phonetic Alphabets, Articulatory Features, Auditory Perceptions, Anatomical Pathways from Ear to the Perception of Sound Peripheral Auditory System.

Unit-II Automatic Speech Recognition
Components of a typical recognizer, parameterization of the speech signal, dynamic time warping, distance measures, the Hidden Markov Model, the generative model paradigm, simple probability theory, conditional and joint probabilities, Gaussian probability density function, continuous density HMMs, monophone models with Gaussian observation densities, Viterbi algorithm for recognition, training from fully labelled data, Viterbi training, bigram language models. components of a typical text-to-speech synthesiser, text analysis, phonology, finite-state automata, POS tagging, lexicon, phrasing, accents, F0, learning from data, CART models, waveform generation, concatenative methods, TD-PSOLA and linear prediction, F0 and duration modification.

Unit-III Spectral Analysis of Speech Signal
Time Domain Parameter of Speech Signal, Methods of Extracting The Parameters: Energy Filter bank Analysis, Short Time Fourier analysis, Formant Extraction, Pitch Extraction; Noise Reduction Techniques, Spectral Estimation, Feature Analysis: MFCC, PLP, RASTA, PLP-RASTA; TRAP

Unit-IV Statistical Machine Translation
Statistical Framework of ASR: Probability, Bayes Theorem, Covariance and Correlation, Gaussian Mixture Model, ASR Framework: Feature Extraction, Acoustic Model, Pronunciation Model, Language Model, Decoder; Unit Selection, Limitation of Basic HMM and Applications, Advanced HMM, Refinement of HMM, Hybrid HMM/ANN.

Unit-V Language Processing Models
Language Processing: Formal Language Theory: Chomsky Hierarchy, Chart Parsing for Context-Free Grammars, Stochastic Language Models: Probabilistic Context-Free Grammar, N-gram Language Models, Complexity measure of Language Models: N-Gram Smoothing, Deleted Interpolation Smoothing, Backoff Smoothing, Class n-grams, Performance of N-gram Smoothing, Adaptive Language Models: Cache Language Models, Topic-Adaptive Models, Maximum Entropy Models.

LIST OF EXPERIMENTS

1. Record speech signals and perform basic preprocessing techniques like noise removal, normalization, and trimming.
2. Convert spoken words into text using a pre-trained Automatic Speech Recognition (ASR) model
3. Recognize and transcribe phonemes from speech signals.
4. Segment speech signals into individual phonemes or words.
5. Translate sentences from one language to another using sequence-to-sequence models.
6. Perform POS tagging on a given text to identify nouns, verbs, adjectives, etc.
7. Fine-tune a transformer model to solve a specific task (e.g. PoS-tagging, NER, WSD) and carefully evaluate it w.r.t. the state-of-the-art using a standard benchmark.
8. Speaker Identification from different speakers using a set of speech samples using Machine Learning.
9. Implement a basic Hidden Markov Model (HMM) for recognizing isolated spoken words.
10. Build a neural network to classify speech emotions from speech signals using deep learning
11. Implement the word-sense disambiguation algorithms discussed during the lessons (the naive-bayes supervised method, the Lesk-based lexical algorithm, and the non-supervised method based on the EM algorithm.
12. Implement an application for parts of the speech tagging based on deep neural networks using the datasets used for EVALITA 2007

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the concept and significance of Speech and language processing	K2
CO2	Analyze and implement NLP models speech recognition systems	K4
CO3	Construct neural network models with attention mechanism	K3
CO4	Build a machine translation system using sequence-to-sequence model architecture	K4
CO5	Design and develop two state-of-the-art speech technology systems for real-world application in an interdisciplinary field.	K6

TEXT BOOKS

1. Daniel Jurafsky and James H. Martin., *"Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics"*, Prentice-Hall, 3rd Edition, 2023.
2. Christopher D. Manning and Hinrich Schütze., *"Foundations of Statistical Natural Language Processing"*, MIT Press, 1999.
3. Steven Bird, Ewan Klein and Edward Loper, *"Natural Language Processing with Python"*, OReilly Media, 1st Edition, 2009.
4. Lawrence Rabiner And Biing-Hwang Juang, *"Fundamentals Of Speech Recognition"*, Pearson Education, 2003.

REFERENCE BOOKS

1. Xuedong Huang, Alex Acero and Hsiao-Wuen Hon, *"Spoken Language Processing"*, Prentice Hall, 2001.
2. Paul Taylor, *"Test-to-speech Synthesis"*, Cambridge University Press, 2009.
3. Nitin Indurkhya and Fred J. Damerau, *"Handbook of Natural Language Processing"*, Chapman and Hall/CRC Press, 2nd Edition, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, *"Natural Language Processing and Information Retrieval"*, Oxford University Press, 2008.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	3	-	-	-	-	1	3	2
CO2	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO3	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO4	2	3	3	3	1	-	-	-	-	-	-	3	3	3	2
CO5	2	2	3	3	1	-	-	3	-	-	-	3	3	3	3
Score	10	13	15	13	5	-	-	6	-	-	-	12	13	15	11
COM	2	3	3	3	1	-	-	3	-	-	-	3	3	3	3

Course Code	CSSE308
Course Title	Computer Vision
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To introduce the fundamental concepts and challenges in computer vision and provide a deep understanding of how machines interpret and process visual data
- To explore image formation, colour models, and basic image processing techniques essential for visual analysis
- To enable students to extract, describe, and match visual features, and apply geometric transformations for real-world vision tasks like image stitching and object tracking.
- To develop proficiency in motion estimation, stereo vision, and 3D reconstruction, enabling students to understand scene geometry and depth from visual data.
- To provide hands-on experience in using machine learning and deep learning algorithms for object detection, classification, and segmentation tasks.

COURSE CONTENT

Unit-I Fundamentals of Computer Vision and Image Processing
Introduction to Computer Vision, Applications and Scope, Image formation, camera models, and projection geometry, Color spaces, image types and representations, Basic image processing: histogram, thresholding, filtering, Morphological operations: erosion, dilation, opening, closing

Unit-II Feature Detection, Description and Matching
Edge detection: Sobel, Prewitt, Canny, Keypoint detection: Harris, FAST, DoG, Descriptors: SIFT, SURF, ORB, Feature matching: Brute-force, FLANN, Geometric transformations: affine, perspective

Unit-III Segmentation and Contour-based Representations
Threshold-based segmentation: global, adaptive, Otsu's method, Clustering-based: K-means, Mean Shift, Graph-based and energy minimization methods, Watershed algorithm, contour detection and shape descriptors, Object segmentation: GrabCut, semantic segmentation overview

Unit-IV Motion Analysis and 3D Reconstruction
Optical flow: Lucas-Kanade, Horn-Schunck methods, Stereo vision and disparity estimation, Structure from motion and triangulation, Epipolar geometry, essential and fundamental matrices, Applications: visual odometry, scene reconstruction

Unit-V Deep Learning in Vision and Advanced Topics
CNN architectures for image classification (VGG, ResNet, MobileNet), Transfer learning and fine-tuning on vision datasets, Object detection: YOLO, SSD, Faster R-CNN, Semantic segmentation: U-Net, DeepLab, Generative models: GANs for synthesis and style transfer, Vision transformers and 3D vision

LIST OF EXPERIMENTS

1. Image Reading and Color Space Conversion using OpenCV
2. Image Smoothing and Sharpening using Filters
3. Edge Detection using Sobel, Prewitt, and Canny Operators
4. Image Thresholding and Morphological Operations
5. Keypoint Detection and Feature Matching using SIFT and ORB
6. Image Stitching using Homography and Feature Matching
7. Contour Detection and Shape Feature Extraction
8. Image Segmentation using K-means, Watershed, and GrabCut
9. Motion Tracking using Lucas-Kanade and Dense Optical Flow
10. Image Classification using Transfer Learning with CNNs
11. Object Detection using YOLOv5/YOLOv8 Pre-trained Models.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand the fundamental concepts of image formation, color models, and image processing techniques.	K2
CO2	Apply various filtering, thresholding, and morphological operations to enhance and segment images	K3
CO3	Implement feature detection, description, and matching algorithms for real-world image analysis tasks	K3
CO4	Analyze motion in video and estimate scene geometry using optical flow, stereo vision, and 3D reconstruction methods	K4
CO5	Design and develop computer vision applications using deep learning models such as CNNs and object detection frameworks like YOLO.	K6

TEXT BOOKS

1. Richard S., *"Computer Vision: Algorithms and Applications"*, Springer, 2022.
2. Arcangelo Distante , Cosimo Distante, *"Handbook of Image Processing and Computer Vision"* Springer, 2020.
3. Forsyth and Ponce, *"Computer Vision: A Modern Approach"*, 2nd Edition, Pearson Education, 2015.

REFERENCE BOOKS

1. Simon J.D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
2. E.R. Davies, Computer and Machine Vision: Theory, Algorithms, Practicalities, Academic Press, 4th Edition, 2012.
3. Gary Bradski and Adrian Kaehler, Learning OpenCV: Computer Vision with the OpenCV Library, O'Reilly Media, 2nd Edition, 2016.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	2	2	2	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO5	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-
Score	-	-	-	-	-	2	6	4	2	2	-	-	-	-	-
COM	-	-	-	-	-	2	2	2	2	2	-	-	-	-	-

Course Code	CSSE309
Course Title	Cloud Computing
Number of Credits(L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To comprehend fundamental cloud computing concepts and its distinct advantages/ disadvantages over traditional paradigms.
- To analyze cloud architectural models and various virtualization technologies (compute, storage, network).
- To evaluate real-world cloud case studies and identify key cloud security challenges and solutions.
- To identify and describe diverse cloud application scenarios across various industry sectors.
- To explore mobile cloud integration, emerging distributed computing paradigms, and future cloud trends

COURSE CONTENT

Unit-I Introduction to Cloud Computing
Introduction to cloud computing; Cloud Computing (NIST Model), History of Cloud Computing Cloud delivery models and services: Software as a service, platform as a service, and infrastructure as a service; Key concepts of distributed computing; Key concepts of distributed computing; Managing and scheduling of cloud resources. Cloud service providers: Properties, Characteristics and Disadvantages Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Role of Open Standards.

Unit-II Cloud Computing Architecture and Virtualization
Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services. Compute virtualization: Full and para virtualization based hypervisors; Storage virtualization: Ceph; Network virtualization: virtual local area network, virtual extensible local area network, and generic routing encapsulation.

Unit-III Cloud Based Case Studies
Cloud computing case study: Amazon elastic compute core, Microsoft Azure, and Eucalyptus. Cloud security: Cloud Security Alliance recommendations, rogue virtual machines, data and infrastructure security, and access management and control.

Unit-IV Real World Cloud Applications
Cloud in Business and Finance (e.g., CRM, ERP, Data Analytics), Cloud in Healthcare (e.g., Telemedicine, Electronic Health Records), Cloud in Media and Entertainment (e.g., Video

Streaming, Content Delivery Networks), Cloud in Education and Research (e.g., Learning Management Systems, Large-Scale Scientific Computing).

Unit-V Mobile Cloud and Future Trends
Working with Mobile Devices in the Cloud Era, Mobile devices cloud services for enhanced functionality, Mobile Web Services, Development and consumption of services, Edge Computing and Fog Computing, Distributed computing paradigms for cloud computing. Serverless Computing, Understanding the ”function as a service” model and its implications. Cloud Computing Trends and Future Outlook, Emerging technologies and the evolution of the cloud landscape.

LIST OF EXPERIMENTS

1. Set up VirtualBox or VMware Workstation to run different versions of Linux or Windows operating systems on top of Windows 7 or 8.
2. Install a C compiler in the virtual machine created using VirtualBox and execute simple programs
3. Install Google App Engine (GAE). Develop a ”Hello World” application and other basic web applications using Python or Java.
4. Use the GAE Launcher to deploy the web applications.
5. Simulate a cloud environment with CloudSim and implement a scheduling algorithm that is not included in CloudSim by default.
6. Configure a virtual private cloud (VPC) and test basic network security.
7. Configure and compare public, private, and hybrid cloud setups in a simulated environment.
8. Find a procedure to transfer the files from one virtual machine to another virtual machine.
9. Find and follow the steps to launch a virtual machine using TryStack (Online OpenStack Demo).
10. Set up a single-node Hadoop cluster and run basic applications such as WordCount.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Differentiate and explain the various cloud computing models (IaaS, PaaS, SaaS) and deployment types, outlining their benefits, disadvantages, and distinctions from traditional computing paradigms.	K1
CO2	Design and illustrate the components of cloud computing architecture, including the role of virtualization technologies (compute, storage, and network) in enabling cloud services	K3
CO3	Analyze and articulate the security challenges and best practices within cloud environments, drawing insights from real-world cloud provider case studies.	K2
CO4	Evaluate and propose appropriate cloud-based solutions for diverse application scenarios across various industry sectors, such as business, healthcare, and education.	K4
CO5	Discuss the concepts of mobile cloud computing and articulate the implications of emerging trends like edge computing, fog computing, and serverless computing on the future of cloud environments.	K3

TEXT BOOKS

1. Sosinsky Barrie, ”Cloud Computing: Bible”, Wiley Publication, First Edition 2018.
2. Marinescu D C, Cloud Computing Theory and Practice, Morgan Kaufmann, 2014.
3. Bhowmik, Sandeep. Cloud computing. Cambridge University Press, 2017.

REFERENCE BOOKS

1. Erl T, Mahmood Z and Martinez J W, Cloud Computing: Concepts, Technology and Architecture, Prentice Hall, 2014.
2. Stallings W, Foundations of Modern Networking, Pearson, 2017.
3. Cloud Computing: Principles and Paradigms, Editors: Raj Kumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011.
4. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antono Poulos, Lee Gillam, Springer, 2018.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	-	-	2	-	2	1	1	1
CO2	3	3	2	1	2	-	-	-	-	1	-	2	2	1	2
CO3	2	3	2	2	2	3	-	2	-	2	-	3	2	3	2
CO4	2	2	3	1	2	2	1	-	1	2	2	2	2	1	2
CO5	2	2	2	2	3	1	1	-	-	2	-	3	2	2	2
Score	12	12	10	7	10	7	3	2	1	9	2	12	9	8	9
COM	3	3	2	2	2	2	1	2	1	2	2	3	2	2	2

Course Code	ICPR301
Course Title	Minor Project
Number of Credits (L-T-P-C)	0-0-8-4
Course Type	PR

COURSE OBJECTIVES

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To analyze state-of-the-art techniques to solve real-world problems.
- To demonstrate and implement the proposed solution.

COURSE CONTENT

The project work is designed for a one semester duration as a single project involving detailed literature survey, experimentation plan and its implementation.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Demonstrate a sound technical knowledge of the selected project topic.	K2
CO2	Survey research studies, find research gaps, and formulate a complex engineering problem.	K6
CO3	Experiment with state-of-the-art methods and identify the available solutions.	K4
CO4	Analyze and compare the available solutions.	K4
CO5	Plan, propose, and implement the proposed solution.	K6

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	1	2	2	-	3	3	-	3	-	-	3
CO2	3	3	1	3	1	2	2	3	3	3	3	3	3	3	3
CO3	3	3	-	3	1	2	2	-	3	3	3	3	3	3	3
CO4	3	3	2	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Score	15	14	6	14	9	9	9	6	15	15	12	15	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

Course Code	ICHC302
Course Title	Honours Online Course- II*
Number of Credits (L-T-P-C)	X-X-X-3
Course Type	HC

This is an optional course for the students who want to opt for B.Tech. (Honours). The Students must adhere the guidelines mentioned in the applicable UG Ordinance. The students can choose online courses from NPTEL or SWAYAM or MOOCs. They should undergo the online course completely, submit assignments, projects, etc., and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

Course Code	ICOC302
Course Title	Optional Online Course- II*
Number of Credits (L-T-P-C)	X-X-X-(0-3)
Course Type	OC

The Students can opt for Optional Online Course along with their normal courses. The students can choose online courses from NPTEL/SWAYAM/MOOCs. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

SEMESTER VII

Course Code	SCMS401
Course Title	Deep Learning
L T P C	3-0-2-4
Course Type	MS

COURSE OBJECTIVES

- To understand the core principles of deep learning and neural networks.
- To develop proficiency in building and training convolutional neural networks (CNNs).
- To gain knowledge of sequence modeling techniques, including recurrent neural networks (RNNs) and LSTM networks.
- To explore advanced deep learning architectures like transformers and auto-encoders.
- To familiarize with the latest advancements in deep learning, including generative adversarial networks (GANs) and large language models.

COURSE CONTENT

Unit-I Basics of Deep Networks
Deep Networks: Gradient-based Learning, Hidden Units, Architecture Design, Back propagation, Regularization, Activation functions, Training Deep Models, Hyper-parameters, Optimization.

Unit-II Convolutional Networks
Motivation, Applications, Convolution Operations, CNN layers: Convolutional layer, activation layer, pooling layer, flattening, CNN architecture: 1D-CNN, 2D-CNN, 3D-CNN. Pretrained models: VGG16, ResNet50.

Unit-III Sequence Modeling
Motivation, Applications, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence architecture, Deep Recurrent Networks, Recursive Neural Networks, Long Short-Term Memory (LSTM), Bi-LSTM.

Unit-IV Transformers and Autoencoders
Transformers: Motivation, Applications, Attention-mechanism, encoder-decoder architecture, BERT Model. Autoencoders: Undercomplete Autoencoders, Regularized Autoencoders, Representational power, Layer Size and Depth, Stochastic Encoders and Decoders, Denoising Encoders., Applications of Autoencoders.

Unit-V Advancements in Deep Learning
Introduction to Generative AI, Generative Adversarial Networks, Large Language Models, Diffusion models, Neuromorphic computing.

LIST OF EXPERIMENTS

1. Implementation of Perceptron Network
2. Implementation of Multilayer Perceptron (MLP) and Hyperparameter Tuning
3. Implementation of Multilayer Neural Network using Keras and Data Augmentation on MNIST Dataset
4. Implementation of Convolutional Neural Network (CNN) on MNIST Dataset.
5. Implementation of Pretrained Transfer Learning Models for Plant Disease Detection
6. Implementation of Autoencoder on MNIST Dataset for Handwritten Digit Recognition
7. Implementation of Recurrent Neural Networks (RNN) for Sentiment Analysis
8. Implementation of LSTM for Text Generation
9. Implementation of GAN for Generating Handwritten Digits on MNIST Dataset
10. Implementation of Capsule Networks for Image Classification
11. Implementation of U-Net for Image Segmentation
12. Implementation of Object Detection Using YOLOv7
13. Implementation of ResNet Architecture for Image Classification
14. Implementation of Spatial and Channel Attention in CNN
15. Implementation of Bidirectional LSTM for Named Entity Recognition (NER)

COURSE OUTCOMES

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

CO	Description	Level
CO1	Develop and deploy deep neural networks for real-world problem solving, mastering model training and optimization.	K3
CO2	Employ convolutional neural networks to ensure high accuracy and efficiency for different classification/regression task.	K2
CO3	Utilize sequence modeling to capture temporal dependencies and enhance performance in sequential prediction tasks.	K4
CO4	Implement advanced architectures like transformers and autoencoders for tasks such as language understanding, language translation.	K4
CO5	Explore the emerging technologies in deep learning like GANs, LLMs.	K2

TEXT BOOKS

1. Bengio, Yoshua, Ian Goodfellow, and Aaron Courville. *"Deep learning"*. Cambridge, MA, USA: MIT press, 2017.
2. Zhang, Aston, et al. *"Dive into deep learning"*. Cambridge University Press, 2023.

REFERENCE BOOKS

1. Wani, M. Arif, et al. *"Advances in deep learning"*. Springer, 2020.
2. Huang, Kaizhu, et al., *"Deep learning: fundamentals, theory and applications"*. Vol. 2. springer, 2019.
3. Chollet, Francois. *"Deep learning with Python"*. Simon and Schuster, 2021.
4. Foster, David. *"Generative deep learning"*. " O'Reilly Media, Inc.", 2022.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	3	3	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	3	3	-	-	3	3	3
Score	11	-	-	7	3	-	-	-	3	3	-	-	3	3	3
COM	3	-	-	3	3	-	-	-	3	3	-	-	3	3	3

Course Code	SEMS401
Course Title	Introduction to IoT
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	MS

COURSE OBJECTIVES

- To understand the fundamentals of IoT and Networking concepts.
- To familiarize with IoT architecture, sensors, actuators, device design, and the considerations involved in building IoT-enabled systems.
- To provide knowledge about various IoT communication technologies, including constrained devices, low-power networks, and key protocols for data transmission.
- To explore how cloud, fog, and edge computing architectures support IoT applications.
- To examine practical IoT applications in fields such as agriculture, healthcare, and transportation.

COURSE CONTENT

Unit-I IOT Introduction and Fundamentals
Basics of networking (types of networks, layered models, addressing, TCP/IP transport layer), Introduction to the architecture of wireless sensor networks, Machine-to-Machine (M2M) communication and cyber physical systems. Introduction to IoT and its comparison with M2M, WSN and CPS. IoT networking components, Addressing strategies in IoT.

Unit-II IOT architecture and networking
Introduction to IoT Sensors and their characteristics, Sensing types and their considerations, Introduction to IoT Actuators, their types and characteristics, IoT processing topologies, their types and its importance, Data formatting, Processing topologies, IoT device design and selection considerations, Processing offloading, IoT connectivity technologies.

Unit-III IOT Communication Technologies
Introduction to nodes, Constrained nodes and network, and the type of devices, Low power and lossy networks, Infrastructure protocols, Discovery protocols, Data protocols, Identification protocols, Device management protocols, Sematic protocols, IoT interoperability standards and frameworks.

Unit-IV Cloud and FOG Computing in IOT
Introduction to cloud computing, Virtualization, Cloud Models, SLA in cloud computing, Cloud implementation in Sensor – Cloud, Introduction to fog computing and its architecture, Fog computing in IoT, Application of fog computing in IoT, Edge computing in IoT.

Unit-V IOT applications and Data analytics
IoT applications in agriculture, vehicular networks and healthcare, IoT analytics, Uses of machine learning in IoT, Advantages and challenges of ML in IoT, ML algorithms for IoT applications, Performance metrices for evaluating ML algorithms.

LIST OF EXPERIMENTS

1. Study the fundamental of IOT softwares and components.
2. Familiarization with Arduino/Raspberry Pi and perform necessary software.
3. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
4. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
5. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
6. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
7. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
8. To install MySQL database on Raspberry Pi and perform basic SQL queries
9. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.
10. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Associate and classify the architecture of various communication systems.	K2
CO2	Elaborate the IoT infrastructure and data processing methodologies.	K2
CO3	Interpret the various networking protocols used in IoT.	K2
CO4	Acquire the concepts of fog and cloud computing in IoT.	K3
CO5	Illustrate the various real-life applications of IoT.	K3

TEXT BOOKS

1. Misra, S., Mukherjee, A. and Roy, A. *"Introduction to IoT"*, Cambridge University Press, 2021.
2. Serpanos, D. and Wolf, M. *"Internet-of-things (IoT) systems: architectures, algorithms, methodologies"*, Springer, 2017.

REFERENCE BOOKS

1. Xiao, P. *"Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed"*, John Wiley & Sons, 2018.

2. Hersent, O., Boswarthick D., and Elloumi, O., *"The Internet of Things: Key Applications and Protocols"*, John Wiley & Sons, 2011.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	3	3	2	2	2	2	1	3	1	3	3	3	3
CO2	2	3	2	3	3	2	-	-	-	3	2	3	-	2	2
CO3	2	2	3	3	1	-	-	-	-	3	-	3	3	2	2
CO4	2	3	3	3	3	-	-	-	-	3	-	3	-	2	2
CO5	2	3	3	1	-	-	-	-	-	3	-	3	-	2	2
Score	10	14	14	13	9	4	2	2	1	15	3	15	6	11	11
COM	2	3	3	3	3	2	2	2	1	3	2	3	3	3	3

Course Code	SCMS402
Course Title	Cyber Physical Systems
Number of Credits(L-T-P-C)	3-0-0-3
Course Type	MS

COURSE OBJECTIVES

- To understand the basic principles behind cyber physical systems.
- To understand the control theory of cyber physical systems.
- To understand the hardware platform components for Cyber Physical Systems
- To understand the implementation issues related to cyber-physical systems.
- To understand applications of cyber physical systems to expose new opportunities.

COURSE CONTENT

Unit-I INTRODUCTION TO CYBER-PHYSICAL SYSTEMS
Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, Industry 4.0 AutoSAR, IIOT implications, Building Automation, Medical CPS, Basic Techniques, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques, Software Tools.

Unit-II CONTROL SYSTEMS
Mathematical modelling of electrical systems, mechanical systems, electro-mechanical systems. Laplace transforms, transfer functions, electrical analogues of other dynamical systems. State-space modelling of dynamical systems. Block diagrams, block diagram reductions. Signal flow graph, Mason's gain formula. Linearity, time-invariance versus nonlinearity and time-variance. Linearization. Distributed parameter systems, Feedback Control Systems, Basic Techniques, Controller Timing, Controller Design for resource efficiency

Unit-III PLATFORM COMPONENTS FOR CYBER PHYSICAL SYSTEMS
CPS HW platforms - Processors, Sensors, Actuators CPS Network – Wireless Hart, CAN, Automotive Ethernet Scheduling Real Time CPS tasks: Table-driven and Event driven schedulers Hybrid schedulers. Dynamical Systems and Stability Controller Design Techniques Performance under Packet drop and Noise

Unit-IV CPS IMPLEMENTATION ISSUES
From features to automotive software components Mapping software components to ECUs. CPS Performance Analysis: Effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion Building real-time networks for CPS Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques, System Theoretic Approaches.

Unit-V CYBER PHYSICAL SYSTEMS APPLICATION DOMAIN
Medical Cyber-Physical Systems, Energy Cyber-Physical Systems, Cyber-Physical Systems Built on Wireless Sensor Networks.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Construct the basic models for a given cyber physical system.	K3
CO2	Design a controller system to improve resource efficiency.	K6
CO3	Inspect the hardware requirements of various cyber physical systems.	K4
CO4	Inspect the implementation issues of the CPS.	K2
CO5	Assess the application of cyber physical systems in different domains.	K5

TEXT BOOKS

1. Rajkumar R., Dionisio de Niz and Klein M., *"Cyber-Physical Systems"*, First Edition, Addison-Wesley Professional, 2017.
2. CPS: Platzer, A., *"Logical foundations of cyber-physical systems (Vol. 662)"*. Cham: Springer, 2018.

REFERENCE BOOKS

1. Rajeev Alur, *"Principles of Cyber-Physical Systems"*, MIT Press, 2015.
2. Roy S. and Sajal K. Das, *"Principles of Cyber-Physical Systems: An Interdisciplinary Approach"*, Cambridge University Press, 2020.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	3	2	-	-	-	-	-	-	-	3	-	-
Score	10	10	3	6	2	-	-	-	-	-	-	-	6	-	-
COM	2	2	3	3	2	-	-	-	-	-	-	-	3	-	-

Course Code	SEMS402
Course Title	Biomedical Signal Processing
Number of Credits(L-T-P-C)	3-0-0-3
Course Type	MS

COURSE OBJECTIVES

- To learn types, sources, acquisition, and analysis of biomedical signals.
- To learn electrocardiography and electromyography, including systems, signals, and processing techniques.
- To learn to identify artifacts and noise in various biosignal processes.
- To understand digital filtering, FIR and IIR filters, and their design.
- To Learn signal averaging, ECG QRS detection, and related analysis techniques.

COURSE CONTENT

Unit-I INTRODUCTION TO BIOMEDICAL SIGNALS
The nature of biomedical signals, examples of biomedical signals, action potential, electroneurogram (ENG), electromyogram signal (EMG), electrocardiogram (ECG), electroencephalogram (EEG), event-related potentials (ERPs), The electrogastrogram (EGG), phonocardiogram (PCG), carotid pulse (CP), speech signal, objectives of biomedical signal analysis, difficulties in biomedical signal processing, what is medical instrument, computer-aided diagnostics.

Unit-II ELECTROCARDIOGRAPHY
Basic electrocardiography, ECG leads systems, ECG signal characteristics, concurrent, coupled and correlated processes.
ELECTROMYOGRAPHY: Muscular system, Electrical signals of the motor unit and gross muscle, Human motor coordination system, Electrodes, Correlation of force and work; EMG integrators, Signals conditioning & processing.

Unit-III 3:ARTEFACTS IN BIOSIGNALS
Random noise, structured noise, and physiological interference, stationary Vs non-stationary processes. Noise in event-related potentials, high-frequency noise in ECG, motion artifacts in ECG, power-line interference in ECG signals, and maternal interference in fetal ECG.

Unit-IV BASICS OF DIGITAL FILTERING
Digital filters, z transform, elements of a digital filter, types of digital filters, the transfer function of difference equation, the z-plane pole-zero plot, the rubber membrane concept.
FINITE IMPULSE RESPONSE FILTERS: Characteristics of FIR filters, smoothing filters, notch filters, derivatives, window design, frequency sampling, and minimax design.
INFINITE IMPULSE RESPONSE FILTERS: Generic equations of IIR filters, simple one-pole example, integrators, and design methods for two-pole filters.

Unit-V SIGNAL AVERAGING
Basics of signal averaging, signal averaging as a digital filter, a typical average, software for signal averaging, limitations of signal averaging. ECG QRS DETECTION: Power spectrum of the ECG, band pass filtering techniques, differentiation techniques, template matching techniques, A QRS detection algorithm. ECG interpretation, ST- segment analyzer, portable arrhythmia monitor.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Knowledge of fundamental background for biomedical signal processing leading towards automatic disease diagnostics.	K2
CO2	Interpret ECG and EMG systems, signals, and processing techniques effectively.	K2
CO3	Detect and manage random, structured, and physiological artifacts in various biosignal processes.	K6
CO4	Understanding of basic digital filtering techniques and ability to design various types of filters.	K4
CO5	Ability to detect and analyze ECG signals by QRS algorithm.	K4

TEXT BOOKS

1. Rangayyan, R. M., *"Biomedical Signal Analysis"*, 2nd edition, Wiley, 2016.
2. Tompkins, W. J., *"Biomedical Digital Signal Processing: C Language Examples and Laboratory. Experiments for the IBM PC"*, Prentice-Hall India, 1998.
3. D C Reddy, *"Biomedical Digital Signal Processing"*, McGraw Hills.

REFERENCE BOOKS

1. Bruce, E. N., *"Biomedical Signal Processing and Signal Modeling"*, Wiley, 2007.
2. Semmlow, J. L. and Griffel, B., *"Biosignal and Medical Image Processing"*, 3rd edition, CRC press, 2014.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	3	3	-	-	2	-	-	-	-	3	-	3	-	-	2
CO3	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3
CO4	3	2	2	3	2	-	-	-	-	3	-	3	-	-	2
CO5	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3
Score	15	13	8	9	10	-	-	-	6	15	-	15	6	4	10
COM	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3

Course Code	SCMS403
Course Title	Introduction to Federated Learning
Number of Credits(L-T-P-C)	3-0-0-3
Course Type	MS

COURSE OBJECTIVES

- To learn distributed machine learning.
- To explore the basics of federated learning.
- To learn with the various types of Federated learnings.
- To apply the federated learning concepts in various applications like transfer learning, computer vision, and natural language processing.
- To explore with different federated learning frameworks for their implementation

COURSE CONTENT

Unit-I Distributed Machine Learning
Introduction to Distributed Learning, Scalability- motivated Distributed Machine Learning, Privacy Motivated Distributed Machine Learning, Privacy-Preserving Distributed Machine Learning, Privacy-Preserving Gradient Descent, Distributed Learning Vs Federated Learning.

Unit-II Federated Learning
Federated Learning as a solution: Motivation and Challenges, Current development in Federated Learning, Classification of Federated Learning, Frameworks of Federated Learning, Privacy-preserving Machine Learning, Privacy-preserving Machine Learning vs Secure Machine Learning, Threats and Security Model.

Unit-III Horizontal and Vertical Federated Learning
Horizontal Federated Learning: Definition, Architecture, Federated Averaging algorithm, Improvement in Federated Averaging algorithm, Research Challenges. Vertical Federated Learning: Definition, Architecture, Algorithms, and Challenges.

Unit-IV Federated Learning for Computer Vision and Natural Language Processing
Federated Transfer Learning (FTL), FTL Framework and Challenges. Federated CV: Introduction, Application, and Challenges. Federated NLP: Introduction, Application, and Challenges. Federated Recommendation: Recommendation Model, Federated Recommendation Systems, Application, and Challenges.

Unit-V Federated Learning: Case Studies and Tools
Case Studies: Finance, Healthcare, Education, Urban Computing, and Smart City. Federated Learning Tools: TensorFlow Federated, Layers of TensorFlow Federated, Installation and Setup, Model Building, Computation Building, and Model Aggregation.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand the basis of distributed machine learning.	K1
CO2	Understand the basics of federated learning.	K1
CO3	Apply suitable federated learning techniques for an application.	K3
CO4	Design and develop an efficient federated learning system for an application.	K5
CO5	Implement an effective learning system for the various application domain.	K4

TEXT BOOKS

1. Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, and Han Yu: *"Federated Learning"*, Morgan and Claypool Publishers, 2020.
2. Yaochu Jin, Hangyu Zhu, Jinjin Xu, and Yang Chen: *"Federated Learning: Fundamentals and Advances"*, Springer, 2020.

REFERENCE BOOKS

1. Saravanan Krishnan, A. Jose Anand, R. Srinivasan, R. Kavitha, S. Suresh. *"Handbook on Federated Learning Advances, Applications and Opportunities"*, CRC Press, 2024.
2. Ziller, Alexander, et al. *"Pysyft: A library for easy federated learning."* Federated Learning Systems: Towards Next-Generation AI (2021): 111-139.
3. TensorFlow Federated: Machine Learning on Decentralized Data : https://www.tensorflow.org/federated/get_started

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	-	-	-	-	-	-	-	3	-	3
CO2	3	3	3	3	1	-	-	-	-	-	-	-	3	-	3
CO3	3	2	3	3	1	-	-	-	-	-	-	-	3	-	2
CO4	3	2	3	3	1	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	3	1	-	-	-	-	-	-	-	3	-	3
Score	15	13	15	15	5	-	-	-	-	-	-	-	15	-	13
COM	3	3	3	3	1	-	-	-	-	-	-	-	3	-	3

Course Code	SEMS403
Course Title	Quantum Computing
Number of Credits(L-T-P-C)	3-0-0-3
Course Type	MS

COURSE OBJECTIVES

- To learn the mathematical foundations of quantum computing.
- To understand the basic principles of model of computations in quantum world.
- To learn the key concepts of quantum mechanics for solving computing problems.
- To apply quantum mechanics concepts for solving significant computing problems.
- To understand quantum noise and correction techniques.

COURSE CONTENT

Unit-I Foundation
Overview of traditional computing, Church-Turing Thesis, Circuit model of computation, reversible computation, Dirac notation, complex inner and Hilbert spaces, Hermitian and Unitary operators, Dual vectors, tensor products, polar and singular value decompositions, the spectral theorem, Schmidt decomposition theorem.

Unit-II Quantum Model of Computation
Postulates of quantum mechanics, state space, time evolution of a closed system, measurement, dynamics, composite systems, Bits and Qubits as vector spaces, unary quantum operators – single qubit gates, Bloch sphere, mixed states and density matrices, multiple qubits and multi-qubit gates, Universal quantum gates, quantum black-box model, quantum circuit complexities – gates, qubits, depth, query.

Unit-III Quantum Computations
No-cloning theorem, dense coding, quantum teleportation, quantum parallelism and entanglement, phase kickback, Deutsch algorithm, Deutsch-Jozsa algorithm, Bernstein-Vazirani algorithm, Simon's algorithm, Quantum Key Distribution – BB84 protocol, Simulation of quantum systems.

Unit-IV Quantum Algorithms
Quantum integral transform, quantum Fourier transform (QFT), application of QFT – Period-finding, Shor's factorization algorithm, quantum phase estimation, discrete logarithm solution, hidden subgroup solution, Grover's search, optimality of quantum search, amplitude amplification, quantum counting, minimum and maximum finding algorithms.

Unit-V Quantum Error Correction
Decoherence, open quantum system, errors – bit-flip, phase-flip, depolarizing, amplitude-damping,

Lindblad equation, Quantum Error Correction Codes (QECC) – 3-qubit bit-flip QECC, 3-qubit phase- flip QECC, Shor's 9-qubit QECC, Hamming QECC, 7-qubits and 5-qubits QECC.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the fundamentals of quantum computing and relevant mathematical ideas.	K2
CO2	Understand formal model of computation for quantum computing and components for constructing quantum circuits.	K2
CO3	Explain primary concepts of quantum computing used for solving mathematical and computing problems.	K3
CO4	Solve significant computing problems using quantum mechanical phenomenon.	K3
CO5	Understand decoherence and error correction techniques for fault tolerant quantum systems.	K2

TEXT BOOKS

1. M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information," Cambridge University Press, 2010.
2. N. D. Mermin, "Quantum Computer Science: An Introduction (1st ed.)," Cambridge University Press, 2007.

REFERENCE BOOKS

1. M. Nakahara and T. Ohmi, "Quantum Computing – From Linear Algebra to Physical Realizations (1 st ed.)," CRC Press, 2008.
2. R. T. Perry, "Quantum Computing from the Ground Up (1 st ed.)," World Scientific Publishing Co.Pte. Ltd., 2012.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	3	3	-	-	-	-	-	-	-	2	3	2	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	-	2	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	3	3	3	-	-	-	-	-	-	2	3	2	-
Score	11	12	9	9	3	-	-	-	-	-	-	4	9	8	-
COM	3	3	3	3	3	-	-	-	-	-	-	2	3	2	-

Course Code	CSSE401
Course Title	Pattern Recognition and Applications
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To introduce the fundamental principles of classical pattern recognition.
- To familiarize students Bayesian decision theory and discriminant analysis.
- To understand parametric, non-parametric, neural-network classifiers, and clustering.
- To provide techniques for feature extraction and dimensionality reduction.
- To expose students to real-world applications and emerging areas of research.

COURSE CONTENT

Unit-I Introduction
Overview of pattern recognition systems; Applications and goals; Learning and design cycles; Probability review; machine perception, system components-sensing, segmentation, feature extraction, classification, and the design-evaluation cycle.

Unit-II Bayesian Decision Theory
Bayesian decision theory: decision surfaces, minimum risk, error probabilities; Normal density and discriminant functions, Bayes Decision Theory - Binary Features, continuous/discrete feature spaces, class-conditional densities.

Unit-III Non-parametric Techniques and Nearest Neighbor Rule
Histogram Density Estimation, Maximum Likelihood, Parzen window methods; k-Nearest neighbor classification; Metrics for nearest neighbor; Decision trees, ROC curves and performance evaluation.

Unit-IV Linear Discriminant Functions and Feature Extraction
Curse of dimensionality, Linear and piecewise linear discriminant functions; Perceptron criterion; Gradient descent methods; Principal Component Analysis (PCA); Fisher's Linear Discriminant; Feature extraction and separability.

Unit-V Emerging Topics and Applications
Neural networks (MLP, Hopfield, RBF), support vector machine, Applications in biometrics, medical image analysis, document recognition, industrial inspection, and multimedia; Pattern recognition in real-time and embedded systems; Introduction to current research topics: explainable pattern recognition, zero-shot learning, bias and fairness in classification, transferability of features; Benchmark datasets and evaluation protocols (MNIST, LFW, UCI, etc.).

LIST OF EXPERIMENTS

1. Demonstrate the basic architecture of a pattern recognition system using real-world examples (e.g., OCR, biometrics).
2. Demonstrate feature extraction using statistical and geometric descriptors (e.g., mean, variance, Hu's moments).
3. Demonstrate the implementation of Bayes classifier for two-class classification with Gaussian distributions.
4. Demonstrate risk minimization and decision boundary visualization using synthetic data.
5. Demonstrate parameter estimation techniques: Maximum Likelihood Estimation (MLE) and Bayesian Estimation.
6. Demonstrate non-parametric classification using k-Nearest Neighbors (KNN) and Parzen window methods.
7. Demonstrate dimensionality reduction using Principal Component Analysis (PCA) with visualization.
8. Demonstrate the use of Fisher's Linear Discriminant (FLD) for feature projection and class separability.
9. Demonstrate classification performance analysis using confusion matrix, ROC curve, and accuracy metrics.
10. Demonstrate a complete pattern recognition application pipeline (e.g., handwritten digit classification using MNIST) with proper documentation and evaluation.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand the architecture and components of a pattern recognition system	K2
CO2	Apply statistical techniques for designing classifiers	K3
CO3	Implement parametric and non-parametric estimation methods and evaluate classification.	K3
CO4	Apply dimensionality reduction and feature selection techniques	K4
CO5	Analyze and apply pattern recognition techniques to real-world and emerging applications and explore contemporary research challenges in it.	K5

TEXT BOOKS

1. Duda, R. O., Hart, P. E., & Stork, D. G., Pattern Classification, Wiley, 2nd Edition, 2001.
2. Schalkoff, R. J., Pattern Recognition: Statistical, Structural and Neural Approaches, Wiley, 1992.
3. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 2006 (selectively, non-ML parts).

REFERENCE BOOKS

1. Theodoridis, S., & Koutroumbas, K., Pattern Recognition, Academic Press, 4th Edition, 2009.
2. Jain, A. K., Duin, R. P. W., & Mao, J., "Statistical Pattern Recognition: A Review", IEEE PAMI, 2000.

CO to PO/PSO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO2	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Score	10	4	-	-	6	-	-	-	-	-	-	9	-	-	-
COM	2	2	-	-	3	-	-	-	-	-	-	3	-	-	-

Course Code	CSSE402
Course Title	Software Engineering and Maintenance
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To impart knowledge of Software Engineering Practices and various Process Models such as waterfall and evolutionary models.
- To understand the software requirements and SRS document.
- To impart knowledge of software engineering approach to design and develop high-quality software products and testing of the product.
- To impart the knowledge of Software Cost Computing models.
- To learn the fundamental principles and methodologies of software reengineering.

COURSE CONTENT

Unit-I Introduction
Role of software engineering, Software evolution, Legacy system structures, Legacy system Design, Legacy System Assessment, Software development life cycle, Software process and models, Characteristics of software process, Extreme Programming, Agile Methodology, Scrum, and The Unified Process.

Unit-II Software Requirements Analysis and Specification
Software requirements, Problem analysis, Requirements specification, functional specification with use cases, Feasibility Study, Information Modeling, Software Models, Data Flow Diagrams, Entity Relationship Diagrams, Designing the architecture, Architecture style for C and C view, Discussion and Evaluating architectures.

Unit-III Planning, Design, Quality and Testing
Effort estimation, Project scheduling and Staffing, Software configuration management plan, Quality assurance plan, Risk management, Project monitoring plan, Function oriented design, Verification, metrics, the basic concept of object-oriented design, Software Measurements, metrics and Models Detailed design and PDL, verification, Quality concepts, Review techniques, Testing Objectives, Manual testing, Top-Down and Bottom-Up Testing, Software Testing Strategies - Strategies: Test Drivers and Test Stubs, Testing conventional applications, Web applications, Formal modelling and verification, Product metrics, Refactoring.

Unit-IV Software Cost Modeling in Maintenance
The nature of Software maintenance, Software Maintenance types, Software Evolution vs. Software Maintenance, Software Maintenance Process Models: The Software Maintenance, Process Lifecycle, Cost estimation models COCOMO, ISO 9000 and CMM, Bohem's Maintenance Cost Model.

Unit-V System Evolution and Re-engineering
Re-Engineering Process, Reverse engineering: Reverse Engineering vs. Forward Engineering, Software Reusability, Quick-and-Fix Model, and Reuse based Model, Reuse Capability, Halstead's software metrics, Cyclomatic complexity. Software Quality Measures, Types of measures: Size –Oriented Metrics, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance.

LIST OF EXPERIMENTS

1. Develop requirements specification for a given problem (The requirements specification should include both functional and non-functional requirements).
2. Develop DFD Model (Level 0, Level 1 DFD and data dictionary) of the sample problem (Use of a CASE tool required).
3. Develop structured design for the DFD model developed.
4. Develop ER Diagrams for a sample problem.
5. Develop Use case model for a problem.
6. Develop Sequence Diagrams.
7. Develop Class diagrams.
8. Develop code for the developed class model.
9. Use testing tool such as Junit.
10. Use configuration management tool.
11. Use any one project management tool such as Microsoft Project or Gantt Project, etc.
12. Software development cost estimation by COCOMO I and II model.
13. Software maintenance cost computing by Bohem's Maintenance Cost Model.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the Software Engineering Approach and various Process Models.	K2
CO2	Analyze and identify user requirements in SRS.	K4
CO3	Plan, Design, develop prototypes and test small software products using software engineering principles, tools and process models.	K6
CO4	Analyze and apply different models for Computing the Software Cost.	K4
CO5	Change, document, test and validate software changes using software maintenance and reengineering principles.	K6

TEXT BOOKS

1. Pressman, R. S., *"Software Engineering: A Practitioner Approach"*, 9th edition, McGraw Hill, 2024.
2. Mall, Rajib, *"Fundamentals of Software Engineering"*, 5th edition, PHI Publication, 2018.
3. Mohammad Kamran, *"Software Maintenance Engineering"*, 2014

REFERENCE BOOKS

1. Sommerville, Ian, *"Software Engineering"*, Addison-Wesley 10th Edition, 2017.
2. Jalote P., *"Software Project Management in practice"*, Pearson Education, New Delhi, 2002.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	3	3	-	-	3	-	-
CO3	3	2	2	-	-	-	-	-	3	2	-	-	2	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	-	-	-	-	3	-	3	-	-	-	-
Score	15	10	11	-	-	-	-	-	9	5	3	-	7	-	-
COM	3	3	3	-	-	-	-	-	3	3	3	-	3	-	-

Course Code	CSSE403
Course Title	Cloud Security
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	SE

COURSE OBJECTIVES

- To introduce cloud software security fundamentals, including CIA triad, secure development, and policy implementation.
- To identify and analyze common cloud security risks, threats, vulnerabilities, and associated legal/compliance issues.
- To explain unique cloud security challenges posed by virtualization, multi-tenancy, APIs, and vendor lock-in, along with best practices.
- To design and implement secure cloud architectures, covering identity management, network security, and SIEM integration.
- To address security considerations across the cloud lifecycle, from adoption to incident response and future trends/standards.

COURSE CONTENT

Unit-I Cloud Computing Software Security Fundamentals
Cloud Information Security Objectives, Confidentiality, Integrity, Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Secure Development practices, Approaches to Cloud Software Requirement Engineering, Cloud Security Policy Implementation.

Unit-II Cloud Computing Risk Issues
Common Threats and Vulnerabilities (Logon Abuse, Inappropriate System Use, Eavesdropping, Network Intrusion, DoS, Session Hijacking), Cloud Access Control Issues, Data Protection in the Cloud (Data Ownership, Data Privacy, Data Mobility, Data Retention), Compliance and Legal Issues (Jurisdictional Issues, Regulatory Requirements), Audit and Accountability Challenges

Unit-III Cloud Computing Security Challenges
Virtualization Security (Hypervisor Risks, VM Escape, Increased DoS Risk), Virtual Machine (VM) Security Recommendations and Best Practices, Challenges in Multi-tenancy, Interoperability and Portability Issues (”Vendor Lock-in”), Security of APIs and Control Planes

Unit-IV Cloud Computing Security Architecture
Architectural Considerations, General Issues, Trusted Cloud Computing, Secure Execution environments and Communications, Micro architectures, Identity Management and Access Control, Autonomic Security. Designing a Secure Cloud Architecture, Implementing Security Controls in IaaS, PaaS, and SaaS Models, Network Security Architectures for Cloud (VPC,

Segmentation, Firewalls, IDS/IPS), Identity Management and Access Control Systems in the Cloud, Security Information and Event Management (SIEM) in Cloud Environments

Unit-V Cloud Computing Life Cycle Issues and Future Trends
Security Considerations for Cloud Adoption and Migration, Secure Development and Deployment of Cloud Applications, Continuous Monitoring and Auditing in the Cloud, Incident Response in Cloud Environments, Decommissioning and Data Erasure in the Cloud, Future Trends in Cloud Security, Standards and Certifications (e.g., ISO 27001, CSA STAR), Emerging Technologies and their Security Implications

LIST OF EXPERIMENTS

1. Implement IAM policies to enforce least privilege access for cloud resources and test access.
2. Encrypt data at rest in cloud storage and in transit via secure connections.
3. Configure VPCs, security groups, and NACLs for robust network segmentation.
4. Detect common cloud threats by analyzing logs from cloud logging and monitoring services.
5. Harden a cloud VM by disabling unnecessary services and enforcing secure authentication.
6. Simulate a DoS attack on a cloud web app and observe load balancer/auto-scaling response.
7. Enable and test Multi-Factor Authentication (MFA) for cloud account access.
8. Implement automated security policies using cloud governance tools to detect non-compliance.
9. Test the security of a simple cloud API by attempting unauthorized access.
10. Practice incident response by detecting and containing a simulated cloud compromise using logs and network controls.

COURSE OUTCOMES

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

TEXT BOOKS

1. Ronald L. Krutz, Russell Dean Vines, “Cloud Security A comprehensive Guide to Secure Cloud Computing” Wiley.
2. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
3. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008

CO	Description	Level
CO1	Apply fundamental cloud information security objectives and design principles to develop secure cloud software.	K2
CO2	Analyze and mitigate common cloud-specific risks, vulnerabilities, and legal/compliance challenges.	K4
CO3	Propose solutions for inherent cloud security challenges related to virtualization, multi-tenancy, and API security.	K3
CO4	Architect and implement security controls for various cloud service models (IaaS, PaaS, SaaS), encompassing IAM, network security, and SIEM.	K4
CO5	Evaluate and manage security considerations across the entire cloud computing lifecycle, including emerging trends and standards.	K6

REFERENCE BOOKS

1. Cloud computing for dummies- Judith Hurwitz , Robin Bloor, Marcia Kaufman , Fern Halper, Wiley Publishing, Inc, 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3. Sosinsky Barrie, ”Cloud Computing: Bible”, Wiley Publication, First Edition 2018.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	2	1	-	1	2	-	2	2	2	2
CO2	2	3	2	3	2	3	1	3	1	2	1	3	2	3	2
CO3	2	2	3	2	2	2	1	2	1	2	1	3	2	3	3
CO4	3	3	3	2	3	2	1	2	2	2	2	3	3	3	3
CO5	2	2	2	3	2	2	1	2	1	2	2	3	2	2	2
Score	12	12	12	11	10	11	5	9	6	10	6	14	11	13	12
COM	3	3	3	3	2	3	1	3	2	2	2	3	3	3	3

Course Code	ICPR401
Course Title	Major Project-I
Number of Credits (L-T-P-C)	0-0-10-5
Course Type	PR

COURSE OBJECTIVES

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To analyze state-of-the-art techniques to solve real world problems.
- To demonstrate and implement the proposed solution.

COURSE CONTENT

In this course, the student is expected to work on a project to solve a real-world problem under the supervision of the faculty member. The project work include detailed literature survey, problem formulation, experimentation plan and its implementation in a form of working prototype.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Demonstrate a sound technical knowledge of the selected project topic.	K2
CO2	Survey research studies, find research gaps, and formulate a complex engineering problem.	K6
CO3	Experiment with state-of-the-art methods and identify the available solutions.	K4
CO4	Analyze and compare the available solutions.	K4
CO5	Plan, propose, and implement the proposed solution.	K6

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	1	2	2	-	3	3	-	3	-	-	3
CO2	3	3	1	3	1	2	2	3	3	3	3	3	3	3	3
CO3	3	3	-	3	1	2	2	-	3	3	3	3	3	3	3
CO4	3	3	2	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Score	15	14	6	14	9	9	9	6	15	15	12	15	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

Course Code	ICHC401
Course Title	Honours Online Course- III*
Number of Credits (L-T-P-C)	X-X-X-3
Course Type	HC

This is an optional course for the students who want to opt for B.Tech. (Honours). The Students must adhere the guidelines mentioned in the applicable UG Ordinance. The students can choose online courses from NPTEL or SWAYAM or MOOCs. They should undergo the online course completely, submit assignments, projects, etc., and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

Course Code	ICOC401
Course Title	Optional Online Course- III*
Number of Credits (L-T-P-C)	X-X-X-(0-3)
Course Type	OC

The Students can opt for Optional Online Course along with their normal courses. The students can choose online courses from NPTEL/SWAYAM/MOOCs. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.

SEMESTER VIII

Course Code	SCMS403
Course Title	Introduction to Federated Learning
Number of Credits(L-T-P-C)	3-0-0-3
Course Type	MS

COURSE OBJECTIVES

- To learn distributed machine learning.
- To explore the basics of federated learning.
- To learn with the various types of Federated learnings.
- To apply the federated learning concepts in various applications like transfer learning, computer vision, and natural language processing.
- To explore with different federated learning frameworks for their implementation

COURSE CONTENT

Unit-I Distributed Machine Learning
Introduction to Distributed Learning, Scalability- motivated Distributed Machine Learning, Privacy Motivated Distributed Machine Learning, Privacy-Preserving Distributed Machine Learning, Privacy-Preserving Gradient Descent, Distributed Learning Vs Federated Learning.

Unit-II Federated Learning
Federated Learning as a solution: Motivation and Challenges, Current development in Federated Learning, Classification of Federated Learning, Frameworks of Federated Learning, Privacy-preserving Machine Learning, Privacy-preserving Machine Learning vs Secure Machine Learning, Threats and Security Model.

Unit-III Horizontal and Vertical Federated Learning
Horizontal Federated Learning: Definition, Architecture, Federated Averaging algorithm, Improvement in Federated Averaging algorithm, Research Challenges. Vertical Federated Learning: Definition, Architecture, Algorithms, and Challenges.

Unit-IV Federated Learning for Computer Vision and Natural Language Processing
Federated Transfer Learning (FTL), FTL Framework and Challenges. Federated CV: Introduction, Application, and Challenges. Federated NLP: Introduction, Application, and Challenges. Federated Recommendation: Recommendation Model, Federated Recommendation Systems, Application, and Challenges.

Unit-V Federated Learning: Case Studies and Tools
Case Studies: Finance, Healthcare, Education, Urban Computing, and Smart City. Federated Learning Tools: TensorFlow Federated, Layers of TensorFlow Federated, Installation and Setup, Model Building, Computation Building, and Model Aggregation.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand the basis of distributed machine learning.	K1
CO2	Understand the basics of federated learning.	K1
CO3	Apply suitable federated learning techniques for an application.	K3
CO4	Design and develop an efficient federated learning system for an application.	K5
CO5	Implement an effective learning system for the various application domain.	K4

TEXT BOOKS

1. Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, and Han Yu: *"Federated Learning"*, Morgan and Claypool Publishers, 2020.
2. Yaochu Jin, Hangyu Zhu, Jinjin Xu, and Yang Chen: *"Federated Learning: Fundamentals and Advances"*, Springer, 2020.

REFERENCE BOOKS

1. Saravanan Krishnan, A. Jose Anand, R. Srinivasan, R. Kavitha, S. Suresh. *"Handbook on Federated Learning Advances, Applications and Opportunities"*, CRC Press, 2024.
2. Ziller, Alexander, et al. *"Pysyft: A library for easy federated learning."* Federated Learning Systems: Towards Next-Generation AI (2021): 111-139.
3. TensorFlow Federated: Machine Learning on Decentralized Data : https://www.tensorflow.org/federated/get_started

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	-	-	-	-	-	-	-	3	-	3
CO2	3	3	3	3	1	-	-	-	-	-	-	-	3	-	3
CO3	3	2	3	3	1	-	-	-	-	-	-	-	3	-	2
CO4	3	2	3	3	1	-	-	-	-	-	-	-	3	-	2
CO5	3	3	3	3	1	-	-	-	-	-	-	-	3	-	3
Score	15	13	15	15	5	-	-	-	-	-	-	-	15	-	13
COM	3	3	3	3	1	-	-	-	-	-	-	-	3	-	3

Course Code	SEMS403
Course Title	Quantum Computing
Number of Credits(L-T-P-C)	3-0-0-3
Course Type	MS

COURSE OBJECTIVES

- To learn the mathematical foundations of quantum computing.
- To understand the basic principles of model of computations in quantum world.
- To learn the key concepts of quantum mechanics for solving computing problems.
- To apply quantum mechanics concepts for solving significant computing problems.
- To understand quantum noise and correction techniques.

COURSE CONTENT

Unit-I Foundation
Overview of traditional computing, Church-Turing Thesis, Circuit model of computation, reversible computation, Dirac notation, complex inner and Hilbert spaces, Hermitian and Unitary operators, Dual vectors, tensor products, polar and singular value decompositions, the spectral theorem, Schmidt decomposition theorem.

Unit-II Quantum Model of Computation
Postulates of quantum mechanics, state space, time evolution of a closed system, measurement, dynamics, composite systems, Bits and Qubits as vector spaces, unary quantum operators – single qubit gates, Bloch sphere, mixed states and density matrices, multiple qubits and multi-qubit gates, Universal quantum gates, quantum black-box model, quantum circuit complexities – gates, qubits, depth, query.

Unit-III Quantum Computations
No-cloning theorem, dense coding, quantum teleportation, quantum parallelism and entanglement, phase kickback, Deutsch algorithm, Deutsch-Jozsa algorithm, Bernstein-Vazirani algorithm, Simon's algorithm, Quantum Key Distribution – BB84 protocol, Simulation of quantum systems.

Unit-IV Quantum Algorithms
Quantum integral transform, quantum Fourier transform (QFT), application of QFT – Period-finding, Shor's factorization algorithm, quantum phase estimation, discrete logarithm solution, hidden subgroup solution, Grover's search, optimality of quantum search, amplitude amplification, quantum counting, minimum and maximum finding algorithms.

Unit-V Quantum Error Correction
Decoherence, open quantum system, errors – bit-flip, phase-flip, depolarizing, amplitude-damping,

Lindblad equation, Quantum Error Correction Codes (QECC) – 3-qubit bit-flip QECC, 3-qubit phase- flip QECC, Shor's 9-qubit QECC, Hamming QECC, 7-qubits and 5-qubits QECC.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the fundamentals of quantum computing and relevant mathematical ideas.	K2
CO2	Understand formal model of computation for quantum computing and components for constructing quantum circuits.	K2
CO3	Explain primary concepts of quantum computing used for solving mathematical and computing problems.	K3
CO4	Solve significant computing problems using quantum mechanical phenomenon.	K3
CO5	Understand decoherence and error correction techniques for fault tolerant quantum systems.	K2

TEXT BOOKS

1. M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information," Cambridge University Press, 2010.
2. N. D. Mermin, "Quantum Computer Science: An Introduction (1st ed.)," Cambridge University Press, 2007.

REFERENCE BOOKS

1. M. Nakahara and T. Ohmi, "Quantum Computing – From Linear Algebra to Physical Realizations (1 st ed.)," CRC Press, 2008.
2. R. T. Perry, "Quantum Computing from the Ground Up (1 st ed.)," World Scientific Publishing Co.Pte. Ltd., 2012.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	3	3	-	-	-	-	-	-	-	2	3	2	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-	-	2	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	3	3	3	-	-	-	-	-	-	2	3	2	-
Score	11	12	9	9	3	-	-	-	-	-	-	4	9	8	-
COM	3	3	3	3	3	-	-	-	-	-	-	2	3	2	-

Course Code	ICPR402
Course Title	Major Project-II
Number of Credits (L-T-P-C)	0-0-20-10
Course Type	PR

COURSE OBJECTIVES

- To explore project domain and state objectives clearly and concisely.
- To learn the state-of-art methods for the project domain.
- To survey research problems and derive methodologies to solve the problem.
- To analyze state-of-the-art techniques to solve real-world problems.
- To demonstrate and implement the proposed solution.

COURSE CONTENT

In this course the student may extend the work done in Major Project-I. The extension (if any) should be significant and justifiable with respect to the credits of the course. If extension of the project is not feasible, then the student may work on the new project under the supervision of a faculty member.

COURSE OUTCOMES

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

CO	Description	Level
CO1	Illustrate a sound technical knowledge of the selected project domain.	K2
CO2	Survey research studies, find research gaps, and formulate a complex engineering problem.	K6
CO3	Experiment with state-of-the-art methods and identify the available solutions.	K4
CO4	Demonstrate and compare the available solutions.	K4
CO5	Construct and implement the proposed solution.	K6

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	1	2	2	-	3	3	-	-	-	-	3
CO2	3	3	1	3	1	2	2	3	3	3	3	3	3	3	3
CO3	3	3	-	3	1	2	2	-	3	3	3	3	3	3	3
CO4	3	3	2	3	3	-	-	-	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Score	15	14	6	14	9	9	9	6	15	15	12	12	12	12	15
COM	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3

Course Code	ICHC402
Course Title	Honours Online Course- IV*
Number of Credits (L-T-P-C)	X-X-X-3
Course Type	HC

This is an optional course for the students who want to opt for B.Tech. (Honours). The Students must adhere the guidelines mentioned in the applicable UG Ordinance. The students can choose online courses from NPTEL or SWAYAM or MOOCs. They should undergo the online course completely, submit assignments, projects, etc., and appear for the final exam conducted by the online instructor. The awarded marks/grade must be submitted for the award of suitable letter grade in this course.

Course Code	ICOC402
Course Title	Optional Online Course- IV*
Number of Credits (L-T-P-C)	X-X-X-(0-3)
Course Type	OC

This course is an optional for students who wants to opt for B.Tech. (Optional). The Students can opt for Optional Online Course along with their normal courses. The students can choose online courses from NPTEL/SWAYAM/MOOCs. In Optional course the credit will not be counted for the calculation of the final CGPA but the credit will appear in the Grade card and transcript.