DAYANANDA SAGAR UNIVERSITY

SHAVIGE MALLESHWARA HILLS, KUMARASWAMY LAYOUT
BENGALURU – 560 111, KARNATAKA.

SCHOOL OF ENGINEERING

SCHEME & SYLLABUS
FOR
BACHELOR OF TECHNOLOGY (B.Tech) – I YEAR

COMMON TO ALL BRANCHES

(With effect from 2020-21)

SCHEME - B.TECH – 2020-21 ONWARDS

I SEM - CHEMISTRY CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	101-105 & 121-123	20EN1101	ENGINEERING MATHEMATICS – I	CR	03	01	--	--	04	*	***
2	101-105 & 1 121-123	20EN1102	ENGINEERING CHEMISTRY	CR	03	--	02	--	04	*	***
3	101-105 & 121-123	20EN1103	FUNDAMENTALS OF PROGRAMMING	CR	03	--	04	--	05	*	***
4	101-105 & 121-123	20EN1104	BASIC ELECTRICAL ENGINEERING	CR	03	--	--	--	03	*	***
5	101-105 & 121-123	20EN1105	ENVIRONMENTAL STUDIES	CR	02	--	--	--	02	*	***
6	101-105 & 121-123	20EN1106	ELEMENTS OF MECHANICAL ENGINEERING	CR	02	--	02	--	03	*	***
					16	**01**	**08**	**--**	**21**		
7	101-105 & 121-123	20AU0004	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	AU	02	--	--	--	--	*	***

CR – Credit, AU – Audit, L – Lecture, T – Tutorial, P – Practical, S/P – Seminar/Project, C – No. of Credits

SCHEME - B.TECH – 2020-21 ONWARDS
I SEM - PHYSICS CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	101-105 & 121-123	20EN1101	ENGINEERING MATHEMATICS – I	CR	03	01	--	--	04	*	***
2	101-105 & 121-123	20EN1107	ENGINEERING PHYSICS	CR	03	--	02	--	04	*	***
3	101-105 & 121-123	20EN1108	BASIC ELECTRONICS	CR	03	--	02	--	04	*	***
4	101-105 & 121-123	20EN1109	BIOLOGICAL SCIENCES	CR	02	--	--	--	02	*	***
5	101-105 & 121-123	20EN1110	TECHNICAL COMMUNICATION	CR	02	--	02	--	03	*	***
6	101-105 & 121-123	20EN1111	ENGINEERING GRAPHICS & DESIGN	CR	01	--	04	--	03	*	***
7	101-105 & 121-123	20EN1112	DESIGN THINKING & INNOVATION	CR	--	--	02	--	01	*	***
					14	**01**	**12**	**--**	**21**		
8	101-105 & 121-123	20AU0021	KANNADA KALI – II	AU	02	--	--	--	--	*	***
		20AU0025	KANNADA MANASU – II	AU	02	--	--	--	--	*	***

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SCHEME - B.TECH – 2020-21 ONWARDS
II SEM - PHYSICS CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/ P	C	SEM	COURSE CODE
1	101-105 & 121-123	20EN1201	ENGINEERING MATHEMATICS – II	CR	03	01	--	--	04	*	***
2	101-105 & 121-123	20EN1107	ENGINEERING PHYSICS	CR	03	--	02	--	04	*	***
3	101-105 & 121-123	20EN1108	BASIC ELECTRONICS	CR	03	--	02	--	04	*	***
4	101-105 & 121-123	20EN1109	BIOLOGICAL SCIENCES	CR	02	--	--	--	02	*	***
5	101-105 & 121-123	20EN1110	TECHNICAL COMMUNICATION	CR	02	--	02	--	03	*	***
6	101-105 & 121-123	20EN1111	ENGINEERING GRAPHICS & DESIGN	CR	01	--	04	--	03	*	***
7	101-105 & 121-123	20EN1112	DESIGN THINKING & INNOVATION	CR	--	--	02	--	01	*	***
					14	**01**	**12**	**--**	**21**		
9	101-105 & 121-123	20AU0021	KANNADA KALI	AU	02	--	--	--	--	*	***
		20AU0025	KANNADA MANASU	AU	02	--	--	--	--	*	***

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SCHEME - B.TECH – 2019 -20 ONWARDS

II SEM - CHEMISTRY CYCLE

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	101-105 & 121-123	20EN1201	ENGINEERING MATHEMATICS – II	CR	03	01	--	--	04	*	***
2	101-105 & 121-123	20EN1102	ENGINEERING CHEMISTRY	CR	03	--	02	--	04	*	***
3	101-105 & 121-123	20EN1103	FUNDAMENTALS OF PROGRAMMING	CR	03	--	04	--	05	*	***
4	101-105 & 121-123	20EN1104	BASIC ELECTRICAL ENGINEERING	CR	03	--	--	--	03	*	***
5	101-105 & 121-123	20EN1105	ENVIRONMENTAL STUDIES	CR	02	--	--	--	02	*	***
6	101-105 & 121-123	20EN1106	ELEMENTS OF MECHANICAL ENGINEERING	CR	02	--	02	--	03	*	***
					16	**01**	**08**	**--**	**21**		
7	101-105 & 121-123	20AU0004	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	AU	02	--	--	--	--	*	***

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SCHEME - B.TECH – 2021-22 ONWARDS

III SEM – CSE(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	121	21CS2301	DISCRETE MATHEMATICAL STRUCTURES	CR	3	–	–	–	3	*	***
2	121	21CS2302	DATA STRUCTURES	CR	3	–	–	–	3	*	***
3	121	21CS2303	DIGITAL ELECTRONICS & LOGIC DESIGN	CR	3	–	–	-	3	*	***
4	121	21CS2304	FULL STACK DEVELOPMENT	CR	2	–	2	-	3	*	***
5	121	21CS2305	COMPUTATIONAL THINKING WITH PYTHON	CR	2	–	2	-	3	*	***
6	121	21AM2301	PROBABILITY AND STATISTICS	CR	3	–	–	–	3	*	***
7	121	21CS2307	DATA STRUCTURES LAB	CR	–	–	2	–	1	*	***
	121	21CS2308	DIGITAL ELECTRONICS & LOGIC DESIGN LAB				2		1		
9	121	21CS2309	MANAGEMENT AND ENTREPRENEURSHIP	CR	2	–	–	–	2	*	***
10	121	21CS2310	LIBERAL STUDIES – I	CR	1	-	–	–	1	*	***
					19	-	08	-	23		

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SCHEME - B.TECH – 2021-22 ONWARDS

IV SEM – CSE(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

SL	PROGRAM CODE	COURSE CODE	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	COURSE CODE
1	121	21AM2401	ARTIFICIAL INTELLIGENCE	CR	3	-	-	-	3	*	***
2	121	21CS2402	DESIGN AND ANALYSIS OF ALGORITHMS	CR	3	-	-	-	3	*	***
3	121	21CS2403	PRINCIPLES OF MICROPROCESSORS AND COMPUTER ORGANIZATION	CR	4	-	-	-	4	*	***
4	121	21CS2404	FINITE AUTOMATA & FORMAL LANGUAGES	CR	3	-	2	-	4	*	***
5	121	21CS2405	SOFTWARE ENGINEERING AND PROJECT MANAGEMENT	CR	3	-	-	-	3	*	***
6	121	21AM2402	FOUNDATION OF DATA SCIENCE	CR	2	-	2	-	3	*	***
7	121	21CS2407	DESIGN AND ANALYSIS OF ALGORITHMS LAB	CR	-	-	2	-	1	*	***
8	121	21AM2403	ARTIFICIAL INTELLIGENCE LABORATORY	CR	-	-	2	-	1	*	***
9	121	21CS2409	SPECIAL TOPICS – I	CR	-	-	-	4	2	*	***
10	121	21CS2410	LIBERAL STUDIES – II	CR	1	-	-	-	1	*	***
					19	-	08	04	25		

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V SEM – CSE(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
1	121	21AM3501	DBMS	CR	3	-	-	-	3	*	***
2	121	21AM3502	INTRODUCTION TO NETWORKS AND CYBERSECURITY	CR	3	-	2	-	4	*	***
3	121	21AM3503	OOP WITH JAVA	CR	3	-	-	-	3	*	***
4	121	21AM3504	MACHINE LEARNING	CR	3	-	2	-	4	*	***
5	121	21AM35XX	PROFESSIONAL ELECTIVE-1	CR	3	-	-	-	3	*	AS INDICATED IN ELECTIVE LIST
6	121	21OEXXXX	OPEN ELECTIVE-1	CR	3	-	-	-	3	*	AS INDICATED IN ELECTIVE LIST
7	121	21AM3505	SPECIAL TOPICS -II	CR	-	-	4	-	2	*	***
8	121	21AM3506	DBMS- LAB	CR	-	-	2	-	1	*	***
9	121	21AM3507	OOP WITH JAVA - LAB	CR	-	-	2	-	1	*	***
					18	-	**14**	-	**24**		

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V SEM-PROFESSIONAL ELECTIVES– I

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
1	121	21AM3508	PRINCIPLES OF ROBOTICS	CR	3	-	-	-	3	*	AI, CTPY
2	121	21AM3509	ML FOR PATTERN RECOGINITION	CR	3	-	-	-	3	*	AI & CTPY
3	121	21AM3510	OPERATING SYSTEM WITH UNIX	CR	3	-	-	-	3	*	SEPM

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V SEM-OPEN ELECTIVE– I

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
1		21OE0026	INDUSTRIAL ROBOTICS	CR	3	-	-	-	3	*	***
2		21OE0001	ARTIFICIAL INTELLIGENCE	CR	3	-	-	-	3	*	***

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VI SEM – CSE(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
1	121	21AM3601	CDSS	CR	3	-	-	-	3	*	***
2	121	21AM3602	NATURAL LANGUAGE MODELS	CR	3	-	-	-	3	*	***
3	121	21AM3603	DEEP LEARNING & COMPUTER VISION	CR	3	-	-	-	3	*	***
4	121	21AM36XX	PROFESSIONAL ELECTIVE- 2		3	-	-	-	3	-	AS INDICATED IN ELECTIVE LIST
5	121	21AM36XX	PROFESSIONAL ELECTIVE-3	CR	3	-	-	-	3	-	AS INDICATED IN ELECTIVE LIST
6	121	21OEXXXX	OPEN ELECTIVE-2	CR	3	-	-	-	3	*	AS INDICATED IN ELECTIVE LIST
7	121	21AM3604	CDSS Lab	CR	-	-	2	-	1	*	***
8	121	21AM3605	DEEP LEARNING AND COMPUTER VISION LAB		-	-	2	-	1	*	***
					18	-	**14**	-	**20**		

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VI SEM-PROFESSIONAL ELECTIVES – II &III

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
Professional Elective-II											
1	121	21AM3606	EXPLAINABLE AI	CR	3	-	-	-	3	*	
2	121	21AM3607	MACHINE LEARNING FOR HEALTH CARE	CR	3	-	-	-	3	*	
3	121	21AM3608	DIGITAL SIGNAL PROCESSING	CR	3	-	-	-	3	*	
4	121	21AM3609	REINFORCEMENT LEARNING	CR	3	-	-	-	3	*	
Professional Elective-III											
1	121	21AM3610	INDUSTRIAL ROBOTICS	CR	3	-	-	-	3	*	
2	121	21AM3611	INTRODUCTION TO IOT & EMBEDDED COMPUTING	CR	3	-	-	-	3	*	
3	121	21AM3612	ADVANCED DATA SCIENCE	CR	3	-	-	-	3	*	

VI SEM-OPEN ELECTIVE– II

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
1	121	21OE0039	DEEP LEARNING	CR	3	-	-	-	3	*	***

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SEMESTER/YEAR : I SEM
COURSE CODE : 20EN1101
TITLE OF THE COURSE : ENGINEERING MATHEMATICS – I
L: T/A: P: C : 3 : 1 : 0 : 4

Course Objectives

1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications to science and Engineering.
2. Apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. The course is discussed with algebraic as well as geometric perspectives.
4. Solve problems in cryptography, computer graphics and wavelet transforms.

Expected Course Outcomes

At the end of this course the students are expected to learn

1. the abstract concepts of matrices and system of linear equations using decomposition methods
2. the basic notion of vector spaces and subspaces
3. apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces
4. applications of inner product spaces in cryptography

Student Learning Outcomes

1. Having an ability to apply knowledge or Mathematics in Science and Engineering.
2. Having a clear understanding of the subject related concepts and of contemporary issues.
3. Having computational thinking.

Module: 1 LINEAR EQUATIONS 8 hours

Introduction - The Geometry of Linear Equations - Row reduction and echelon forms- Gaussian Elimination - Solution sets of linear equations – LU decomposition - Inverse of a matrix by Gauss Jordan method.

Self-Learning Component: Algebra of Matrices.

Module: 2 VECTOR SPACES AND SUBSPACES 8 hours

Linear spaces – Subspaces - Linear independence – Span - Bases and Dimensions -Finite dimensional vector space.

Self-Learning Component: Examples of vector spaces and subspaces, Rank of a matrix.

Module: 3 LINEAR TRANSFORMATIONS AND ORTHOGONALITY 8 hours

Linear transformations – Basic properties - Invertible linear transformation - Matrices of linear transformations - Vector space of linear transformations – change of bases – Orthogonal Vectors - Projections onto Lines - Projections and Least Squares - The Gram-Schmidt Orthogonalization process.

Self-Learning Component: Inner Products

Module 4 EIGEN VALUES AND EIGEN VECTORS 10 hours

Introduction to Eigen

values and Eigen vectors - Matrix- Diagonalization of symmetric matrices - Quadratic forms - Singular Value Decomposition - QR factorization. **12 hours**

Self-Learning Component: Determinant and Properties of Eigen values and Eigen vectors

Module 5 APPLICATIONS OF LINEAR EQUATIONS 6 hours

An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets from Raw data – curve fitting

Contemporary Issues

Industry Expert Lecture

Tutorial
- Variety of minimum 10 problems to be worked out by students in every Tutorial Class
- Another set of 5 problems per Tutorial Class to be given for self-solving.

Text Book(s)

1. D C Lay, S R Lay and JJMcDonald, Linear Algebra and its Applications, Pearson India, Fifth edition.
2. Linear Algebra and its Applications by Gilbert Strang, 4 th Edition, Thomson Brooks/ Cole, Second Indian Reprint 2007.
3. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition, Pearson Education, 2011.

Reference Books

1. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).
2. Higher Engineering Mathematics by B S Grewal, 42 nd Edition, Khanna Publishers.
3. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016)
4. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003

SCILAB components

There will be a computational component to the course, using a mix of computational packages like SCILAB to solve engineering problems using the mathematical concepts developed in the course:

1. Gaussian Elimination
2. The LU Decomposition
3. Inverse of a Matrix by the Gauss- Jordan Method, curve fitting
4. The Span of Column Space of a Matrix
5. Fundamental Subspaces
6. Projections by Least Squares
7. The Gram-Schmidt Orthogonalization

8. Eigen values and Eigen Vectors of a Matrix
9. The Largest Eigen Value of a Matrix by the Power Method
10. Singular value decomposition

SEMESTER/YEAR : II SEM
COURSE CODE : 20EN1201
TITLE OF THE COURSE : ENGINEERING MATHEMATICS – II
L: T/A: P: C : 3 : 1 : 0 : 4

Course Objectives

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration

Expected Course Outcomes

At the end of this course the students should be able to

1. apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints
3. evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates
4. understand gradient, directional derivatives, divergence, curl and Greens', Stokes, Gausstheorems

Student Learning Outcomes

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary Issues
3. Having problem solving ability- solving social issues and engineering problems

Module: 1 Application of Single Variable Differential Calculus 8 hours

Differentiation- Extrema on an Interval-Rolle's Theorem and the Mean Value Theorem - Increasing and Decreasing functions and First derivative test-Second derivative test-Maxima and Minima-Concavity.
Integration-Average function value - Area between curves - Volumes of solids of revolution - Beta and Gamma functions

Module: 2 MULTI VARIABLE DIFFERENTIAL CALCULUS 8 hours

Functions of two or more real variables, Partial derivatives of second and higher order, Euler's theorem on homogenous function, Total derivatives, Differentiation of composite and implicit functions, Change of variable, Jacobians, Maxima and minima of functions of two or more variable, Lagrange's method of undetermined multipliers, Taylor's formula for two variables

Module 3 MULTI VARIABLE INTEGRAL CALCULUS 8 hours

Double integrals, Triple integrals, Change of order of integration in a double integral, Change of variables in double and triple integrals, Area as a double integral, Volume as a triple integral, Line integrals, Vector Fields and Line integrals.

Module 4 VECTOR CALCULUS 10 hours

Scalar and vector valued functions – gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials-Simple problems

Line integral- Surface integral - Volume integral - Path independence- Green's theorem-Stoke's Theorem- Divergence Theorem

Module 5 LAPLACE TRANSFORM 6 hours

Basic concepts, Linearity and First shifting theorem, Laplace transforms of derivatives and integrals, Second shifting theoerem, Initial and Final value theorems, Some basic transforms, Inverse Laplace transform, Convolution theorem, Applications to differential equations**.**

Tutorial **12 hours**

- Variety of minimum 10 problems to be worked out by students in every Tutorial Class
- Another set of 5 problems per Tutorial Class to be given for self solving.

Text Book(s)

1. Thomas' Calculus, George B.Thomas, D.Weir and J. Hass, 2014, 13th edition, Pearson.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India.

Reference Books

1. Higher Engineering Mathematics, B.S. Grewal, 2015, 43rd Edition, Khanna Publishers.
2. Higher Engineering Mathematics, John Bird, 2017, 6 th Edition, Elsevier Limited.
3. Calculus: Early Transcendentals, James Stewart, 2017, 8 th edition, Cengage Learning.
4. Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 2013, 7 th Edition, Palgrave Macmillan.

SCILAB components

There will be a computational component to the course, using a mix of computational packages like SCILAB to solve engineering problems using the mathematical concepts developed in the course:

1. Plotting and visualizing curves
2. Plotting and visualizing surfaces
3. Evaluating Extremum of a single variable function
4. Evaluating maxima and minima of functions of several variables
5. Tracing of curves
6. Applying Lagrange multiplier optimization method
7. Line integral
8. Surface integral
9. Volume integral
10. Solving Differential equation using Laplace transform

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1102
TITLE OF THE COURSE : ENGINEERING CHEMISTRY
L: T/A: P: C : 3 : 0 : 2 : 4

Course learning objectives:
The Theory Course intends to provide chemical concepts most relevant to engineering students and demonstrate them in an applied context. The student is exposed to the principles required to understand important contemporary topics like alternate energy sources, corrosion control, polymer technology, phase equilibria nanomaterials and green chemistry and catalysis. The underlying theme is to emphasize on applications of these concepts to real world problems

Course outcome:

- Appreciate the basic principles of electrochemistry, use of different types of electrodes in analysis and evaluate cell potential for different cell reactions.
- Know construction, working and applications of various energy storage devices such as batteries, fuel cells and supercapacitors.
- Understand basic principles of corrosion and apply suitable techniques for corrosion control. Also know the technological importance and processes involved in metal finishing.
- Understand and interpret phase equilibria of one and two-component systems.
- Know the synthesis, structure –property relationship and applications of commercially important polymers and polymer composites. Understand properties and applications of nanomaterials. Also learn the principles of green chemistry for a sustainable and eco-friendly world.

Engineering Chemistry (Theory –Syllabus) Total: 52 Hrs

Module 1

Chemical Energy Source:

- Introduction to energy; Fuels - definition, classification, importance of hydrocarbons as fuels; Calorific value-definition, Gross and Net calorific values (SI units). Determination of calorific value of a solid / liquid fuel using Bomb calorimeter. Numerical problems on GCV&NCV. Petroleum cracking-fluidized catalytic cracking. Reformation of petrol. octane number, cetane number, anti-knocking agents, power alcohol, Biodiesel & Biogas-Dry gas harvesting and its efficiency.

  Note: Video lecture on
  (i) Fractional distillation of crude petroleum
  (ii) Biogas
  (iii) Biodiesel

Solar Energy:

- Thermal energy: Photovoltaic cells- Introduction, definition, importance, working of PV cell. Solar grade silicon physical and chemical properties relevant to photo-voltaics, doping of silicon by diffusion technique.

Module 2
Energy Science and Technology

- Single electrode potential - Definition, origin, sign conventions. Standard electrode potential- Definition-Nernst equation expression and its Applications. EMF of a cell-Definition, notation and conventions. Reference electrodes– Calomel electrode, Ag/AgCl electrode. Measurement of standard electrode potential. Numerical problems on electrode potentials and EMF. Ion-selective electrode- glass electrode-Derivation electrode potential of glass electrode
- Battery technology: Basic concepts including characteristics of anode, cathode, electrolyte and separator. Battery characteristics. Classification of batteries–primary, secondary and reserve batteries. State of the art Batteries-Construction working and applications of Zn-air, Lead acid battery, Nickel-Metal hydride and Lithium ion batteries.
  Introduction to fuel cells, types of fuel cells. Construction, working and application of Methanol-Oxygen fuel cell.

Module 3
Corrosion Science:

- Definition, Chemical corrosion and Electro-chemical theory of corrosion, Types of corrosion, Differential metal corrosion, Differential aeration corrosion (pitting and water line corrosion), Stress corrosion. Factors affecting the rate of corrosion, Corrosion control: Inorganic coatings-Anodization. Metal coatings-Galvanization, Tinning and its disadvantages. Cathodic protection of Corrosion: Sacrificial anode method and current impression method.

Surface Modification Techniques:

- Definition, Technological importance of metal finishing. Significance of polarization, decomposition potential and over-voltage in electroplating processes. Electroplating of Chromium. Electroless Plating. Distinction between electroplating and Electroless plating, advantages of electroless plating. Electroless plating of copper.
  Note: Video lecture on surface modification using polymer

Module 4

- **High Polymers:** Introduction to polymers, Glass transition temperature, structure and property relationship. Synthesis, properties and applications of Teflon. PMMA. Elastomers - Deficiencies of natural rubber and advantages of synthetic rubber. Synthesis and application of silicone rubber, Conducting polymers-Definition, mechanism of conduction in polyacetylene. Structure and applications of conducting Polyaniline.
- **Nanotechnology:** Introduction, properties, synthesis by sol-gel. Fullerenes, Carbon nanotubes, dendrimers and nano-composites-metal oxide-polymer nano-composite

Note: Video lecture on metal oxide-polymer nano-composite.

- **Advances in engineering chemistry**: Synthesis of carbon and sulphur containing compounds.

Module: 5

- **Water Technology:** Impurities in water. Hardness of Water: Types of Hardness and determination of total hardness of water by using disodium salt of ethylenediaminetetraacetic acid method. Alkanity. Potable water treatment by Electro dialysis and Reverse Osmosis. Water analysis- Biochemical oxygen demand and Chemical oxygen demand. Determination of COD. Numerical problems on COD. Sewage treatment, problems on quantity of flocculent required in sewage treatment. Principle and applications of green chemistry
- **Instrumental Methods of Analysis:**
  Instrumental methods of analysis, Principles of spectroscopy-Beer's Lamberts law, Difference between spectrometer and spectrophotometer, Potentiometry, Conductometry (Strong acid against strong base, weak acid against strong base, mixture of strong acid and a weak acid against strong base) and viscometer.

Text Books

1. Dr. S. Vairam, Engineering Chemistry, Wiley-India Publishers, 2017,

2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015

Reference Books

1. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.

2. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

ENGINEERING CHEMISTRY- LABORATORY

Volumetric Analysis and Preparations

1. Evaluation of quality of water in terms of total hardness by Complexometic titration.
2. Determination of Chemical Oxygen Demand (COD) of the given industrial waste water sample.
3. Determination of Alkalinity of the given water sample
4. Preparation of MgO nanoparticles by solution combustion method (Demonstration experiment) and spectrometric analysis.
5. Electroless plating of copper (Demo experiment)
6. Preparation of Polyaniline (Demo experiment)

Instrumental methods of Analysis

1. Potentiometric titration–Estimation of FAS using standard $K_2Cr_2O_7$ solution.
2. Conductometric estimation of hydrochloric acid using standard sodium hydroxide solution
3. Determination of viscosity coefficient, surface tension, density of a given liquid
4. Colorimetric estimation of copper in a given solution
5. Determination of Pka of given weak acid.
6. Determination of calorific value of coal/oil using Bomb calorimeter (Group experiment)

Reference books:

1. Dayanada Sagar University laboratory manual.
2. J. Bassett, R.C. Denny, G.H. Jeffery, Vogels, Text book of quantitative inorganic analysis, 4th Edition.

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1103
TITLE OF THE COURSE : FUNDAMENTALS OF PROGRAMMING
L: T/A: P: C : 3: 0: 4: 5

Course objective: To develop student competence in writing clear, correct, and maintainable programs that implement known algorithms.

Course outcomes: After completing this course, students will be able to:

- **Express** algorithms learned implicitly in school explicitly in algorithmic form and **calculate** the number of basic operations (exact or upper bound)
- **Trace** the execution of short programs/code fragments involving fundamental programming constructs
- **Explain** what a short program/code fragment involving fundamental programming constructs does
- **Determine** whether code meets consistent documentation and programming style standards, and **make changes** to improve the readability and maintainability of software using a modern IDE
- **Write** a short program/code fragment for a given task using fundamental programming constructs
- **Rewrite** a short program/code fragment with fundamental programming constructs using more appropriate programming constructs
- **Debug** a short program/code fragment with fundamental programming constructs manually, and debug more complex code using a modern IDE and associated tools
- **Add/modify** functionality and decompose monolithic code into smaller pieces
- **Design** a large program, conduct a personal code review, and contribute to a small-team code review focused on common coding errors and maintainability using a provided checklist
- **Use** appropriate tools to build source code for testing and deployment
- **Identify** potential computing ethics issues in a given programming task and **suggest** ways to address these issues

Course Content:

Module 1. The primary focus is on code comprehension. Simple expressions, operator precedence, integer issues (overflow, integer division), floating point issues, implicit and explicit typecasting, conditionals, Boolean expressions, lazy evaluation. 14 Hours

Module 2. The primary focus will be on debugging (gdb) and code rewriting. Simple recursion (factorial and GCD), functions with variables, functions with loops (e.g., Taylor series), switch statements, command line arguments. 14 Hours

Module 3. The primary focus is on writing code for given specifications. Functions with const array arguments (e.g., linear search, binary search), arrays and pointers, library functions (especially strings), functions with side-effects (non-const arrays, pointers), structs as arguments and return value, global variables. 14 Hours

Module 4. The primary focus is on managing heap memory (malloc, free, realloc), memory leaks (valgrind). 14 Hours

Module 5. Header files and multiple implementations (e.g., using dictionary ADT and array-based implementations), file I/O. 14 Hours

Note: The hours include 4 Hours of Lab per week.

Textbook:

Brian W. Kernigham and Dennis M. Ritchie, (2012) "The C Programming Language", 2ndEdition, PHI.

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1108
TITLE OF THE COURSE : BASIC ELECTRONICS
L: T/A: P: C : 3: 0: 2: 4

COURSE OBJECTIVE:

1. Imparting knowledge of fundamentals of semiconductor devices
2. Understanding electronic circuits

COURSE OUTCOME:

1. Analyze and design the basic electronic circuits containing semiconductor devices
2. Identify the need of Integrated Circuits and use them in realizing circuit applications.
3. Analyze and implement basic Digital Electronic circuitsfor a given application.
4. Identify the applications and significance of electronics in interdisciplinary engineering domains.

Module 1: Semiconductors
Semiconductor diodes, Diode types, Bipolar junction transistors BJT, FET characteristics, Packages and coding, Integrated circuits
Power supplies: Rectifiers, Reservoir and smoothing circuits, improved ripple filters Full-wave rectifiers, Voltage regulators, Practical power supply circuits, Related Problems.
Module 2: Amplifiers
Types of amplifier, Gain, Class of operation, Input and output resistance, Frequency response, Bandwidth, Phase shift, Negative feedback, Transistor amplifiers Bias, Predicting amplifier performance, Practical amplifier circuits
Oscillators: Positive feedback, conditions for oscillation, types of oscillators, practical oscillator circuits. , Related Problems.

Module 3: Operational Amplifiers
Symbols and connections, Operational amplifier parameters, Operational amplifier characteristics, Operational amplifier applications, Related Problems Circuit simulation: Introduction, types of analysis, net lists and component models.

Module 4: Logic Circuits
Logic functions, Switch and lamp logic, logic gates, combinational logic, bistables/flipflops, Integrated circuit logic devices, Logic simulation using SPICE **Microprocessors:** Microprocessor a n d microcontrollers, Microprocessor systems, architecture, operation, microcontroller systems, Related Problems.

Module 5: Radio
The radio frequency spectrum, Electromagnetic waves, a simple CW transmitter and receiver, Modulation, Demodulation, Types of transmitters and receivers, aerials, Related Problems.

Text book(s)

1. Electronic Circuits: Fundamentals and Applications by Michael Tooley BA Elsevier Ltd., Third Edition, 2006.
2. Electronic Devices and Circuits, Allan Mottershed, PHI.

Reference book(s)

1. Robert. L. Boylestad and L.Nashelsky, Electronic Devices and circuit Theory, Pearson Education,9th edition, 2005.
2. David A Bell, Electronic Devices and Circuits, PHI, 5th edition 2007.
3. Millman & Halkias, Electronics Devices and Circuits, McGraw Hill.

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1112
TITLE OF THE COURSE : DESIGN THINKING & INNOVATION
L: T/A: P: C : 1: 0: 0: 1

Course Summary

The course 'Design Thinking and Innovation' gives an overview of design thinking to helps students in understanding design thinking as a problem-solving approach. Ideas are developed through these processes and then applied to a basic approach to understand their value in the market place.

This course integrates the laboratory component into the theory enabling students to understand different phases of Design thinking by creating models using various workbenches from Autodesk Fusion 360 platform.

This course also aims at developing skillsets by using different design approaches to create components that can provide solutions to various engineering problems. It also enables students to use the tool proficiently to create their engineering models independently.

Course Objectives

Theory Component:

The objectives of the Course are to:

- Introduce students to a discipline of design thinking that enhances innovation activities in terms of value creation, speed, and sustainability
- Understand the importance and phases of design thinking and innovation
- Discuss key concepts and principles related to design process
- Examine approaches to innovation practiced by various organizations
- Explain the fundamental principles that guide design thinking
- Explain design thinking practices, their applications and importance.
- Enable students to use basic presentation techniques.
- Come up with new ideas and potential innovations.
- Understand the significance of Team Work and roles of individuals within a team.

Lab Component:

- To impart knowledge and skills to use various workbenches in Autodesk Fusion 360.
- To provide hands-on training on different commands to create part models in Autodesk Fusion 360.

Course Outcomes (CO):

After undergoing this course students will be able to:

- **Apply** the design thinking principles and recognize the significance of innovation

- **Explain** the importance of approaching innovation projects with concept development
- **Discuss** both individual and contextual factors that are linked to creativity
- **Discuss** the need for and significance of adopting a design thinking mind set
- **Develop** creative ideas through design criteria & brainstorming sessions
- **Design** various part models related to engineering field using Autodesk Fusion 360

Module 1: Introduction to Design Thinking & Innovation
Design Thinking Phases, Scoping, and Importance of storytelling. Design brief and visualization, Creativity and Idea Generation.

Module 2: Scope of Design Process
Introduction, Steps of Design Process, Design Components, Product and Process design, Ethnography and Identifying Insights, Requirements of a good product, Customer Satisfaction and Profitability

Module 3: Morphology of Design Process
Establishing design criteria, Design Morphology, Creative Design & Engineering Design, Product life cycle, Concept Development, Testing and Prototyping, Brainstorming & decision making.

Module 4: Analysis of Design Problem
Design inputs and outputs, Constraints in Design, Tools for Preliminary Design- Prescriptive and Descriptive Design, Market & Technology driven process.

Module 5: Communication & Presentation
Types of design communications, Qualities of a Good Poster & Presenter, Barriers & Difficulties in Communication, Effective Communication, Presentation Skills, Professional Ethics in Engineering.

Text Book(s)

1. C. L. Dym and Patrick Little, Engineering Design- A Project Based Introduction, John Wiley, 1995.
2. N. Cross, Engineering Design Methods: Strategies for Product Design, John Wiley, 1995.

References(s)

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation (Harper Business, 2009)
2. Bruce Hannington and Bella Martin, Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions (Rockport Publishers, 2012)

3. Ian C. Wright, Design Methods in Engineering & Product Design, McGraw-Hill, 1998.
4. M. A. Parameswaran, an Introduction to Design Engineering, Narosa, 2004.

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1106
TITLE OF THE COURSE : ELEMENTS OF MECHANICAL ENGINEERING
L: T/A: P: C : 2: 0:2: 3

Course Summary

The course 'Elements of Mechanical Engineering' aims at introducing principles of energy resources, thermodynamics, prime movers, pumps, materials science & composites, mechanical design, power transmission, manufacturing techniques (metal cutting, joining & foundry), mechatronics, 3D printing, robotics, electric mobility and applications.

This course integrates the laboratory component into the theory enabling students to understand the working and application of various mechanical systems. Students belonging to all branches of engineering are introduced to fundamental topics related to mechanical engineering.

This course also aims at developing skills by using workshop tools, equipment's and materials to create various physical models. The course deals with basic manufacturing processes like fitting, sheet metal work, welding, soldering, machining, carpentry, casting and smithy useful for industries.

Course Objectives:

Theory Component:

The objectives of the Course are to:

- Explain the basic concepts of renewable & non-renewable energy resources
- State first and second laws of thermodynamics
- Describe Carnot, Otto, diesel, Brayton, Rankine & refrigeration cycles
- Discuss 4 stroke petrol & diesel engines, turbines and pumps
- Study materials types, properties and stress- strain diagram
- Explain simple stresses, strains, elastic constants and power trains
- Discuss the operations of lathe, drilling, shaper, milling, and grinding machines
- Describe Joining Processes and foundry
- Explain mechatronics, PLC, instrumentation & control systems
- Explain robot anatomy, configurations, sensors and applications
- Discuss rapid prototyping, 3D printing and electric mobility

Lab Component:

- To impart knowledge and skills to use tools, machines, equipment, and measuring instruments
- To cultivate safety aspects in handling of tools and equipments
- To provide hands-on training on fitting, sheet metal, carpentry, casting , smithy, machining operations
- To provide hands-on training on soldering and welding processes

Course Outcomes (CO):

- Explain various energy resources, laws of thermodynamics, gas and vapour cycles, prime movers and pumps
- Discuss fundamentals of materials and mechanical design aspects
- Describe basics of machine tools, joining processes and foundry
- Explain advanced topics in mechanical engineering
- Construct different types of fitting, welding, sheet metal, turning models
- Demonstrate working of engines, turbines, pumps, 3D printing; wood working, foundry & smithy operations

Course content

Module 1: Energy Conversion

Renewable & Nonrenewable energy resources – Introduction to Steam, Hydro & Nuclear power plants, solar, wind and biomass energy based power plants, Effect of power generation on environment

Thermodynamics- First and second laws of thermodynamics, Efficiency, COP, Carnot theorem, Numericals

Module 2: Prime Movers & Pumps
Gas and Vapour cycles -Carnot, Otto, Diesel, Brayton, Rankine & Refrigeration cycles **Prime movers**- 4 stroke- petrol and Diesel engines, Gas turbines-open and closed Cycle,steam turbines-Impulse and reaction, Numericals.
Introduction to pumps-working of centrifugal and reciprocating

Module 3: Materials & Mechanical Design
Materials- Introduction to ferrous, non-ferrous & composites, Stress-strain diagrams, Mechanical Properties for materials.
Mechanical Design-Introduction, Simple Stresses and strains, Elastic constants.
Power Transmission- Gear & Belt Drives, Numerical problems.

Module 4: Manufacturing Processes
Metal cutting: Introduction, classification of machine tools, basic operations on lathe, drilling, shaper, milling, grinding, introduction to CNC machining.
Joining Processes- Welding- classification, gas, arc, laser & friction welding, brazing and soldering
Foundry- Basic terminology, Types of patterns, sand moulding.

Module 5: Advanced Technologies in Mechanical Engineering
Mechatronics - Introduction, Mechatronics, PLC, Instrumentation & control systems
Robotics- Introduction, Robot anatomy, configurations, Sensors, applications.
Rapid prototyping & 3D Printing- Introduction & applications, powder-based additive manufacturing processes.
Electric Mobility -Introduction, electric, hybrid and autonomous vehicles

Lab Component

1. Fitting Shop- Simple exercises involving fitting work-Dove tail.
2. Welding Shop- Simple butt and Lap welded joints using arc welding
3. Sheet-metal Shop- Fabrication of tray, Making Funnel complete with soldering
4. Lathe machining on plain and step turning

Demonstration of

1. Pelton wheel, and Francis turbine
2. 4 stroke petrol and diesel engines
3. Lathe, milling, drilling, grinding & CNC milling machines and wood turning lathe
4. Foundry and smithy operations
5. 3D printing

Text book(s)

1. Nag P K, Basics and applied thermodynamics, Second edition, Tata McGraw Hill, New Delhi -2017.
2. P.N. Rao-Manufacturing Technology-Foundry, Forming and Welding, Volume 1, 4 Edition, Tata McGraw Hill Publishing Co Ltd, 2018.
3. P.N. Rao-Manufacturing Technology- Metal Cutting and Machine Tools, Volume 2, 4 Edition, Tata McGraw Hill Publishing Co Ltd, 2018.

Reference(s)

1. El-Wakil M M, Power plant technology, Tata McGraw Hill edition, New Delhi -2017. Larminie J,Lowry J, Electric vehicle technology explained, John Wiley and &sons Ltd. USA
2. William D. Callister and David G. Rethwisch-Fundamentals of Materials Science and Engineering: An Integrated Approach, John Wiley & Sons; 4th Edition edition, 2011

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1107
TITLE OF THE COURSE : ENGINEERING PHYSICS
L: T/A: P: C : 3: 0:2: 4

Course learning objectives:
This course will enable students to learn the basic concepts in Physics which are very muchessential in understanding and solving problems in engineering.

Course Aim and Summary:

The course '**Engineering Physics'** aims at introducing principles of physics to understand the working and behaviour of engineering systems. To begin with, the course emphasises upon the basics of Classical mechanics, principles of Quantum mechanics, and subsequently deals with engineering materials such as Electrical-Electronics and Mechanical properties of materials. Semiconductor Physics, devices like, LED, photodiode, Solar cell and BJT. The course also covers topics like Laser Physics and Crystallography. Finally the course concludes with Thin-Film deposition techniques and Nano science & technology. During the course virtual lab and physical tools/models will be used to demonstrate the behaviour of different engineering systems.

Course Objectives

The Objectives of the Course are:

- To introduce the basic concepts of Quantum mechanics which are essential in understanding and solving problems in engineering.
- To review different types of Engineering materials –Electronic, electrical, mechanical and Magnetic materials Properties and their applications in Science and Engineering.
- To understand Band structure of solids, Semiconductors and electrical conductivity of SC's, and their applications.
- To explain semiconductor devices like LED, Photodiode and Solar cell and Semiconductor BJT.
- To learn how to find Lattice parameters of different crystalline solids by using X-ray diffraction methods
- To explain Principle and working of LASERS, Different types of Lasers. and Applications of Lasers in defence, engineering and medicine.
- To introduce Polar and non-polar dielectrics, dielectric constant, electronic, ionic and orientation polarization mechanisms.

- Lorentz field in cubic materials, Clausius-Mossotti equation, Ferro, Piezo and Pyro electric materials and their applications in engineering.
- To explain Thin-film Phenomena, Thin-film fabrication Process and their applications in engineering.
- To learn how to fabricate Nano materials by using Top-down and Bottom –up approach

To review Nano science and technology and its practical applications in science and engineering.

Course Outcomes (CO's):

On completion of the Course the Students are able to

- Describe the concepts of Quantum mechanics, basics of Quantum computing and select for solving problems in engineering.
- Discuss the different engineering materials such as Electronic, electrical and mechanical materials properties and their applications in engineering
- Illustrate Semiconductors , Semiconductor devices like Photo diode, LED, Solar cell and BJT and its applications
- Classify Lattice parameters of different crystalline solids by using X-ray diffraction methods and Summarize theoretical background of laser, construction and working of different types of lasers and its applications in science and engineering
- Interpret Basic concepts of Thin films and Thin film deposition processes and their applications leads to Sensors and engineering devices
- Discuss Nano materials ,Properties and fabrication of Nano materials by using Top-down and Bottom –up approach's-Applications for Science and technology

Module 1: Introduction to Basics of Classical mechanics

Quantum Mechanics 1: Foundations of quantum theory, Wave function and its properties, One dimensional time independent Schrodinger wave equation, Eigenvalues and Eigen functions, Uncertainty principle, Applications: one dimensional motion of an electronin a potential-well.

Quantum Mechanics 2: Matrix formulation: Linear & matrix algebra, Dirac's bra & ket notation, matrix representation of vectors & operators, Expectation values, Basics of quantum computing - Concepts of Superposition, entanglement, Interference and Qubit

Module 2:

Introduction to Engineering materials: Introduction to Principles of Electromagnetic theory (Maxwell's Equations).Classification of Engineering Materials such as Conductors, Semiconductors, Insulators and Magnetic materials ; Electrical conductivity of metals and Semiconductors. Effect of temperature, composition on resistivity/conductivity

of materials.

Mechanical Engineering materials – mechanical properties: stress- strain curve for different materials. Introduction to Tensile strength, Compressive strength, Ductility, Malleability, Toughness, Brittleness, Impact strength, Fatigue, Creep. Testing of engineering materials: Hardness Tests: Brinell, Rockwell and Vickers hardness test-Numericals **Dielectrics:** polar and non-polar dielectrics, internal fields in a solid, Different Polarization techniques. Clausius-Mossotti equation, applications of dielectrics. Ferro, Piezo and Pyro electric materials and their applications.

Module 3:

Semiconductor Physics: Band structure, Fermi level in intrinsic and extrinsic semiconductors, Density of energy states in conduction and valence bands of a semiconductor (Mention the expression), Expression for concentration of electrons in conduction band (Derivation), Hole concentration in valance band (Mention the expression), Intrinsic carrier concentration Conductivity of semiconductors, Measurement of Electrical resistivity using 4 probe method.

Semiconducting devices of interest for optoelectronics applications: Principle and working of LED, photodiode, and solar cell. BJT, FET-JFET and MOSFET

Module 4:

LASER PHYSICS: Einstein's coefficients (expression for energy density). Requisites of a Laser system. Conditions for laser action. Principle, Construction and working of Nd-YAG, Semiconductor Laser and CO2 Lasers. Application of Lasers in Defense (Laser range finder), Engineering (Data storage) and Applications of Lasers in medicine [6 hours]

Crystallography: Lattice, unit cell, lattice parameters, crystal systems, Bravais lattices, Introduction to Miller Indices. Determination of Crystal structure by Miller Indices. X-ray diffraction, Bragg's law and Powder method.

Module 5:

Thin films technology: Introduction to thin-films-Advantages of thin-films over bulk materials. Thin film deposition processes- Physical vapour deposition (Thermal evaporation technique, and sputtering technique) process, Applications of Thin film.

Nano Science & technology: Introduction to Nano materials, Classification of nano materials, Scaling laws in miniaturization electrical systems, Size dependent properties of materials, Top-down and Bottom-up approach- Ball milling, self-assembly process. Fundamental Principles of Bio-Physics and Applications of Nano technology in Biology and Engineering.

Introduction to Micro machining techniques: Silicon micromachining techniques-Etching (isotropic and anisotropic etching)-Numiricals

Lab component

1. I-V characteristics of a Zener Diode

I–V Characteristics of a Zener diode in forward and reverse bias condition

2. Four probe technique

Measurement of resistivity of a semiconductor using Four probe technique

3. Newton's Rings

Measurement of radius of curvature of a plano-convex lens using Newton's Rings

4. Dielectric constant

Determination of dielectric constant of a dielectric material

5. Torsional Pendulum

Determination of moment of inertia of a circular disc using torsional pendulum

6. Band gap energy

Determination of energy gap of an intrinsic semiconductor

7. Diffraction grating

Determination of wavelength of a laser light using diffraction grating

8. Planck's constant

Measurement of Planck's constant using LED

9. LCR series and parallel resonance

Study the frequency response of a series and parallel LCR circuit

10. Transistor characteristics

Input and output characteristics of a NPN transistor in C-E configuration

Text Book(s)

1. M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy (2018), A textbook of Engineering Physics, S Chand, New Delhi.
2. Materials Science and Engineering by V S Raghavan
3. Engineering Physics (2019), DSU Pearson, New Delhi
4. Engineering Physics (2017), DSU WILEY Publications
5. Engineering Physics Laboratory manual, DSU

Reference Book(s)

1. M. Young (1977), Optics & Lasers an Engineering Physics approach, Springer, Verlag
2. S. O. Pillai (2018), Solid State Physics, revised edition, New Age International Publishers, New Delhi.
3. Thin-Films Phenomena-K L Chopra, McGraw -Hill Publishing
4. K. Thyagarajan, A.K. Ghatak (1981), Lasers: Theory & Applications, Plenum Press, New York.

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1104
TITLE OF THE COURSE : BASIC ELECTRICAL ENGINEERING
L: T/A: P: C : 3: 0:0: 3

COURSE OBJECTIVE:

1. Imparting Knowledge of basic circuits.
2. Understanding analysis of circuits.
3. Basics of electric and magnetic fields.
4. Working principles of machines, measuring equipments.

COURSE OUTCOME:

1. Able to get the basic knowledge about the Electric and Magnetic circuits.
2. Able to understand the AC fundamentals.
3. Able to understand the working of various Electrical Machines.
4. Able to get the knowledge about various measuring instruments and house wiring.

Course content

Module 1: INTRODUCTION TO ELECTRICAL ENGINEERING

Introduction to Electrical Engineering: General structure of electrical power systems, Electric current, ohm's law, Resistance, Inductance and capacitance parameter, Kirchoff's laws, node voltage and mesh current methods, Series and parallel combinations, current division, voltage division rule, Electrical power and energy. Related Numerical problems.
Domestic Wiring: Earthing-significance and types, two way & three way control of lamps, basic protective devices like MCB's and Fuses.

Module 2: Magnetic Circuits

Faradays laws of electromagnetic induction, Lenz's law, Magnetic circuit- concept and analogies, Force on a current carrying conductor placed in a magnetic field, Dynamically induced emf, Fleming's rules and its applications. Self and mutual inductance. Related Numerical Problems.

Module 3: Alternating Quantities

Average and effective values of periodic functions, solution of R,L,C series circuits, the j operator, complex representation of impedances, phasor diagram, instantaneous and average power, power factor, power in complex notation, response of series, parallel and series – parallel circuits. Related numerical problems.
Necessity and advantages of Three phase supply, delta and Y – connections, line and phase quantities, solution of balanced three phase circuits, phasor diagram, Three phase three wire and four wire circuits.

Module 4: DC Machines
Construction, Working principle and analysis of DC motor and generator, EMF and Torque equations, Connections and working of DC generators and motors- series and shunt, back emf. Related numerical problems.

Module 5: Transformers
Principle of operation, Construction, Equivalent circuit, EMF equation, ratings, losses, Efficiency and voltage regulation, related simple problems.
Induction motors: brief idea about construction, concept of rotating magnetic field. Slip and its significance, Ratings and applications, Problems on slip calculation

Text Book(s)

1. M. Maria Louis, Elements of Electrical Engineering, fifth edition, PHI Publications, 2014.
2. D.P.Kothari and I.J. Nagrath, Basic Electrical Engineering, TataMcGraw Hill.

Reference book(s)

1. S.S. Parker Smith and NN Parker Smith, Problems in Electrical Engineering.
2. Rajendra Prasad, "Fundamentals of Electrical, PHI Publications, 3RDEdition.

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1109
TITLE OF THE COURSE : BIOLOGICAL SCIENCES
L: T/A: P: C : 2: 0:0:2

Biology in the 21st century: The new world in the post genome era. Past, present and future of our society, industry and life style: Impact of discoveries and technological innovations in biology. Challenges and excitement of research in biology and bioengineering. Bioengineering as an emerging science at the intersection of biology, engineering, physics and chemistry.

Carrier opportunities in biotechnology, biomedical engineering, pharmaceutical industry, agro-biotechnology and in the diverse areas of basic science and medical research. Emerging trends of collaboration between industry and academia for development of entrepreneurship in biotechnology.

Quantitative views of modern biology. Importance of illustrations and building quantitative/ qualitative models. Role of estimates. Cell size and shape. Temporal scales. Relative time in Biology. Key model systems - a glimpse.

Management and transformation of energy in cells. Mathematical view - binding, gene expression and osmotic pressure as examples. Metabolism. Cell communication.

Genetics. Eukaryotic genomes. Genetic basis of development. Evolution and diversity.
Systems biology and illustrative examples of applications of Engineering in Biology

Text Book(s)

1. R. Phillips, J. Kondev and J. Theriot, Physical biology of the cell, Garland Science Publisher, 2008, Ist Edition.
2. J.B. Reece, L.A. Urry, M.L. Cain, S.A. Wasserman, P.V. Minorsky and R.B. Jackson. Campbell Biology, Benjamin Cummings Publishers, 2010, 9th Edition.

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1110
TITLE OF THE COURSE : TECHNICAL COMMUNICATION
L: T/A: P: C : 2: 0:2:3

Course Aim and Summary

The course 'Technical Communication Skills' aims at enhancing Communication skills of the students in dimensions of - Listening, Speaking, Reading, Writing, Grammar and Vocabulary. The course introduces Communication and types of Communication and deals in detail the listening, referencing, report writing and group discussions. The course covers team, team building skills and effective leadership skills. The course also deals with resume writing, covering letter, job application and e-mail etiquettes. The practical course is designed to acquire correct pronunciation and to enable students to get rid of stage fear and become a good orator.

Course Objectives

The objectives of the Course are:

- To improve students lexical, grammatical competence
- To enhance their communicative skills
- To equip students with oral and appropriate written communication skills
- To inculcate students with employability and job search skills
- To achieve proficiency in English
- To Develop professional communication skills
- To create interest among the students about a topic by exploring thoughts and ideas
- To enable students with good use of tenses
- To learn the use of body language and improve verbal message
- To equip with Types of Teams and Leadership styles -to develop managing skills in corporate world.
- To Acquire skills for placement

Course Outcomes

After undergoing this course students will be able to:

- Explain communication and types of Communication: Managerial, Corporate, Technical & Organizational Communication.
- Distinguish Listening and hearing. Demonstrate various aspects of speaking. Discuss Word formation and types.
- Write a report, essay. Minutes of Meeting. Evaluate current issues and debate
- Use Leadership skills and Team building. Solve Tense exercise.
- Write a job application and CV.

- Discuss E-Mail etiquettes.
- Discuss topic and speak on the spot. Interpret data

Course content

1. Communication; Types of Communication: Managerial, Corporate, Technical & Organizational Communication.
Listening: Types & its Importance. Difference between hearing & listening.
Speaking: Different aspects of Effective Speaking
Word Formation and Types of Word Formation**,** Word Family.

2. Referencing Skills: Academic Writing: Definition & Tips for writing
Report Writing: Importance. Steps for Report Writing.
Group Discussion: Definition, How GD helps in Student Life & Corporate Life.
Minutes of Meeting: Importance; Steps for writing MOM in Organizations.

3. TEAM & TEAM BUILDING: Definition, Importance, Types of Team; Team Building & Team Dynamics.
Leadership: Styles of Leadership; Characteristics of a good leader, Influence of different forces on leadership.

4. JOB Application, Covering Letter; Resume/CV Writing; Difference between Job Application & Resume.

5. E-mail Etiquettes: Definition, Rules for e-mail etiquettes, Business E-mail etiquettes, Tips for perfecting e-mail etiquettes.

6. ICE Breaking activity and JAM sessions

7. Situational Dialogues/ Role Play (Greetings, enquiring, complaining**)**

8. Tenses and Subject Verb Concord

9. Extempore, Public Speaking, Debates.

10. Data Interpretation.

Reference(s)

1. Chauhan, Gajendra S., L. Thimmesha and Smita, Kashiramka (2019) Technical Communication, Cengage Learning, New Delhi

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1111
TITLE OF THE COURSE : ENGINEERING GRAPHICS & DESIGN
L: T/A: P: C : 1: 0:4:3

Course Aim & Summary:

The course aims at introducing engineering graphics as a language of engineers for universal communication. This course covers orthographic projections of points, lines, planes and solids. It also deals with development of surfaces and isometric projections of planes and solids. Students solve problems using manual sketching and professional CAD software for modelling and assembly of simple engineering components from various engineering domains. They work in teams to develop conceptual designs for an identified need.

Course Objectives

The objectives of the Course are:

- To create awareness and emphasize the need for Engineering Graphics
- To follow basic drawing standards and conventions
- To Introduce free hand sketching as a tool for technical Communication
- To understand the principles of geometrical curves and construct manually
- To learn using professional CAD software for construction of geometry
- To understand the concepts of orthographic and isometric projections
- To construct orthographic projection of points, lines, planes and solids
- To develop the lateral surfaces of solids
- To construct isometric projections of planes and solids
- To create simple engineering 3D components and assembly
- To work in a team for creating conceptual design of products

Course Outcomes

After undergoing this course students will be able to:

- Explain usage of instruments, dimensioning & tolerances, conventions and standards related to working drawings
- Construct points, lines, planes and solids using orthographic projections principles
- Construct geometries of planes and solids using isometric projection principles
- Prepare the lateral surfaces of the given solid by applying the basic concepts
- Construct lateral surfaces of solids using geometry development principles

- Create associative models at the component and assembly levels for product design

Course content

Module 1:
Introduction: Fundamentals, Drawing standard - BIS, dimensioning, Lines, lettering, scaling of figures, symbols and drawing instruments, Introduction to orthographic & perspective projection. Types of projections, Principles of Orthographic projection
Plain & Miscellaneous Curves: Construction of ellipse, parabola, hyperbola, Construction of Tangent and Normal at any point on these curves. Construction of Cycloid, Epicycloid and Hypocycloid, Involute of a circle. Construction of Tangent and Normal at any point on these curves.

Module 2:
Projection of Points and Lines: Projections of points located in same quadrant and different quadrants. Projection of straight lines inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method.
Projection of planes: Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by change of position method.

Module 3:
Projection of Solids: Projection of solids such as prisms, pyramids, cone, cylinder, tetrahedron, Projections of solids with axis perpendicular and parallel to HP and VP, solids with axis inclined to one or both the planes, suspension of solids.

Module 4:
Sections of Solids: Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other, obtaining true shape of section.
Development of Surfaces: Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

Module 5:
Isometric Projection: Principles of isometric projection, isometric scale, Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones, combination of two solid objects in simple vertical positions, Conversion of orthographic views into isometric projection and vice versa

Module 6:
Computer Aided Design: Introduction to computer aided drafting and tools to make drawings. Layout of the software, standard tool bar/menus and description, drawing area, dialog boxes and windows, Shortcut menus, setting up and use of Layers, layers to create drawings, customized layers, create, zoom, edit, erase and use changing line lengths through modifying existing lines (extend/lengthen) and other commands
Demonstration of a simple team design project: Product Design- Introduction, stages, Design Geometry and topology of engineered components creation of engineering models and their presentation in standard 3D view. Use of solid-modeling software for creating

associative models at the component and assembly levels; include: simple mechanical components-bolts, nuts, couplings; simple civil

Text Book(s)

1. Gopalakrishna, K. R. (2005) Engineering Graphics, 32nd edition, Subash Publishers Bangalore, India
2. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House, Gujarat, India
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education, New Delhi.
4. DSU Text book, Wiley-India Publications, Bangalore

Reference(s)

1. Luzzader, Warren. J and Duff John M., (2005) ,Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi.
2. Basant Agarwal and Agarwal C.M., (2008), Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi.

SEMESTER/YEAR : I/II SEM
COURSE CODE : 20EN1105
TITLE OF THE COURSE : ENVIRONMENTAL STUDIES
L: T/A: P: C : 2: 0:0:2

Course Aim

This course aims at creating awareness regarding preservation of environment for providing safe and healthy atmosphere. This course deals with concepts of ecosystem, renewable and non-renewable energy resources, environmental pollution, laws and regulations governing the environment.

Course Objectives

The objectives of the Course are:

- To explain the importance of this course
- To expose engineering students to the basic concepts and principles of environment;
- To have knowledge of the current issues of pollution endangering life on earth
- To educate about the environmental resources, energy, pollution, management, impact assessment and law

Course Outcomes

After undergoing this course students will be able to:

• Delineate basic concepts that govern environmental quality, atmospheric principles and environmental standards;
• Recognize and conversant with sources and nature of pollution types, control and management
• Explain Energy resource types and their environmental implications
• Apply the process of environmental impact assessment and implications of Indian Environment Laws

Course content

Module 1: Basic Concepts of Environment

Scope and importance of environmental studies, Definition of environment- comprehensive understanding of environment, Basic concepts: Xenobiotic, natural & anthropogenic; why are we concerned? Types of xenobiotics: Chemical, Physical, Biological pollutants; Hazard & Risk, Eco-kinetic & Bio-kinetic Properties of a xenobiotic, Dose-Response Relationships-chronic and acute effects, Environmental Standards: AAQS, TLV's, Appraisal, Assessment & Abatement (Recognition, Evaluation & Control) of pollutants- Structure of Atmosphere; Atmospheric inversions, Environmental System.

Air Pollution: Criteria pollutants – Ozone, Particulate Matter, Carbon Monoxide, Nitrogen, Oxides, Sulphur Dioxide, Lead; SMOG & Air-pollution episodes

Aerosols: Primary & Secondary pollutants, Acid Rain Cycle.

Module 2: Water Treatment

Hydrosphere, Lentic and Lotic Water Systems, Fresh Water as a resource; Rain Water Harvesting, Treatment of potable water, Waste water- Characteristics, Municipal Sewage Water and Treatment.

Waste Management

Types of Wastes: Municipal Solid Waste, Hazardous Waste, Nuclear Waste, Electronic Waste, Biomedical Waste, Solid Waste Management: Landfills, compostingnWater Standards

Module 3: Energy

Types of energy: Conventional sources of energy, fossil fuel, Coal, Nuclear based, Solar, wind, sea-Tidal Wave energy, Geo-Thermal, Non-conventional sources of Energy, Biofuels - biomass, biogas, Natural Gas; Hydrogen as an alternative future source of energy.

Module 4: Disasters & Management

Definition, origin and classification. Natural (Earthquakes, landslides, floods, Cyclones),Man-made disasters (biological, chemical, nuclear, radiological explosions) – definition,causes and management and/or mitigation strategies; Bhopal & Chernobyl Disasters, Environment & Health - Occupational Health Hazards, Occupational Diseases, Epidemics, Pandemics, Endemics (Fluoride, Arsenic), Principles and Significance of Sanitation

Module 5: Environmental Impact Assessment (EIA) and Indian acts and regulations

Principles of EIA, Indian Acts and Rules, Wildlife (Protection) Act 1972. Water Act – 1974 (Rules 1975), Forest Conservation Act 1980 (Rules 2003), Air Act -1981 (Rules 1982, 1983), Environment Protection Act, 1986

Text Book(s)

1. R.C. Gaur, "Basic Environmental Engineering (2008)", New age international (p) limited, publishers.
2. J. Glynn Henry and Gary. W. Heinke, "Environmental Science and Engineering (2004)", Pretice Hall of India.
3. P. Venugopala Rao, "A Text Book of Environmental Engineering (2012)", PHI Learning Pvt. Ltd.

Reference(s)

1. P.Aarne Vesilind, Susan M.Morgan, Thomson, "Introduction to Environmental Engineering" (2008), Thomson learning, Second Edition, Boston.
2. R Rajagopalan, "Environmental Studies – From Crisis to Cure" (2005) Oxford University Press, New Delhi.
3. R J Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies" (2014), Wiley India Pvt Limited, New Delhi.

SEMESTER/YEAR : I SEM / I YEAR
COURSE CODE : 20AU0004
TITLE OF THE COURSE : CONSTITUTION OF INDIA & PROFESSIONAL ETHICS
L : T : P : S/P : C : 2 : 0 : 0 : 0 : 0

Course objectives

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.

Course outcomes

At the end of the course student will be able

- Understand state and central policies, fundamental duties
- Understand Electoral Process, special provisions
- Understand powers and functions of Muncipalities, Panchayats and Cooperative Societies,
- Understand Engineering ethics and responsibilities of Engineers

Introduction to the Constitution of India, The Making of the Constitution and Sailent features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.
Directive Principles of State Policy & Relevance of Directive Principles State Policy fundamental Duties.
Union Executives – President, Prime Minister Parliament Supreme Court of India. State Executives – Governor Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th&91st Amendments.

Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions.

Powers and functions of Municipalities, Panchyats and Co – Operative Societies.

Text Books:

1. Brij Kishore Sharma,"Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.
2. Durga Das Basu: "Introduction to the Constitution on India", (Students Edn.) PrenticeHall, 19th / 20th Edn., 2001

Reference Books:

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.

SEMESTER/YEAR	**:**	**I YEAR**
COURSE CODE	**:**	**20AU0021**
TITLE OF THE COURSE	**:**	**KANNADA KALI – II**
L : T : P : S/P : C	**:**	**2 : 0 : 0 : 0 : 0**

Course Learning Objectives:

Learners are Non – Kannadigas, so this course will make them,

· To Read and understand the simple words in Kannada language
· To learn Vyavaharika Kannada (Kannada for Communication)
· will create a some interest on Kannada Language and Literature

Lesson 1 : Introducing each other – 1. Personal Pronouns, Possessive forms, Interrogative words.
Lesson 2 : Introducing each other – 2. Personal Pronouns, Possessive forms, Yes/No Type Interrogation
Lesson 3 : About Ramanaya. Possessive forms of nons, dubitive question, Relative nouns
Lesson 4 : Enquiring about a room for rent. Qualitative and quantitative adjectives.
Lesson 5 : Enquiring about the college. Predicative forms, locative case.
Lesson 6 : In a hotel Dative case defective verbs.
Lesson 7 : Vegetable market. Numeral, plurals.
Lesson 8 : Planning for a picnic. Imperative, Permissive, hortative.
Lesson 9 : Conversation between Doctor and the patient. Verb- iru, negation – illa, non – past tense.
Lesson 10: Doctors advise to Patient. Potential forms, no – past continuous.
Lesson 11: Discussing about a film. Past tense, negation.
Lesson 12: About Brindavan Garden. Past tense negation.
Lesson 13: About routine activities of a student. Verbal Participle, reflexive form, negation.
Lesson 14: Telephone conversation. Past and present perfect past continuous and their negation.
Lesson 15: About Halebid, Belur. Relative participle, negation.
Lesson 16: Discussing about examination and future plan. Simple conditional and negative
Lesson 17: Karnataka (Lesson for reading)
Lesson 18: Kannada Bhaashe (Lesson for reading) Lesson
19: Mana taruva Sangati alla (Lesson for reading)Lesson
20: bEku bEDagaLu (lesson for reading)

1. Kannada Kali (ಕನ್ನಡ ಕಲಿ) – ಲಿಂಗದೇವರು ಹಳೆಮನೆ. A Text Book to Learn Kannada by Non – Kannadigas who come to study Diploma, Engineering and Health Sciences in Karnataka. ಪ್ರಕಟಣೆ: ಪ್ರಸಾರಾಂಗ ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ. ಹಂಪಿ.
2. Spoken Kannada – ಮಾತಾಡುವ ಕನ್ನಡ. ಪ್ರಕಟಣೆ – ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್ ಬೆಂಗಳೂರು.
3. Kannada Kirana - ಕನ್ನಡ ಕಿರಣ. ಪ್ರಕಟಣೆ – ಬೆಂಗಳೂರು ಇನ್ಸ್‌ಟಿಟ್ಯೂಟ್ ಅಪ್ ಲಾಂಗ್ವೇಜಸ್. ಬೆಂಗಳೂರು .

SEMESTER/YEAR : I SEM / I YEAR
COURSE CODE : 20AU0025
TITLE OF THE COURSE : KANNADA MANASU – II
L : T : P : S/P : C : 2 : 0 : 0 : 0 : 0

COURSE OBJECTIVES:

1. To equip the native Kannada speaking students with advanced skills in Kannada communication and understanding
2. To enrich the students with creative writing

COURSE OUTCOMES:

1. Students will have better speaking and writing communication skills in Kannada

ಕನ್ನಡ ಭಾಷಾ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
- ಪದವಿ ವಿದ್ಯಾರ್ಥಿಳಾಗಿರುವುದರಿಂದ ಆಡಳಿತ ಕನ್ನಡದ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಒಲವು ಮತ್ತು ಆಸಕ್ತಿಯನ್ನು ಬೆಳೆಸುವುದು

1. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ
2. ವಿವಿಧ ರೀತಿಯ ಅರ್ಜಿ ಸಮೂಹಗಳು
3. ಪತ್ರ ವ್ಯವಹಾರ – ಸರ್ಕಾರಿ ಅರೆಸರ್ಕಾರಿ ಪತ್ರಗಳು – ಆಹ್ವಾನ ಪತ್ರಿಕೆ, ಜಾಹೀರಾತು, ಪತ್ರಿಕಾ ಪ್ರಕಟಣೆ ಇತ್ಯಾದಿ ಪತ್ರಗಳು
4. ಭಾಷೆ ಮತ್ತು ಬರಹ – ಡಾ. ಎಂ ಚಿದಾನಂದ ಮೂರ್ತಿ ರವರ ಭಾಷಾ ವಿಜ್ಞಾನದ ಮೂಲ ತತ್ವಗಳು ಪುಸ್ತಕದಿಂದ
5. ಭಾಷಾಭ್ಯಾಸ – ತತ್ಸಮ ತದ್ಭವ, ಸಮಾನಾರ್ಥಕ ಪದಗಳು, ವಿರುದ್ಧಾರ್ಥಕ ಪದಗಳು, ನಾನಾರ್ಥ ಪದಗಳು, ನುಡಿಗಟ್ಟುಗಳು, ಅನುಕರಣಾವ್ಯಯಗಳು (ದ್ವಿರುಕ್ತಿ) ಮತ್ತು ಜೋಡು ನುಡಿಗಳು, ಕನ್ನಡದ ದೇಶ್ಯ ಪದಗಳು, ಅನ್ಯದೇಶ್ಯ ಪದಗಳು.
6. ಭಾಷಾ ರಚನೆ – ವಾಕ್ಯ ಪದ್ಧತಿ ಮತ್ತು ಲೇಖನ ಚಿಹ್ನೆಗಳು, ಪತ್ರ ಲೇಖನ, ವರದಿ ಲೇಖನ, ಪ್ರಬಂಧ ಲೇಖನ.
7. ಶ್ರಾವಣ (ಕವನ) – ದ ರಾ ಬೇಂದ್ರೆ
8. ಡಾ. ವಿಶ್ವೇಶ್ವರಯ್ಯ – ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ (ವ್ಯಕ್ತಿ ಚಿತ್ರ) – ಎ ಎನ್ ಮೂರ್ತಿರಾವ್
9. ಮೋಡಿ ಹರಿಗೋಲುಗಳಲ್ಲಿ (ಪ್ರವಾಸ ಕಥನ) – ಶಿವರಾಮ ಕಾರಂತ
10. ಅಣ್ಣಪ್ಪನ ರೇಷ್ಮೆ ಕಾರ್ಯಾಲೆ (ಪ್ರಬಂಧ) – ಕುವೆಂಪು
11. ನಮ್ಮ ಎಮ್ಮೆಗೆ ಮಾತು ತಿಳಿಯುವುದೆ? (ವಿನೋದ) – ಗೊರೂರು ರಾಮಸ್ವಾಮಿ ಅಯ್ಯಂಗಾರ್
12. ಆನೆಹಳ್ಳದಲ್ಲಿ ಹುಡುಗಿಯರು (ವಿಜ್ಞಾನ ಲೇಖನ) – ಬಿ ಜಿ ಎಲ್ ಸ್ವಾಮಿ
13. ಬೆಡ್ ನಂಬರ್ ಏಳು (ಕತೆ) – ತ್ರಿವೇಣಿ
14. ರೊಟ್ಟಿ ಮತ್ತು ಕೋವಿ (ಕವನ) – ಸು ರಂ ಎಕ್ಕುಂಡಿ
15. ಗುಬ್ಬಚ್ಚಿಯ ಗೂಡು (ಅಂಕಣ ಬರಹ) – ಪಿ ಲಂಕೇಶ್

16. ಚೀಂಕ್ರ ಮೇಸ್ತ್ರಿ ಮತ್ತು ಅರಿಸ್ಟಾಟಲ್ (ಪರಿಸರ ಲೇಖನ) – ಕೆ ಪಿ ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ
17. ಗಾಂಧಿ (ಕತೆ) – ಬೆಸಗರಹಳ್ಳಿ ರಾಮಣ್ಣ
18. ಬೆಲ್ಚಿಯ ಹಾಡು (ಕವನ) – ಸಿದ್ಧಲಿಂಗಯ್ಯ
19. ಎಲ್ಲ ಹುಡುಗಿಯರ ಕನಸು (ಕವನ) – ಸವಿತಾ ನಾಗಭೂಷಣ
20. ನೀರು (ಕತೆ) – ಬಸವರಾಜ ಕುಕ್ಕರಹಳ್ಳಿ
21. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿಯ ಒಂದು ಚಿತ್ರಣ (ಪರಿಚಯ ಲೇಖನ) – ರಹಮತ್ ತರೀಕೆರೆ
22. ವೃತ್ತಿ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಮಾಧ್ಯಮ (ತಂತ್ರಜ್ಞಾನ ಬರಹ) – ಎಸ್ ಸುಂದರ್
23. ಕೊಣಬೇಗೌಡ (ಕಾವ್ಯ) – ಜಾನಪದ

ಪಠ್ಯಪುಸ್ತಕಗಳು

1. ಕನ್ನಡ ಮನಸು – ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ತರಗತಿ ಕನ್ನಡ ಪಠ್ಯ. ಪ್ರಕಟಣೆ: ಪ್ರಸಾರಾಂಗ ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಹಂಪಿ.
2. ಕನಸಡ – ಆಡಳಿತ ಕನ್ನಡ (ಪತ್ರಿಕೆ – 1, ಬ್ಲಾಕ್ 4) ಪ್ರಕಟಣೆ: ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮುಕ್ತ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಮೈಸೂರು.
3. ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಟ್ಟದ ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳ ಕನ್ನಡ ಸಾಹಿತ್ಯ ಮತ್ತು ಭಾಷೆ ಕುರಿತಾದ ಉತ್ತಮ ಪುಸ್ತಕಗಳು.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	21CS2301					
TITLE OF THE COURSE	**DISCRETE MATHEMATICAL STRUCTURES**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Solve problems using relations and generating functions.
- Understand and Construct mathematical arguments.
- Use propositional and predicate logic in knowledge representation and program verification.
- Develop recursive algorithms based on mathematical induction.
- Know essential concepts in graph theory and related algorithms.
- Apply knowledge of discrete mathematics in Elementary Number Theory and problem solving.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Classify functions, basic set theory relations.	L4
CO2	Demonstrate the correctness of an argument using propositional and predicate logic, laws and truth tables.	L2
CO3	Compare and differentiate graphs in different geometries related to edges.	L4
CO4	Apply mathematical induction, counting principles, recursion, elementary number theory.	L3
CO5	Apply and solve Euclidean Division Algorithm and Chinese Remainder Theorem.	L3

COURSE CONTENT:	
MODULE 1	**8Hrs**
RELATIONS AND FUNCTIONS: Relation and Types of relations, Closure Properties, Equivalence Relations, Partial Ordering Relations, n-ary relations, Functions: one-to-one, onto and invertible functions, sequences, indexed classes of sets, recursively defined functions, cardinality Counting Principles: Permutation, combination, the pigeon hole principle, inclusion-exclusion principle Self – Learning Component: Set theory definition and Properties	
MODULE 2	**8Hrs**
LOGIC: Propositions and truth tables, tautologies and contradictions, logical equivalence, algebra of propositions, logical implications, predicate logic, theory of inference for propositional logic and predicate logic. Introduction to Predicate Calculus.	
MODULE 3	**8Hrs**
NUMBER THEORY: Properties of Integers: Introduction, order and inequalities, absolute value, mathematical induction, division algorithm, divisibility, primes, greatest common divisor, Euclidean algorithm, fundamental theorem of arithmetic, congruence relation, congruence equations and Chinese Reminder Theorem (CRT).	
MODULE 4	**7Hrs**
GRAPH THEORY: Graphs and multi-graphs, sub-graphs, isomorphic and homomorphic graphs, paths, connectivity, Euler and Hamilton paths, labelled and weighted graphs, complete, regular and bipartite graphs, planar graphs.	
MODULE 5	**8Hrs**
TREES AND GRAPH COLORING: Trees: Definitions-properties - fundamental theorems of trees-rooted trees-binary trees-spanningtrees. Coloring of planar graphs, Chromatic Number- Chromatic partitioning- The four Color Problem-Five-color.	

TEXT BOOKS:

1. K. H. Rosen, Discrete Mathematics & its Applications, 7th Ed., Tata McGraw-Hill, 2007.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall India (PHI).

REFERENCES:

1. M.Huth and M. Ryan, Logic in Computer Science, Cambridge University N.Press, 2004.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	21CS2302					
TITLE OF THE COURSE	**DATA STRUCTURES**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	***	***

COURSE OBJECTIVES:

- To introduce the concept of data structure and its applications
- To introduce C language concepts required for data structures
- To design data structure operations to solve problems
- To introduce applications of data structures
- To introduce non-primitive data structures
- To analyse the complexity of a data structure
- To introduce static and dynamic memory allocation using C language
- To explain linear data structures – stack, queue, linked list
- To explain non-linear data structures – trees and graphs

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Outline basic C program design for data structures	L2
CO2	Implement stack & queue data structure and their applications	L3
CO3	Apply concepts of dynamic memory allocation to real-time Problems	L3
CO4	Implement tree data structure and its applications	L3
CO5	Implement graph data structure and its applications	L3
CO6	Outline the concepts of file structures	L2

COURSE CONTENT:	
MODULE 1	**7Hrs**
INTRODUCTION TO DATA STRUCTURES: Definition, Types, C Pointers, C Structure, Arrays, Representation of Linear Array in Memory, Array Operations (Insertion, Deletion, Search and Traversal), Single Dimensional Arrays, Two Dimensional Arrays, Function Associated with Arrays, Arrays as Parameters, Recursive Functions.	
MODULE 2	**9Hrs**
INTRODUCTION TO STACK AND QUEUE: **Stack:** Definition, Array Representation of Stack, Operations Associated with Stacks- Push & Pop, Applications of Stack: Recursion, Polish expressions, Conversion of Infix to Postfix, Infix to Prefix,Postfix Expression Evaluation, Tower of Hanoi. **Queue:** Definition, Representation of Queues, Operations of Queues, Priority Queues, Circular Queue.	
MODULE 3	**9Hrs**
DYNAMIC DATA STRUCTURE: **Linked List:** Types, Introduction to Singly Linked lists: Representation of Linked Lists in Memory,Traversing, Searching, Insertion & Deletion from Linked List. Doubly Linked List, Operations on Doubly Linked List (Insertion, Deletion, Traversal). Applications: Polynomial Representation & Basic Operations, Stack & Queue Implementation using Linked Lists.	
MODULE 4	**8 Hrs**
TREES & GRAPHS: **Trees:** Basic Terminology, Binary Trees and their Representation, Complete Binary Trees, Binary Search Trees, Operations on Binary Trees (Insertion, Deletion, Search & Traversal), Application: Expression Evaluation. **Graphs:** Terminology and Representations, Graphs & Multigraphs, Directed Graphs, Sequential Representation of Graphs, Adjacency Matrices, Graph Transversal	
MODULE 5	**6 Hrs**
FILE STRUCTURES: Physical storage media, File Organization, Linked Organization of File, Inverted File, Organization Records into Blocks, Sequential Blocks, Indexing & Hashing	

TEXT BOOKS:

1. A M Tannenbaum, Y Langsam, M J Augentien "Data Structures using C", Pearson, 2013
2. R.L. Kruse, B.P. Leary, C.L. Tondo, "Data Structure and Program Design in C" PHI

REFERENCES:

1. Horowitz Anderson-Freed, and Sahni, "Fundamentals of Data structures in C", 2nd Edition, Orient Longman, 2008
2. Data Structures and Algorithm analysis in C by Mark Allen Weiss, Published by Addison Wesley (3rd Indian Reprint 2000).
3. D E Knuth, The Art of Computer Programming, Volume 1, Addison-Wesley Publishing, 2013

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	21CS2303					
TITLE OF THE COURSE	**DIGITAL ELECTRONICS & LOGIC DESIGN**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To understand various number systems and conversion from one to other number systems
- To introduce basic postulates of Boolean algebra
- To manipulate expressions into POS or SOP form.
- To introduce the methods for simplifying Boolean expressions like K-Map and Quine Mclusky
- To understand the concept of don't care conditions and how they can be used to further optimize the logical functions
- To design simple combinational circuits such as multiplexers, decoders, encoders
- To understand the differences between combinational and sequential Logic circuits
- To familiar with basic sequential logic component-SR Latch
- To understand the basics of various types of memories.
- To present the working of various Flip- Flops (T flip-flop, D flip-flop, R-S flip-flop, JK flip-flop)
- To get familiarized with State Diagram, State Table, State Assignment
- To design combinational circuits using programmable logic devices.
- To design sequential circuits such as different types of Counters, Shift Registers

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate the knowledge of binary number systems, Logic families, Boolean algebra and logic gates	L2
CO2	Analyze different methods used for simplification of Boolean expressions	L4
CO3	Design combinational logic circuits using combinational logic elements	L3
CO4	Design combinational circuits using Programmable Logic Devices	L3
CO5	Analyze sequential logic elements in the design of synchronous and asynchronous systems	L4
CO6	Design sequential systems compose$_1$d$_2$ of standard sequential modules, such as counters and registers	L3

COURSE CONTENT:	
MODULE 1	**9Hrs**
NUMBER SYSTEMS: BCD number representation, Unsigned and signed number representation, Binary arithmetic. **BOOLEAN ALGEBRA AND SIMPLIFICATION:** Laws of Boolean algebra, Theorems of Boolean algebra, Boolean/Switching functions and their implementation. **SIMPLIFICATION OF BOOLEAN EXPRESSIONS AND FUNCTIONS:** Canonical forms, Sum-of-Products Method, Truth Table to Karnaugh Map, Karnaugh Simplifications, Don't-care Conditions. Product-of-sums Method, Product-of-sums simplifications, Simplification by Quine-McClusky Method.	
MODULE 2	**8Hrs**
DESIGN OF COMBINATIONAL LOGIC CIRCUITS: Modular combinational logic elements- Multiplexers and Demultiplexers, Decoders, Magnitude comparator, BCD converter, Encoders, Priority encoders.	
MODULE3	**9Hrs**
INTRODUCTION TO SEQUENTIAL CIRCUITS: Introduction to Sequential Circuits. Combinational Vs sequential circuits, Clock, Clock Triggering, Memory elements and their excitation functions – Latches, T flip-flop, D flip-flop, R-S flip-flop. JK flip-flop and their excitation requirements, State diagram, state table and state equation	
MODULE 4	**6 Hrs**
REGISTERS Registers-Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In –Parallel Out, Universal Shift Register. Applications of Shift Registers	
MODULE 5	**7 Hrs**
COUNTERS, PROGRAMMABLE LOGIC: Ring, Johnson counters, Design of synchronous and asynchronous Counters Programmable Logic Arrays, Design of Combinational Circuits using Programmable Logic Devices (PLDs):	

TEXT BOOKS :

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 6th Edition,N.Pearson Education, 2018

2. Donald.P. Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8thEdition, Tata McGraw Hill, 2015

REFERENCES:

1. D Sudhaker Samuel: Illustrative Approach to Logic Design, Sanguine-Pearson, 2010.
2. Charles H. Roth: Fundamentals of Logic Design, Jr., 7th Edition, Cengage Learning, 2014
3. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	21CS2304					
TITLE OF THE COURSE	**FULL STACK DEVELOPMENT**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**2**	**-**	**26+26**	**3**

Prerequisite Courses			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

1. Understand the major areas of web programming
2. To gain the skill into web applications and development.
3. To create website using HTML5, CSS3, JavaScript.
4. Server Side Scripting using Node.JS, Express JS and Mongo dB

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Know the fundamentals of front end web technologies using HTML 5 and CSS3	L1
CO2	Apply Cascading Style Sheets and XHTML to the idea of a web application.	L3
CO3	Comprehend the principles of client-side programming and understand how to use JavaScript to implement them in order to create dynamic web sites.	L3
CO4	Implementing the principles of server side programming using Node.js, Mongo dB	L3
CO5	Applying the Node.js framework -Express.JS to create web applications faster and smarter	L3

COURSE CONTENT:	
MODULE 1: Markup Language (HTML5)	**4 Hrs**
Introduction to HTML and HTML5 - Formatting and Fonts -Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – HTML Forms, Audio ,Video Tag.	
MODULE 2: CSS3	
CSS3: Levels of style sheets; Style specification formats; Selector forms; Property value forms; Font properties; List properties; Color; Alignment of text; Background images, Conflict Resolution, CSS Box Model .CSS3 features: Box Shadow, Opacity, Rounded corners, Attribute selector.	**4 Hrs**
MODULE 3 : JavaScript	**6 Hrs**
Overview of JavaScript; Object orientation and JavaScript; General syntactic, characteristics; Primitives, operations, and expressions; Screen output and keyboard input. Control statements; Arrays; Functions, Constructors; A brief introduction on pattern matching using regular expressions, DOM Events	
MODULE 4: Node JS	**6 Hrs**
Introduction to NodeJS, Set up Dev Environment, Node JS Modules, Node Package Manager, File System, Events, Database connectivity using Mongo DB.	
MODULE 5: Express.JS	**6 Hrs**
Introducing Express: Basics of Express, Express JS Middleware: Serving Static Pages ,Listing Directory Contents, Accepting JSON Requests and HTML Form Inputs, Handling Cookies.	

List of Laboratory/Practical Experiments activities to be conducted

HTML5

1. Design a web page depicting: -
    - How markup works, including the working of various basic HTML elements and attributes..
    - The basic structure of an HTML document.
    - The usage of table tag to format a web page
    - Use and tags to provide a layout to the page instead of a table Layout.
    - The usage of lists to bring order to web pages
    - The usage of other various HTML tags like Image, anchor, links etc.
2. Design a web page and embed various multimedia features in the page.
3. Building of HTML Forms

CSS3:

4. Change the Look of a web page with a Style Sheet

JAVASCRIPT

5. Design of dynamic and Interactive web pages using Java script
    - Depicting the usage of declaring variables, running loops, if/then statements, and writing functions/Constructors using JavaScript
    - Depicting Event handling using Java script.
    - Depicting the Pattern matching using regular expressions.

NODE.JS

6. Demonstrate how to use Node.js http module to create a web server.
7. Create a Node.js file that that depicts the usage of various File System Modules

EXPRESS.JS

8. Create an app that starts a server using Express.js.
9. Demonstrate the usage of various Express JS Middleware.

TEXT BOOKS:

1. Robert W. Sebesta , "Programming the World Wide Web", 7th Edition, Pearson Education, 2008.
2. Basarat Ali Syed," Beginning Node.js ",Apress ,2014

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	21CS2305					
TITLE OF THE COURSE	**COMPUTATIONAL THINKING WITH PYTHON**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2	**-**	**2**	**-**	**26+26**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- To understand basic concepts of computational thinking.
- To introduce python programming for problem solving.
- To introduce different debugging and unit testing tools.
- To solve real world problems using python data structures.
- Learn to handle files and exception handling in python.
- To explore Python's object-oriented features.
- To build Web services and Networked programs in python.
- To train students to design an application as part of the course mini- project using computational thinking with python.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand basic concepts of computational thinking.	L2
CO2	Outline basic python programming for problem solving.	L2
CO3	Apply computational thinking to solve real world programs using Python	L3
CO4	Build python programs using core data structures like list, dictionaries and tuples	L3
CO5	Implement object oriented concepts using python	L3
CO6	Design applications related to web services and network Programming.	L3

COURSE CONTENT:	
MODULE 1	**5Hrs**
INTRODUCTION TO COMPUTATIONAL THINKING AND PYTHON: Introduction to computational thinking: Stages of Computational thinking, Basics: Values, expressions and statements, Conditional execution,Functions, Iterations	
MODULE 2	**6Hrs**
PYTHON DATA STRUCTURES: Python Data Structures: Strings, Arrays, Lists, Tuples, Sets and Dictionaries	
MODULE 3	**5Hrs**
PYTHON OBJECTS: Classes and Objects: Creating classes, Using Objects, Accessing attributes, Classes as Types, Introduction to Multiple Instances, Inheritance.	
MODULE 4	**5Hrs**
EXCEPTION HANDLING: Try-Except, Exception syntax, examples, Types of exception with except, multiple exceptions with except, Try-Finally, Raise exceptions with arguments, Python built-in exceptions, User-defined exceptions, Assertions	
MODULE 5	**5Hrs**
PYTHON FILES & LIBRARIES Files: File types, modes, File functions, File attributes, File positions, Looping over file. Basics of NumPy and Pandas	

List of Laboratory/Practical Experiments activities to be conduct

1. Python program to evaluate Values, expressions, and statements, Conditional execution, and Functions Iterations
    a. prompt the user to enter an integer and reverse it. And print the sum of the reversed integer.
    b. Write a python program to find whether a number (num1) is a factor of 255.
    c. Write a python program to find whether a number (num1) is a factor of 255.
    d. Write a program to find the sum of the following series:
        i. 1 + 1/3 + 1/5 + 1/7 +..... up to 'N' terms.
        ii. 1 + x/1! + x3/2! + x5/3! + x7/4 +.....x2n-1/n!
2. Python program to evaluate Python Collections
    a. Write a Python Program to demonstrate the inbuilt functions of Strings, List, and sets.
    b. Write a Python program for counting a specific letter 'o' in a given string; the number of times vowel 'o' appears.
    c. Write a Python Program to find the frequency of each word in given strings/strings
    d. Store the following for 'n' countries, using a dictionary:
        i. Name of a country, country's capital, per capita income of the country.
        ii. Write a program to display details of the country with the highest and second lowest per capita income.
3. Write a python program to create two classes "Python" and "Java" having data members "Version" and "name" and a member function "display()". With the help of the object, print the appropriate messages.

4. Create a class “Employee” with__init___method to initialize data members: Name, Designation, Ph. No., and a member function display(). Create an instance for the class and display the details of the employee
5. Write an interactive calculator! User input is assumed to be a formula that consist of a number, an operator (at least + and -), and another number, separated by white space (e.g. 1 + 1). Split user input using str.split(), and check whether the resulting list is valid:
    a. If the input does not consist of 3 elements, raise a FormulaError, which is a custom Exception.
    b. Try to convert the first and third input to a float (like so: float_value = float(str_value)). Catch any ValueError that occurs, and instead raise a FormulaError
    c. If the second input is not '+' or '-', again raise a FormulaError
    d. If the input is valid, perform the calculation and print out the result. The user is then prompted to provide new input, and so on, until the user enters quit.
6. Write a Python program to count the number of lines in a text file and read the file line by line and store it into a list as well as find the longest word in the file.
7. Write a Python program to create a list of student details: usn, name dob and email {using dictionary} and write a list to a file.
8. Generate one-hot encodings for an array in numpy.
9. Write a Pandas program to import excel data into a Pandas dataframe and find a list of employees where hire_date is between two specific month and year.

TEXT BOOKS:

1. “Python for Everybody-Exploring Data Using Python 3”, Dr. Charles R. Severance,
2. “Introduction to Computing & Problem Solving with Python”,Jeeva Jose,P.Sojan Lal, Khanna Book Publishing; First edition (2019).

REFERENCES:

1. “Computer Science Using Python: A Computational Problem- Solving Focus”, CharlesDierbach, Introduction John Wiley, 2012.
2. “Introduction to Computation and Programming Using Python”, John V Guttag,Prentice Hall of India, 2015.
3. "How to think like a Computer Scientist, Learning with Python", Allen Downey,JeffreyElkner and Chris Meyers, Green Tea Press, 2014.
4. “Learning to Program with Python”, Richard L. Halterman, 2011.

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	**21AM2301**					
TITLE OF THE COURSE	**PROBABILITY AND STATISTICS**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**42**	**3**

Prerequisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

1. Understand probability, random variable and random process concepts and their importance in Computer Engineering course.
2. Calculate statistics related to Random variables and process such as mean, variance, etc.
3. Evaluate standard distribution functions such as Poisson's, Normal distributions
4. Apply functions of random variables such as characteristic function, moment generating function to calculate statistics.
5. Understand probability, random variable and random process concepts and their importance in Computer Engineering course.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Compute and interpret descriptive statistics using numerical and graphical techniques.	L4
CO2	Understand the basic concepts of random variables and find an appropriate distribution for analyzing data specific to an experiment.	L2
CO3	Extend the concepts to multiple random variables and apply them to analyze practical problems.	L2
CO4	Make appropriate decisions using statistical inference that is the central to experimental research.	L4

COURSE CONTENT:	
MODULE 1	**6 Hrs**
INTRODUCTION TO PROBABILITY THEORY : Basic Notions of Probability, Axiomatic definition, properties, Conditional Probability and Independence – Baye's Theorem.	
MODULE 2	**7 Hrs**
DISCRETE PROBABILITY DISTRIBUTIONS: Discrete random variables and its properties - Bernoulli trials – Binomial Distribution and its properties – Poisson Distribution and its properties.	
MODULE 3	**10 Hrs**
CONTINUOUS PROBABILITY DISTRIBUTIONS Continuous random variables and its properties - Gamma Distribution and its properties – Exponential Distribution and its properties - Normal Distribution and its properties. **BIVARIATE DISTRIBUTIONS:** Bivariate random variables – Joint – Marginal - Conditional distribution**.**	
MODULE 4	**9 Hrs**
RANDOM PROCESS AND QUEUING THEORY Classification – Stationary process – Markov process – Markov chain – Poisson process – Randomtelegraph process. Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties. Queuing Models, Methods for generating random variables and Validation of random numbers	
MODULE 5	**10 Hrs**
TESTING OF HYPOTHESIS Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis- Large sample tests- Z test for Single Proportion - Difference of Proportion, mean and difference of mean - Small sample tests- Student's t-test, F-test-chi-square test- goodness of fit - independence of attributes.	

TEXT BOOKS :

1. A First Course in Probability, S. Ross, Pearson International Edition, 9th Edition.
2. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand & Sons, 11thEdition.

REFERENCES :

1. K. S. Trivedi, Probability and Statistics with Reliability, Queuing, and L.Computer Science Applications, 2nd Ed., Wiley, 2001.
2. Robert V. Hogg, J.W. McKean, and Allen T. Craig: Introduction to Mathematical Statistics,Seventh Edition, Pearson Education, Asia.
3. Rohatgi, V K. and Saleh , A. K. Md. Ehsanes, "An Introduction to Probability and Statistics", (John Wiley and Sons) , (2nd edition) (200201)
4. Higher Engineering Mathematics by B S Grewal, 42 nd Edition, Khanna Publishers.
5. Probability and Statistics for engineers and scientists, R.,E.Walpole, R.H.Myers, S.L.Mayers andK.Ye, 9th Edition, Pearson Education (2012).
6. An Introduction to Probability Theory and its Applications, W. Feller , Vol. 1, 3rd Ed., Wiley, 196

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	21CS2307					
TITLE OF THE COURSE	**DATA STRUCTURES LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**2**	**-**	**26**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	***

COURSE OBJECTIVES:

- To introduce C language concepts required for data structures
- To design data structure operations to solve problems
- To introduce applications of data structures
- To implement linear data structures – stack, queue, linked list
- To implement non-linear data structures – trees and graphs

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Design and develop the programs in C to understand the different concepts of data structures.	L3
CO2	Implement stack & queue data structure and their applications, Analyse the output based on the given input data.	L3
CO3	Implement Conversions of Polish and reverse polish expressions and Record Experimental process and results	L4
CO4	Apply and implement concepts of dynamic memory allocation	L3
CO5	Use the concepts of file structures and communicate results effectively	L3

Sl. No.	**List of Laboratory/Practical Experiments activities to be conduct**
1.	Write a program to add, subtract, multiply and divide two integers using user defined function with return type.
2.	Write a program to find the sum of digits of the number and print the reverse of that number using Recursive Function.
3.	Write a program to add and multiply two matrices using pointers

4.	Design, Develop and Implement a menu driven Program in C for the Searching Techniques on arrays i.e, 1. Linear search 2. Binary search. If unsorted array is given as input, your program must perform sorting (bubble sort) to use it as input for binary search algorithm.
5.	Write a C program to convert infix expression to prefix expression.
6. 7. 8. 9.	Write a C program to convert infix expression to postfix expression. Write a C program to implement stack, queue and their variations using arrays. Write a C program to evaluate postfix expressions Write a C program to solve tower of hanoi using recursion
10.	Write a C program to implement stack, queue and their variations using linked lists.
11. 12.	Write a C program to implement Binary search tree insertion, deletion and traversal. Write a C program to implement Graph insertion, and traversal.
13.	Write a C program to implement File operations a. Open a file b. Write c. Read d. close d. close

Open-Ended Experiments

1. A man in an automobile search for another man who is located at some point of a certain road. He starts at a given point and knows in advance the probability that the second man is at any given point of the road. Since the man being sought mightbe in either direction from the starting point, the searcher will, in general, must turn around many times before finding his target. How does he search to minimizethe expected distance travelled? When can this minimum expectation be achieved?

2. The computing resources of a cloud are pooled and allocated according to customer demand. This has led to increased use of energy on the part of the service providers due to the need to maintain the computing infrastructure. What data structure will you use for allocating resources which addresses the issue of energysaving? Why? Design the solution.

3. Mini-Project on applying suitable data structure to a given real-world problem

TEXTBOOKS:

1. A M Tannenbaum, Y Langsam, M J Augentien "Data Structures using C", Pearson, 2013
2. R.L. Kruse, B.P. Leary, C.L. Tondo, "Data Structure and Program Design in C" PHI

REFERENCE BOOKS

1. Horowitz Anderson-Freed, and Sahni, "Fundamentals of Data structures in C", 2nd Edition, Orient Longman, 2008

2. Data Structures and Algorithm analysis in C by Mark Allen Weiss, Published by Addison Wesley (3rdIndian Reprint 2000).
3. D E Knuth, The Art of Computer Programming, Volume 1, Addison-Wesley Publishing, 2013

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	21CS2308					
TITLE OF THE COURSE	**DIGITAL ELECTRONICS & LOGIC DESIGN LAB**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	**-**	**2**	**-**	**26**	**1**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	**	**	***

COURSE OBJECTIVES:

- To design digital circuit for given Boolean expressions using logic gates.
- To verify the design of arithmetic circuits using logic gates and ICs.
- To test different code-conversion circuits.
- Applications of Multiplexer and De-multiplexers for implementation of different logic circuits.
- To test comparator circuits.

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Build a logic circuit using basic gates after simplifying the given Boolean expression using Karnaugh map method	L3
CO2	Design and implementation of comparators	L3
CO3	Build logic circuits and realize the given Boolean expression using Multiplexers.	L3
CO4	Design of Combinational circuits like Encoder and Decoder using basic gates	L3
CO5	Design of Synchronous and Asynchronous Sequential circuits like registers and counters.	L3

List of Laboratory/Practical Experiments activities to be conducted

1. Study and verification of Basic gates with Truth Tables
2. Simplification of expressions using Karnaugh Maps and realizing circuitsusing Basic Gates
3. Realize binary to gray code converter and vice versa
4. Simplify the given expression using tabular method and to realize circuits using Multiplexers.
5. Design and implementation parallel adder and subtractor
6. Design and implementation of comparators
7. Design various combinational logic circuits like encoders, decoders
8. Design and implementation of shift register
9. Design and implementation synchronous counters
10. Design and implementation ring counter and Johnson counter
11. Study of 7490 BCD counter

12. Design and implementation of asynchronous counters

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 6th Edition, Pearson Education, 2018
2. Donald.P. Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015

SEMESTER	**III**					
YEAR	**II**					
COURSE CODE	21CS2309					
TITLE OF THE COURSE	**MANAGEMENT & ENTREPRENEURSHIP**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	2		**-**	**-**	**26**	**2**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- Identify and analyze the factors that contribute to the process of successfully launching an entrepreneurial venture and managing a new business.
- Learn the entrepreneurial process from idea generation to implementation.
- Acquaint with special problems of starting new ventures, finding products and services, which can support new enterprises, and raising capital.
- Discuss how to start own business and also to work in or with small business or are involved with entrepreneurship.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate knowledge of the key elements of the entrepreneurial process	L2
CO2	Employ strategies to generate new ideas for startups	L2
CO3	Outline how to protect IP legally	L2
CO4	Examine different ways of generating funding	L2
CO5	Explain organizing managing people, finance and customers	L2

COURSE CONTENT:	
MODULE 1	**5Hrs**
OVERVIEW OF ENTREPRENEURSHIP: THE ENTREPRENEURIAL PERSPECTIVE: Nature and Development of Entrepreneurship. Defining Manager, Entrepreneur, Entrepreneurship and Entrepreneurship. Key Elements of Entrepreneurship. Personality Characteristics of Successful Entrepreneurs. Common Myths about Entrepreneurs. Ethics and Social Responsibility of Entrepreneurs. Types of Start-Up Firms. Process of New Venture Creation. Role of Entrepreneurship in Economic Development. Emerging Trends and Issues in Entrepreneurship. **Case Study: Successful Entrepreneurs Narayana Murthy Infosys**	
MODULE 2	**6Hrs**

THE ENTREPRENEURIAL AND ENTREPRENEURIAL MIND: The Entrepreneurial Process: Identify and Evaluate the Opportunity, Develop a Business Plan, Determine the Resources Required, Manage the Enterprise. Managerial Versus Entrepreneurial Decision Making: Strategic Orientation, Commitment to Opportunity, Commitment of Resources, Control of Resources, Management Structure, Entrepreneurial Venturing inside a Corporation, Causes for Interest in Entrepreneurship, Climate for Entrepreneurship, Entrepreneurial Leadership Characteristics. **Case study: How to develop effective Business Plan**	
MODULE 3	**5Hrs**
CREATIVITY AND BUSINESS IDEA: Identify and Recognizing Opportunities: Observing Trends and Solving Problems. Creativity: Concept,Components and Types of Creativity, Stages of Creative Process. Sources of New Venture Ideas.Techniques for Generating Ideas. Stages of Analyzing and Selecting the Best Ideas. Protecting the Idea:Intellectual Property Rights and its Components. Linking Creativity, Innovation and Entrepreneurship. **Case study: Application of Design Thinking in New business ideas generation in particular sector (Health care, Water Saving, Energy saving)**	
MODULE 4	**5Hrs**
PREPARING THE PROPER ETHICAL AND LEGAL FOUNDATION: Initial Ethical and Legal Issues Facing a New Firm, Establishing a Strong Ethical Culture, Choosing an attorney (Lawyer), Drafting a founder's agreement, Avoiding legal disputes, Choosing a form of business organization, Obtaining business licenses and permits, Choosing a Form of Business Ownership (Sole, Proprietorship, Partnership, Corporation & Limited Liability Company) **Case study: Startup Law A to Z IP** https://techcrunch.com/2019/02/25/startup-law-a-to-z-intellectual-property/	
MODULE 5	**5Hrs**
MANAGING EARLY GROWTH AND CHALLENGES Recruiting and Selecting Key Employees. Lenders and Investors. Funding Requirements: Sources of Personal Financing. Venture Capital. Commercial Banks. Sources of Debt Financing. Key Marketing Issues for New Ventures. Why marketing is critical for Entrepreneurs. Entrepreneurs face unique Marketing Challenges. Guerrilla Marketing. Business Growth: Nature of Business Growth, Planning for Growth, Reasons for Growth. Managing Growth: Knowing and Managing the Stages of Growth, Challenges of Growing a Firm. Strategies for Firms Growth: Internal and External Growth Strategies. Implications of Growth for the Firm and Entrepreneur. Entrepreneurial Skills and Strategies to Overcome Pressures On: Financial Resources (Financial Control, Managing Inventory and Maintaining Good Records). Human Resources, Management of Employees, Time Management. **Case study: 9 ways to get startups funded** https://www.quicksprout.com/how-to-get-your-startup-funded/	

TEXT BOOKS:

1. Barringer, Ireland, "Entrepreneurship: Successfully Learning New Ventures", Pearson,Latest Edition.
2. Hisrich, Peters, Shepherd, "Entrepreneurship", Mc Graw Hill, Sixth Edition.

SEMESTER	**IV**					
YEAR	**III**					
COURSE CODE	**21AM2401**					
TITLE OF THE COURSE	**ARTIFICIAL INTELLIGENCE**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	***	***	***

COURSE OBJECTIVES:

- To explore introductory survey of concepts and techniques in artificial intelligence.
- To learn about with methods for search, classification, reasoning, and machine learning.
- Familiar with applications including core AI (games, planning), robotics, computer vision, and natural language understanding.

COURSE OUTCOMES:

CO No.	Outcomes	**Bloom's Taxonomy** Level
CO1	Demonstrate fundamental understanding of artificial intelligence (AI) especially the notion of problem solving using AI techniques, current scope and limitations thereof.	**L2**
CO2	Apply basic principles of AI in solutions that require problem solving, knowledgerepresentation, and learning	**L3**
CO3	Demonstrate awareness and a fundamental understanding of applying AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	**L2**

COURSE CONTENT:	
MODULE 1: Introduction	**7Hrs**
What is AI? Foundations of artificial intelligence (AI). History of AI; The State of the Art. Agents and Environments, Good Behavior, The Nature of Environments, The Structure of Agents, Problem-solving agents, Example problems, searching for solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions	
MODULE 2: Robotics and Classical Planning	**8Hrs**
Classical Planning: Definition, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of P2la9nning Approaches, Robotics: Introduction, Robot Hardware, Robotic Perception, planning to move, Planning Uncertain Movements.	
MODULE 3: Uncertainty, Naive Bayes and Probabilistic Reasoning	**8Hrs**

Acting Under Uncertainty, Review of Basic Probability, Bayes Theorem, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks,,Exact Inference in Bayesian Networks, Time and Uncertainty, Inference in Temporal Models	
MODULE 4: Learning	**8Hrs**
Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Regression and Classification with Linear Models, Artificial Neural Networks. Reinforcement Learning	
MODULE 5: Applications	**8Hrs**
Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction, Computer Vision: Image Formation, Early Image-Processing Operations, Object Recognition by Appearance, Reconstructing the 3D World, Object Recognition from Structural Information, Using Vision.	

TEXT BOOK:

1. Stuart Russell and Peter Norvig. Artificial Intelligence – A Modern Approach, Pearson Education Press, 3rd or 4th Editions.

REFERENCES:

1 Artificial Intelligence, Pallab Das Gupta and Partha Pratim.C

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	21CS2402					
TITLE OF THE COURSE	**DESIGN AND ANALYSIS OF ALGORITHMS**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	-	-	-	39	3

Perquisite Courses (if any)			
#	**Sem/Year**	**Course Code**	**Title of the Course**
*	**	**	***

COURSE OBJECTIVES:

- To introduce and implement various techniques for designing algorithms and advanced data structures
- To learn space and time complexity analysis of algorithms.
- To understand the Divide and conquer design strategy and the Greedy Technique
- To understand the concepts of Dynamic Programming Applications
- Synthesize efficient algorithms in common engineering design situations

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	Outline the overview of Data structures and Algorithms	L1
CO2	Understand the different Algorithmic Design strategies	L2
CO3	Apply the Design principles and concepts to Algorithmic design	L3
CO4	Describe the DAA paradigms and when an Algorithmic Design situation calls for it.	L6
CO5	Analyse the efficiency of Algorithms using Time and Space complexity theory	L4
CO6	Implement an existing algorithm to improve the run time efficiency	L3

COURSE CONTENT:	
MODULE 1: INTRODUCTION	**6 Hrs**
The role of Algorithms in Computing, Running time analysis -- recall of asymptotic notation, big-oh, theta, big-omega, and introduce little-oh and little-omega. Worst case and average case complexity	
MODULE 2: DIVIDE AND CONQUER	**9 Hrs**
Recursive algorithms, Divide-and-Conquer recurrences, Methods for solving recurrences: substitution method, recursion tree method and the Master method. Examples-Binary search, Quick sort, Merge sort, Strassen's Matrix Multiplication. **GREEDY METHOD** Optimal substructure property- Minimum cost spanning tree, Knapsack problem, Single Source Shortest Path Algorithm. Fractional knapsack	

MODULE 3 : DYNAMIC PROGRAMMING	9 Hrs
Integral knapsack (contrasted with the fractional variant: 0/1 knapsack), longest increasing subsequence, All pair shortest path in graph, Matrix chain multiplication, Travelling salesman Problem	
MODULE 4: APPLICATION OF GRAPH TRAVERSAL TECHNIQUES	**9 Hrs**
Recall representation of graphs, BFS, DFS, connected components, Strongly-connected components of DAGs, Kosaraju's algorithm 1 and 2, Applications. Graph matching, String Matching: Boyer Moore algorithm.	
MODULE 5: REASONING ABOUT ALGORITHMS	**6 Hrs**
Complexity Analysis (Polynomial vs Non-Polynomial time complexity), P, NP-hard and NP-Completeness, Reductions.	

TEXT BOOK:

1. T. H. Cormen, Leiserson, Rivest and Stein, "Introduction of Computer algorithm," , 3rd Edition, The MIT Press, 2015

REFERENCES:

1. E. Horowitz, S. Sahni, and S. Rajsekaran, " Fundamentals of Computer Algorithms," Galgotia Publication, 2015.
2. Anany Levitin, ―Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012
3. Sara Basse, A. V. Gelder, "Computer Algorithms : Introduction Design & Analysis", 3rd Edition, Addison Wesley.
4. J.E Hopcroft, J.D Ullman, "Design and analysis of Computer algorithms", PearsonEducation, 2009.
5. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2008

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	21CS2403					
TITLE OF THE COURSE	**PRINCIPLES OF MICROPROCESSORS & COMPUTER ORGANIZATION**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	4	**-**	**-**	**-**	**52**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES:

- To introduce the architecture of 8086
- To understand the importance and function of each pin of 8086 Microprocessor
- To familiarize with the architecture of 8086 microprocessor and its operation
- To understand the various addressing modes required for assembly language
- Programming and to calculate the physical address.
- To learn the 8086 instruction set and write 8086 Assembly level programs
- To understand the importance of different peripheral devices and their interfacing to 8086
- Understand the concepts of Hardwired control and micro programmed control.
- To explain the current state of art in memory system design
- Discuss the concept of memory organization.
- Summarize the types of memory.
- Learn about various I/O devices and the I/O interface.
- Learn the different types of serial communication techniques.
- To understand DMA technique
- To provide the knowledge on Instruction Level Parallelism
- To understand the concepts of pipelining techniques.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy** Level
CO1	Identify the basic building blocks of 8086 microprocessor and use the addressing modes for executing programs efficiently	L2
CO2	Develop 8086 assembly language programs using modern assembler tools	L3
CO3	Discuss the computer arithmetic and design algorithms for various Arithmetic operations.	L2
CO4	Design data part and control part of a processor	L3
CO5	Analyze the performance of various classes of Memories	L4
CO6	Understand pipeline & parallel processing	L2

COURSE CONTENT:	
MODULE 1: Introduction to Microprocessor & its Architecture:	**8 Hrs**
Introduction-Evolution of Microprocessor, The Microprocessor-Based Personal Computer Systems, Internal Microprocessor Architecture, Real mode memory addressing, 8086 pin diagram, Internal Architecture of 8086, Registers, Addressing Modes-Immediate addressing, Register addressing, direct addressing, indirect addressing, relative addressing, Instruction formats	
MODULE 2: Programming 8086	**12 Hrs**
Assembler directives, Data Movement Instructions, String Data Transfers, Miscellaneous Data Transfer Instructions, Arithmetic and Logic Instructions, BCD and ASCII Arithmetic, Basic Logic Instructions, Shift and Rotate, String Comparisons. Program Control Instructions: The Jump Group,Assembly language programming with 8086, macros, procedures	
MODULE 3: Processor Organization:	**10 Hrs**
Basic organization of computers, Block level description of the functional units as related to the execution of a program; Fetch, decode and execute cycle. Execution cycle in terms machine instructions. Information representation, Floating point representation (IEEE754), computer arithmetic and their implementation; **Data Part Design:** Fixed-Point Arithmetic-Addition, Subtraction, Multiplication and Division, Arithmetic Logic Units control and data path, data path components, design of ALU and data-path, **Control Part Design:** Control unit design; Hardwired and Micro programmed Control unit. Discussions about RISC versus CISC architectures.	
MODULE 4: Memory Technology, Input/Output Organization:	**12 Hrs**
Memory hierarchy, static and dynamic memory, RAM and ROM chips, Memory address map, Auxiliary Memory, Associative Memory, Cache Memory and organization. Peripheral devices, Input-Output Interface; I/O Bus and Interface Modules, Isolated versus Memory-Mapped I/O, Modes of Transfer; Programmed I/O, Interrupt-initiated I/O, Direct memory access (DMA)	
MODULE 5: Pipelining	**10 Hrs**
Basic Concepts, Arithmetic Pipeline, Instruction Pipeline; Four-Segment Instruction Pipeline, Pipeline hazards and their resolution, **Parallel Processing;** Flynn's classification, Multicore architectures, Introduction to Graphics Processing Units, Example: NVIDIA GPU Architecture	

TEXT BOOK:

1. Barry B Brey: The Intel Microprocessors, 8th Edition, Pearson Education, 2009
2. Mano, Morris M. Computer system architecture. Dorling Kindesley Pearson, 2005.

REFERENCES:

1. Douglas V Hall, "MICROPROCESSORS AND INTERFACING, PROGRAMMING ANDHARDWARE" TMH, 2006.
2. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing The PC",Delmar Publishers, 2007
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Danny Causey, The x86 PC Assembly LanguageDesign and Interfacing, 5th Edition, Pearson, 2013.
4. V. Carl Hamacher, Safwat G. Zaky and Zvonko G. Vranesic , Computer Organization ,McGraw-Hillseries 2002
5. Hayes, J.P , Computer Architecture and Organization, McGraw-Hill, 1998
6. David Patterson and John Hennessey, Computer Organization and Design, Elsevier. 2008
7. Comer, Douglas. Essentials of computer architecture. Chapman and Hall/CRC, 2017.
8. Hord, R. Michael. Parallel supercomputing in MIMD architectures. CRC press, 2018.
9. Tanenbaum, Andrew S. Structured computer organization. Pearson Education India, 2016.
10. William Stallings-Computer Organization and Architecture, Seventh Edition, Pearson Education

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	21CS2404					
TITLE OF THE COURSE	**FINITE AUTOMATA AND FORMAL LANGUAGES**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**2**	**-**	**39+26**	**4**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	*	**	***

COURSE OBJECTIVES:

- To learn general theory of automata, properties of regular sets and regular expressions.
- To understand basics of formal languages.
- To know push-down automata, context- free languages, Turing machines.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of formal languages of finite automata techniques such as DFA, NFA and E-NFA	L2
CO2	Design Finite Automata for different Regular Expressions and Languages Demonstrate the properties of regular grammar, regular language, regular expression & their relationship with finite automata	L3
CO3	Construct context free grammar for various languages. Interpret and design different PDA for a given language	L3
CO4	Construct context free, regular, Chomsky normal form grammars to design computer languages	L3
CO5	Design Turing machine to solve problems	L3

COURSE CONTENT:	
MODULE 1	**8Hrs**
Introduction to Finite Automata: Study and Central concepts of automata theory, An informal pictureof finite automata, deterministic and non-deterministic finite automata, applications of finite automata,finite automata with epsilon – transitions.	
MODULE 2	**8Hrs**
Regular expression and languages: Regular expressions, finite automata and regular expressions, algebraic laws of regular expressions. P3r6operties of Regular Languages: closure properties of regular languages, Pumping Lemma, equivalence and minimization of automata .	

MODULE 3	9Hrs
Context – free Grammars and Languages: Context free grammars, Context-free languages,Parse trees, Ambiguity in grammars and languages, Pushdown Automata: Pushdown automation (PDA), the language of PDA, equivalence of PDA's and CFG's, DeterministicPushdown Automata	
MODULE 4	**8Hrs**
Properties of Context – Free Languages: Normal forms of context free grammars, pumping lemma for context free languages, closure properties of context free languages. Applications of CFG - such as spec of programming languages, parsing techniques, and Yacc	
MODULE 5	**6Hrs**
Introduction to Turing Machine- The Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine, Chomsky hierarchy	

List of Laboratory/Practical Experiments activities to be conducted
1. Design a Program for creating machine that accepts three consecutive one.
2. Design a Program for creating machine that accepts the string always ending with 101.
3. Design a Program for Mode 3 Machine
4. Design a program for accepting decimal number divisible by 2.
5. Design a program for creating a machine which accepts string having equal no. of 1's and 0's.
6. Design a program for creating a machine which count number of 1's and 0's in a given string.
7. Design a Program to find 2's complement of a given binary number.
8. Design a Program which will increment the given binary number by 1. 9. Design a Program to convert NDFA to DFA.
10. Design a Program to create PDA machine that accept the well-formed parenthesis.
11. Design a PDA to accept WCWR where w is any string and WR is reverse of that string and C is a Special symbol.
12. Design a Turing machine that's accepts the following language an b n c n where n>0.

TEXT BOOKS:

1. Daniel I. A. Cohen, Introduction to Computer Theory, 2nd Edition, Wiley India Student Edition, 2008.
2. J.E. Hopcroft , R. Motwani, and J. D. Ullman, Introduction to Automata Theory,Languages and Computation, 3rd Edn. Pearson Education , New Delhi 2008

REFERENCES:

1. K.L.P. Misra and N. Chandrashekaran. Theory of Computer Science- Automata,Languages

and Computation, 3rd Edn. PHI, New Delhi, 2007

2. C. Martin - Introduction to Languages and the Theory of Computation 2ndEdn,TMH, New Delhi, 2000.

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	21CS2405					
TITLE OF THE COURSE	**SOFTWARE ENGINEERING AND PROJECT MANAGEMENT**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/ Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	***	***	***

COURSE OBJECTIVES:

- This course is introduced to give the students necessary knowledge.
- Understanding and Design aspects in Software Engineering
- To understand the Software Project Planning and Evaluation

techniques**COURSE OUTCOMES:**

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand software development life cycle models, process models, and various design engineering techniques	L2
CO2	Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development	L3
CO3	Analyze a problem, and identify and define the computing requirements appropriate to its solution	L4
CO4	Apply a wide variety of testing techniques in an effective and efficient manner.	L3
CO5	Understand Project Management principles while developing software.	L2

COURSE CONTENT:	
MODULE 1	**8Hrs**
Introduction to Software Engineering: FAQs about software engineering, Professional and ethical responsibility. Socio-Technical systems: Emergent system properties, Organizations, people and computer systems; Legacy systems, the evolving role of software, Changing Nature of Software, Software myths. **A Generic view of process:** Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models. Software Cost Estimation: Productivity; Estimation techniques	
MODULE 2	**8Hrs**
Process models: A simple safety- critical system; System dependability; Availability and reliability, the waterfall model, Incremental process models, Evolutionary process models, The Unified process. Agile Development: Agile Tech, Extreme Programming, and other Agile Process Models: Scrum Methodology	
MODULE 3	**8Hrs**
Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.	
MODULE 4	**8Hrs**
Testing Strategies: Verification and Validation: Planning; Software inspections; Automated static analysis; Verification and formal methods. A strategic approach to software testing, System testing, the art of Debugging; Component testing; Test case design; Test automation - Selenium, Test strategies for conventional software: Black-Box and White-Box testing, Validation tests, System testing.	
MODULE 5	**7Hrs**
Software Project Management Introduction to Software Project Management – all life cycle activities – Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	

TEXT BOOKS:

1. Software Engineering, by Ian Sommerville Eighth edition, International ComputerScience Series.
2. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition. McGraw Hill International Edition.

REFERENCES:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – FifthEdition, Tata McGraw Hill, New Delhi, 2012.
2. SoftwareEngineering-K.K.Agarwal&YogeshSingh,NewAgeInternationalPublishers
3. Software Engineering, an Engineering approach-JamesF. Peters, Witold Percy, JohnWiley.
4. Systems Analysis and Design –Shelly Cashman Rosenblatt, Thomson Publications.
5. Software Engineering principles and practice-Waman Jawadekar,The McGraw-HillCompanies

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	**21AM2402**					
TITLE OF THE COURSE	**FOUNDATION OF DATA SCIENCE**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	3	**-**	**-**	**-**	**39**	**3**

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course

COURSE OBJECTIVES:

- Impart necessary knowledge of the mathematical foundations needed for data science
- Develop programming skills required to build data science applications

COURSE OUTCOMES:

CO No.	Outcomes	**Bloom's Taxonomy** Level
CO1	Demonstrate understanding of the mathematical foundations needed for data science.	
CO2	Collect, explore, clean, munge and manipulate data.	
CO3	Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.	
CO4	Build data science applications using Python based toolkits.	

COURSE CONTENT:	
MODULE 1: Introduction to Data Science & Programming Tools for Data Science	**8 Hrs**

Concept of Data Science, Traits of Big data, Analysis vs Reporting, Toolkits using Python:, NumPy, Pandas, Scikit-learn, Matplotlib, Visualizing Data: Bar Charts, Line Charts, Scatterplot. Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction, Principal Component Analysis, Feature extraction	
MODULE 2: Mathematical Foundations	**8 Hrs**
Review of Probability theory, Correlation, Dependence and Independence, Conditional Probability, Baye's Theorem, The Normal Distribution, The Central Limit Theorem, Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, P-hacking, Bayesian Inference	
MODULE 3 : Machine Learning	**8 Hrs**
Overview of Machine learning concepts – Over fitting and under fitting, feature selection, train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Linear Regression- regularization (lasso, ridge, elastic net), Clustering algorithms, K-Means Clustering, Classification versus Regression	
MODULE 4 : Popular Machine Learning algorithms	**8 Hrs**
Naive Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification performance metrics, Analysis of Time Series, Neural Networks- Learning and Generalization, Overview of Deep Learning.	
MODULE 5 : Case Studies of Data Science Application	**7 Hrs**
Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.	

TEXT BOOK:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press http://www.deeplearningbook.org
2. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers
3. Jain V.K., "Data Sciences", Khanna Publishing House, Delhi.
4. Jain V.K., "Big Data and Hadoop", Khanna Publishing House, Delhi.
5. Jeeva Jose, "Machine Learning", Khanna Publishing House, Delhi.
6. Chopra Rajiv, "Machine Learning", Khanna Publishing House, Delhi

SEMESTER	**IV**					
YEAR	**II**					
COURSE CODE	21CS2407					
TITLE OF THE COURSE	**DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY**					
SCHEME OF INSTRUCTION	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
	-	-	2	-	26	1

Perquisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
*	****	****	****

COURSE OBJECTIVES:

- To learn mathematical background for analysis of algorithm
- To understand the concept of designing an algorithm.
- To analyze the algorithms using space and time complexity.
- To learn dynamic programming and greedy method.
- To acquire knowledge of various applied algorithms.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's Taxonomy Level**
CO1	Design and develop the Algorithms to understand the different concepts.	L3
CO2	Apply the Design principles and concepts to Algorithmic design	L3
CO3	Describe the DAA paradigms and when an Algorithmic Design situation calls for it.	L6
CO4	Analyse worst-case and best – case running times of algorithms using asymptotic analysis.	L4
CO5	Implement an existing algorithm to improve the run time efficiency	L3

List of Laboratory/Practical Experiments activities to be conducted
1. Design a C program to solve the Tower of Hanoi. Compute the time complexity.
2. Apply divide and conquer method and Design a C program to search an element in a given array and Compute the time complexity. Binary search - recursive method
3. Apply Divide and Conquer method Design a C program to sort an array using Merge sort algorithm and compute its time complexity

4. Apply Divide and Conquer method Design a C program to sort an array using Quick sort algorithm and compute its time complexity.
5. Apply Greedy method and Design a C program to find the minimum cost spanning tree using Prim's and Kruskal's Algorithm and compute its complexity
6. Apply Dynamic Programming Technique and Design a C program to find the all pairs shortest path using Dijkstra's Algorithm and computes its complexity
7. Design a C program to find the optimal solution of 0-1 knapsack problem using dynamic programming and Compute the time complexity
8. Design a C program to solve the Travelling Salesman Problem using dynamic programming and compute its time complexity.
9. Design a C program to find the longest common subsequence using dynamic programming and compute its time complexity
10. Mini project proposal should be submitted and Implementation should be done based on the problem stated in the proposal

TEXT BOOK:

1. Levitin A, "Introduction to the Design And Analysis of Algorithms", Pearson Education, 2008.
2. T. H. Cormen, Leiserson, Rivest and Stein, "Introduction of Computer algorithm," , 3rd Edition, The MIT Press, 2015

REFERENCES:

1. E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galgotia Publication, 2015.
2. Goodrich M.T., R Tomassia, "Algorithm Design foundations Analysis and Internet Examples", John Wiley and Sons, 2006.
3. Sara Basse, A. V. Gelder, "Computer Algorithms : Introduction Design & Analysis", 3rd Edition, Addison Wesley.

SEMESTER	**IV**					
YEAR	**III**					
COURSE CODE	21AM2403					
TITLE OF THE COURSE	**ARTIFICIAL INTELLIGENCE-Lab**					
SCHEME OF Instruction	Lecture Hours	Tutorial Hours	Practical Hours	Seminar/Projects Hours	Total Hours	Credits
		-	**2**	**-**	**30**	**1**

Prerequisite Courses (if any)			
#	Sem/Year	Course Code	Title of the Course
***	III/II	***	CTPY

COURSE OBJECTIVES:

- To provide skills for designing and analyzing AI-based algorithms.
- To familiarize students with skills to work in various sub-areas of AI, such as expert systems, natural language processing, and machine learning.

COURSE OUTCOMES:

CO No.	**Outcomes**	**Bloom's TaxonomyLevel**
1	Demonstrate awareness and a fundamental understanding of applying AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	L6
3	Select and apply appropriate algorithms and AI techniques to solve complex problems.	L6

COURSE CONTENT:	
List of Laboratory/Practical Experiments activities to be conducted:	
1	To implement general-purpose search algorithms and use them to solve 'pacman'-like maze puzzles. This assignment has five parts. 1. Breadth-first search, with one waypoint. 2. *A** search, with one waypoint. 3. *A** search, with many waypoints. 4. Faster *A** search, with many waypoints. Throughout this exercise, the goal will be to find a path from a given **starting position** in a maze which passes through a given set of **waypoints** elsewhere in the maze. We will begin by finding a path from the starting position to a single destination waypoint. Then we will generalize the implementation to handle multiple waypoints. Finally, we will explore heuristics to handle large numbers of waypoints in a reasonable amount of time.
2	Suppose that we're building an app that recommends movies. We've scraped a large set of reviews off the web, but (for obvious reasons) we would like to recommend only movies with positive reviews. In this assignment, you will use the Naive Bayes algorithm to train a binary sentiment classifier with a dataset of movie reviews. The task is to learn a bag of words (unigram, bigram) model that will classify a review as positive or negative based on the words it contains.
3	Implement part of speech (POS) tagging using an HMM model.
4	You are given a dataset consisting of images. Each image contains a picture of an animal or something else. Your task is to implement two algorithms to classify which images have animals in them. Using the training set, you will train a perceptron classifier and K-nearest neighbor classifier that will predict the right class label for an unseen image. Use the development set to test the accuracy of your learned models. We will have a separate (unseen) test set that we will use to run your code after you turn it in. You may use NumPy to program your solution. Aside from that library, no other outside non-standard libraries can be used.
5	Snake is a famous video game that originated in the 1976 arcade game Blockade. The player uses up, down, left and right to control the snake which grows in length (when it eats the food pellet), with the snake body and walls around the environment being the primary obstacle. In this exercise, you will train an AI agent using reinforcement learning to play a simple version of the game snake. You will implement a TD version of the Q-learning algorithm.

SYLLABUS – V Semester / III Year

DATABASE MANAGEMENT SYSTEM

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:	21AM3501	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Understand** the concept of databases, **Apply** the Entity-Relationship Model and relational model for creating and designing databases for the real-world scenario.
2. **Develop** queries to extract data from the databases using a structured query language.
3. **Differentiate** SQL and NoSQL.
4. **Demonstration** of MongoDB and Database connectivity and **Optimize** the Database design using Normalization Concepts.
5. **Get the idea** of Transaction Management, Concurrency control mechanism and recovery techniques.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** clips to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**

INTRODUCTION TO DATABASE SYSTEMS:

Introduction, Characteristics of the Database Approach, Advantages of using DBMS Approach, Data Models, Schemas, Instances and Data Independence, Three Schema Architecture, various components of a DBMS. ***(Text Book-1: Chapter 1: 1.1 to 1.4, 1.6, Chapter 2: 2.1,2.2, 2.4)***

ENTITY-RELATIONSHIP MODEL:

Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; ER Diagrams ***(Text Book-1: Chapter 7: 7.3, 7.4, 7.5, 7.7)***.

UNIT – II	**08 Hours**

RELATIONAL MODEL:

Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update operations and Dealing with Constraint Violations. ***(Text Book-1: Chapter 3: 3.1 to 3.3).***

SQL –THE RELATIONAL DATABASE STANDARD:

SQL Data Definition and Data types, Specifying constraints in SQL, Basic Queries in SQL-Data Definition Language in SQL, Data Manipulation Language in SQL; ***(Text Book-1: Chapter 4: 4.1 to 4.4).***

UNIT – III	**08 Hours**

SQL –THE RELATIONAL DATABASE STANDARD:

Additional Features of SQL; Views (Virtual Tables) in SQL; Database Programming Issues and Techniques; ***(Text Book-1: Chapter 4: 4.5; Chapter 5: 5.1 to 5.4).***

SQL AND NOSQL DATA MANAGEMENT:

Triggers, Database connectivity using Python, SQL vs NoSQL, Introduction to MongoDB,
(Text Book-1: Chapter 5: 5.2,5.3) ***(Text Book-2 Chapter 1: 1.1 to 1.5***)

UNIT – IV	**08 Hours**

NOSQL DATA MANAGEMENT:
Data Types, Data Modelling, CRUD Operations. ***(Text Book-2 Chapter 1: 1.1 to 1.5***)
DATABASE DESIGN:
Design Guidelines, Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; ***(Text Book-1: Chapter 14: 14.1 to 14.5).***

UNIT – V	**07 Hours**

TRANSACTION MANAGEMENT
The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Concurrency Control Mechanisms; Error recovery methods, Firebase.
(Text Book-1: Chapter 20: 20.1 to 20.5, Chapter 21: 21.1 to 21.3, Chapter 22: 22.1 to 22.4)

Course Outcomes:

At the end of the course the student will be able to:

1. **Understand** the Database system and its characteristics. **Develop** database design using E-R model and Relational model. (L6)
2. **Develop** queries for the creation of the database and its data retrieval and **distinguish** between SQL and NoSQL. (L6)
3. **Describe** the Normalization techniques and **Analyse** and apply the database design using these normalization techniques. (L4)
4. **Apply** Mongo DB operations and establish Database connectivity. (L3)
5. **Understand** the transaction management, Concurrency management control, and error recovery techniques in database systems. (L2)

1. Table: Mapping Levels of COs to POs / PSOs

COs	**Program Outcomes (POs)**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	3	3	2	-	1	-	-	-	2	2	-	2	-	2	-
CO2	3	3	2	-	1	-	-	-	2	2	-	2	-	2	-
CO3	3	2	1	-	1	-	-	-	2	2	-	2	-	1	-
CO4	3	1	-	-	1	-	-	-	2	2	-	2	-	2	-
CO5	2	1	3	-	1	-	-	-	2	2	-	2	-	1	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Elmasri and Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2021.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", First Edition, Pearson Education, Inc. 2012.

REFERENCE BOOKS:

1. Elmasri and Navathe, "Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2015.

2. Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, Third Edition, McGraw-Hill, 2003.
3. Silberschatz, Korth and Sudharshan: “Database System Concepts”, Seventh Edition, Mc-GrawHill, 2019.
4. C.J. Date, A. Kannan, S. Swamynatham: “An Introduction to Database Systems”, Eight Edition, Pearson Education, 2012.

E-Resources:

1. http://nptel.ac.in/courses/106106093/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/lecture-notes/
3. http://agce.sets.edu.in/cse/ebook/DBMS%20BY%20RAGHU%20RAMAKRISHNAN.pdf
4. http://iips.icci.edu.iq/images/exam/databases-ramaz.pdf
5. https://db-class.org/
6. https://www.w3schools.com/mongodb/

Activity Based Learning (Suggested Activities in Class)

1. Database designing and data extraction using group discussion.

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INTRODUCTION TO NETWORKS AND CYBERSECURITY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:	21AM3502	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours + 26 Hours
L–T–P–S	:	3–0–2–0			

Course Learning Objectives:

This course will enable students to:

1. Understand networked applications and their protocols, their installation, operation and performance tuning.
2. Understand layering as a means of tackling complexity, layering applied to the Internet.
3. Understand protocols as a structured means of reliable communications.
4. Be conversant with network programming using the socket API.
5. Understand basic cryptography concepts – symmetric vs asymmetric cryptography, Public Key Crypto Infrastructure (PKI), Symmetric Ciphers, Hashing, Digital Signatures.
6. Understand the importance of cyber security (data confidentiality, Integrity, and Availability) and various recent attacks on important digital systems such as banking, e-commerce systems, e-governance systems etc.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** Clips to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**8 Hours**

Overview of the Internet: Protocol, Layering Scenario-(Physical layer,Data Link layer, Network layer, Transport layer, Session layer, Presentation layer, Application layer) ,TCP/IP Protocol Suite: The OSI Model, Internet Architecture; Comparison of the OSI and TCP/IP reference model. Top-down approach Application Layer: Principles of Network Applications, WEB and HTTP, FTP, E-MAIL(SMTP, POP3), TELNET, DNS, SNMP

Text book 1-Chapter 7

UNIT – II	**8 Hours**

Transport Layer: functions- Multiplexing and Demultiplexing. Introduction to TCP and UDP, The TCP Service Model, The TCP Segment Header, The TCP Connection Management, TCP Flow Control- Sliding Window, TCP Congestion Control, User Datagram Protocol.

Text book 1-Chapter 6

UNIT – III	**8 Hours**

Network Layer: Design issues, Routing Protocol Basics, Routing Algorithm (Distance Vector Routing, Link State Routing and Hierarchical Routing). IP addressing, IP Packet format IPV4, IPV6 and IP Tunnelling. Congestion control algorithms, QoS (Traffic Shaping, Packet Scheduling).

Text book 1-Chapter 5

UNIT – IV	**8 Hours**

Network Security: Overview of Network Security: Elements of Network Security , Classification of Network Attacks ,Security Methods ,Symmetric-Key Cryptography :Data Encryption Standard (DES),Advanced Encryption Standard (AES) , Public-Key Cryptography :RSA Algorithm ,Diffie-Hellman Key-Exchange Protocol , Authentication :Hash Function , Secure Hash Algorithm (SHA) , Digital

Signatures , Firewalls and Packet Filtering ,Packet Filtering , Proxy Server . **Text book 1-Chapter 8**
UNIT – V | **7 Hours**
Cyber warfare, case studies: Cyberwarfare and a case study of "Cyber Attack on Kudankulam Nuclear Power Plant A Wake-Up Call", Spyware, ransomware.
Course Outcomes: At the end of the course the student will be able to: 1. **Explain** the basics of Computer Networks and principles of application layer protocols. 2. **Recognize** transport layer services and infer UDP and TCP protocols and **Distinguish** between UDP and TCP Protocols. 3. **Solve** the problems related to Routing Algorithms and also perform the Interpretation of routers, Internet Protocol. 4. **Apply** the cryptographic algorithms for cyber security. 5. **Examine** the types of cyber-attacks. (L3)

1. Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	2	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	2	2	-	-	-	-	-	-	-	1	1	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017 .
2. Nader F Mir, Computer and Communication Networks, 2nd Edition, Pearson, 2014.

Reference Books:

1. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill,Indian Edition
2. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER
3. Andrew S Tanenbaum, Computer Networks, fifth edition, Pearson
4. Mayank Dave, Computer Networks, Second edition, Cengage Learning

E-Resources:

https://faculty.ksu.edu.sa/sites/default/files/computer_networks_-_a_tanenbaum_-_5th_edition.pdf

https://www.kaspersky.com/resource-center/definitions/what-is-cyber-security

https://www.geeksforgeeks.org/basics-computer-networking/

https://www.youtube.com/playlist?list=PLBlnK6fEyqRgMCUAG0XRw78UA8qnv6jEx

Free Cybersecurity Courses and Tutorials

https://www.udemy.com/topic/cyber-security/free/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_Catchall_la.EN_cc.INDIA&utm_content=deal4584&utm_term=_.ag_82569850245_.ad_533220805577_.kw_.de_.c_.dm_.pl_.ti_dsa-554065857551_.li_9062009_.pd_.&matchtype=&gclid=CjwKCAjw44mlBhAQEiwAqP3eVpL8hUJMH-mTsRa5iSNBdZnj2FSMkt9LpVhMazqOOldZFh6yjNKD1RoCxkAQAvD_BwE

Activity Based Learning (Suggested Activities in Class)

1. Collaborative Activity is minor project development with a team of 4 students.

Lab Experiments

1. Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.
2. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
3. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
4. Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.
5. Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
6. Write a program on datagram socket for client/server to display the messages on client side, typed at the server side.
7. Write a program for simple RSA algorithm to encrypt and decrypt the data.
8. Write a program for congestion control using leaky bucket algorithm.

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OOPS with Java

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:	21AM3503	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. Understand the basic concepts of object-oriented design techniques.
2. Understand the fundamentals of object-oriented programming with Java.
3. Make use of UML diagrams for the software system.
4. Impart basics of multi-threading and database connectivity.
5. Develop GUI using event handling techniques in Java.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**

An Overview of Object-Oriented Systems Development: Introduction; Two Orthogonal Views of the Software; Object-Oriented Systems Development Methodology; Why an Object-Oriented? Overview of the Unified Approach. Object Basics: Introduction; An Object- Oriented Philosophy; Objects; Objects are Grouped in Classes; Attributes: Object State and Properties; Object behavior and Methods; Object Respond to Messages; Encapsulation and Information Hiding; Class Hierarchy: Inheritance; Multiple Inheritance; Polymorphism; Object Relationships and Associations: Consumer-Producer Association; Aggregation and Object Containment; Case Study - A Payroll Program. **TEXT BOOK 1: CHAPTER 1**

UNIT – II	**08 Hours**

Introduction to Java: Java's Magic: The Bytecode; JVM; Object-Oriented Programming; Simple Java programs; Two Control Statements; Lexical Issues; Data Types; Variables, Arrays and String constructors; Operators; Control Statements; Introducing Classes: Class Fundamentals; objects; methods; constructors; this Keyword; Garbage Collection; finalize() method; Parameter Passing; Overloading; Access Control Keywords. Inheritance basics; method overriding; abstract classes; Packages and interfaces. Exception handling fundamentals; multiple catch; nested try statements. **TEXT BOOK 2: CHAPTER 9 &10**

UNIT – III	**08 Hours**

Multi-Threaded Programming: Multi-Threaded Programming: Java Thread Model; The main Thread; Creating a thread and multiple threads; Extending threads; Implementing Runnable; Synchronization; Inter Thread Communication; producer-consumer problem. Input/Output: I/O Basic; Reading console input Writing Console output.
TEXT BOOK 2: CHAPTER 11

UNIT – IV	**08 Hours**

Event and GUI Programming: Introducing Swing; The Origins of Swing; Swing Is Built on the AWT; Two Key Swing Features; The MVC Connection; Components and Containers; The Swing Packages; A Simple Swing Application; Event Handling; JLabel; JTextField; JButton **TEXT BOOK 2: CHAPTER 23**
UNIT – V | **07 Hours**
Database Access: The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Result Set. **TEXT BOOK 3: PART III**
Course Outcomes: At the end of the course the student will be able to: 1. Apply the concepts of object-oriented state and properties to design the system.(BTL – L3) 2. Develop Java programs using Java libraries and construct to solve real-time problems.(BTL-L6) 3. Understand, develop and apply various object-oriented features using Java to solve computational problems. (BTL- L2, L3, L6) 4. Implement Database access connectivity using JDBC Packages and JDBC connectivity in Java.(BTL- L3) 5. Test an event-oriented GUI (graphical user interface).(BTL- L4)

1. Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	3	1	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	1	2	1	-	-	-	-	-	-	-	-	2	-
CO3	3	2	3	2	2	1	-	-	-	-	-	-	2	2	-
CO4	3	3	2	3	2	1	-	-	2	2	2	-	-	2	-
CO5	3	3	2	3	3	1	-	-	2	2	2	-	-	2	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Schildt; Herbert. Java The Complete Reference; 11th Edition. TATA: McGraw-Hill Osborne Media; 2019.
2. Bahrami A.; Object Oriented Systems Development using the Unified Modeling Language; McGraw Hill; 1999.
3. Jim Keogh; J2EE: The Complete Reference; McGraw Hill Education in 2002.

REFERENCE BOOKS:

1. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
2. Y. Daniel Liang, Introduction to Java Programming, 7th edition, Pearson, 2013.

3. N. Singh, S. S. Chouhan and K. Verma, "Object Oriented Programming: Concepts, Limitations and Application Trends," *2021 5th International Conference on Information Systems and Computer Networks (ISCON)*, Mathura, India, 2021, pp. 1-4, doi: 10.1109/ISCON52037.2021.9702463.
4. S. Jian, W. Wenyong and W. Zebing, "A Teaching Path for Java Object Oriented Programming," *2009 International Forum on Information Technology and Applications*, Chengdu, China, 2009, pp. 465-468, doi: 10.1109/IFITA.2009.229.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

Activity Based Learning (Suggested Activities in Class)

1. Better Understanding the concept of **Multi-Threaded Programming and GUI Programming** using group discussion.
2. Collaborative Activity is minor project (using Java programming) development with a team of 4 students.

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MACHINE LEARNING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:	21AM3504	**Credits**	:	04
Hours / Week	:	05 Hours	**Total Hours**	:	39 Hours + 26 Hours
L–T–P–S	:	3–0–2–0			

Course Learning Objectives:

This course will enable students to:

1. **Describe** the basic concepts and different types of Machine Learning including Supervised learning, Unsupervised learning algorithms
2. **Explore** and analyze the mathematics behind Machine Learning algorithms and to gain a solid understanding of probability density functions, basics of sampling theorem and estimating the maximum likelihood.
3. **Explore** and analyze the mathematics behind Machine Learning algorithms and to gain a solid understanding of probability density functions, basics of sampling theorem and estimating the maximum likelihood.
4. **Apply** effectively Unsupervised Machine Learning algorithms and feature engineering techniques for solving appropriate real-world applications
5. **Evaluate** the performance of Machine Learning algorithms using appropriate metrics such as accuracy, precision, recall, FI Score.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**8 Hours**

INTRODUCTION TO MACHINE LEARNING

Well-posed learning problems, Designing a Learning system. Introduction to AI, Machine learning, and Deep learning with applications. Types of learning: supervised, unsupervised, and reinforcement learning. Perspective and Issues in Machine Learning.

Classical paradigm of solving learning problems, The learning problems--classes and types of learning, fundamental of statistical learning and its framework. Introduction to feature representation and extraction.

UNIT – II	**8 Hours**

MATHEMATICS FOR MACHINE LEARNING

Introduction to Statistics and Probability: joint probability, conditional probability, Bayes theorem, different distributions, univariate and multivariate Gaussian distribution, PDF, MLE, Motivation, estimating hypothesis accuracy, Basics of the sampling theorem, General approach for deriving confidence intervals, Difference in the error of two hypotheses, Comparing learning algorithms.

UNIT – III	8 Hours

SUPERVISED LEARNING

Introduction to Supervised Learning, Introduction to Perceptron model and its adaptive learning algorithms (gradient Decent and Stochastic Gradient Decent), Introduction to classification, Naive Bayes classification Binary and multi-class Classification, decision trees and random forest, Regression (methods of function estimation) --Linear regression and Non-linear regression, logistic regression, Introduction To Kernel Based Methods of machine learning: K-Nearest neighbourhood , kernel functions, SVM, Introduction to ensemble-based learning methods.

UNIT – IV	8 Hours

Unsupervised Learning

Introduction to Unsupervised Learning, Clustering (hard and soft clustering) Hierarchal clustering: K-means, Fuzzy C-Means (FCM) algorithm, Gaussian mixture models (GMM), Expectation Maximization algorithm, feature Engineering in Machine Learning, Dimensionality reduction, Linear Discriminant Analysis and Principle Component Analysis.

UNIT – V	7 Hours

MODEL SELECTION

Machine Learning model validation - Confusion Matrix, Accuracy, Precision, F score, Cost function, Machine Learning Optimization algorithms: Gradient descent, stochastic GD. Regularization: Normalization and Standardization overfitting, underfitting, optimal fit, bias, variance, cross-validation.

Course Outcomes:

At the end of the course, the student will be able to:

1. **Describe** the basic concepts and different types of Machine Learning including Supervised learning, Unsupervised learning algorithms. **Explore** and analyze the mathematics behind Machine Learning algorithms.(L4)
2. **Explore** and analyze the mathematics behind Machine Learning algorithms to gain a solid understanding of probability density functions, the basics of sampling theorem and estimating the maximum likelihood. (L4)
3. **Apply** the learned concepts of machine learning to interpret the supervised learning algorithms including regression and classification problems. (L3)
4. **Apply** effectively Unsupervised Machine Learning algorithms and feature engineering techniques for solving appropriate real-world applications. (L3)
5. **Evaluate** the performance of Machine Learning algorithms using appropriate metrics such as accuracy, precision, recall, FI Score. (L5)

2. Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	3	3	-	-	-	-	-	-	-	-	-	2	2	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	2	2	2	-
CO3	3	3	3	2	3	2	1	-	-	-	-	2	2	2	-
CO4	3	3	2	2	3	2	1	-	-	-	-	2	2	2	-

CO5	**2**	**2**	**2**	**2**	**3**	**2**	**1**	**-**	**3**	**-**	**-**	**2**	**2**	**2**	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. Thomas M. Mitchell, Machine Learning, McGraw- Hill, Inc. New York, ISBN: 0070428077 9780070428072, 1997.
2. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning series), The MIT Press; second edition, 2009.

REFERENCE BOOKS:

1. V. N. Vapnik " The Nature of statistical Learning" Statistics for Engineering and Information Science, Springer, 2000.
2. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).

E-Resources:

https://onlinecourses.nptel.ac.in/noc21_cs24/preview

Activity-Based Learning (Suggested Activities in Class)

1. Workshops/Seminar (ML Projects Based on Python)
2. Quiz

LIST OF LABORATORY/PRACTICAL EXPERIMENTS ACTIVITIES TO BE CONDUCTED

1. Implementation of linear and logistic regression
2. Implementation of SVM, KNN, Naïve Bayes ML algorithms
3. Implementation of Decision trees, Random Forest classifiers
4. Implement ensemble algorithms.
5. Implementation of different clustering algorithms and PCA
   Implementation of differentneural networks

Capstone project in specific domains (Health care, Transportation, Telecom etc.)

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PRINCIPLES OF ROBOTICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:	21AM3508	**Credits**	:	03
Hours / Week	:	05 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. Understand the concepts and importance of Robotics
2. Summarize various industrial and non-industrial applications of robots.
3. Identify robots and its peripherals for satisfactory operation
4. Understand Computational Motion Planning and Mobility
5. Understand Geometry of Image Formation, Estimation and Learning

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**10 Hours**

1.1 Recap of Preliminaries (4 Hrs)

Probability, Gaussian, Bayesian, Markov Process, Markov Chain and Monte Carlo Methods. Linear Algebra, Basics of Control System – Laplace Transform, Transfer function and State Space Models and Representations.

1.2 Basics (2 Hrs)

Introduction to notions of - Probabilistic Robotics, Basics of Robot Environment Interaction, States , Pose, Landmark, Control and Measurement data, Probabilistic Generative Laws, Belief Distribution for Robotics.

1.3 Introduction to Various Filters for Robot Estimation (4 Hrs)

Bayes Filter, Gaussian (Kalman Filter) and Particle Filters (Sequential Monte Carlo) (Note- Algorithms mostly without or minimal Mathematical Derivations)

Text Book Ref. Sebastian Thrun et.al. – Chapter 1 – 4

Text Book Ref. Bruno Siciliano et.al – Chapter 5

UNIT – II	**6 Hours**

2.1 Introduction to Robot Motion (3 Hrs)

Robot Motion - Kinematic Configuration, Probabilistic Kinematics,Velocity Motion Models, Odometry Motion Models, Introduction to Motion and Maps (Map based Motion Models)

2.2 Introduction to Robot Perception (3 Hrs)

Maps, Beam Models of Range Finders, Likelihood Fields for Range Finders, Correlation-Based Measurement Models, Feature-Based Measurement Models.

Text Book Ref. Sebastian Thrun et.al. – Chapter 5,6

UNIT – III	**8 Hours**

Localization

A Taxonomy of Localization Problems, Markov Localization, EKF Localization, UKF Localization, Grid

Localization, Monte Carlo Localization, Text Book Ref. Sebastian Thrun et.al. – Chapter 7,8	
UNIT – IV	**8 Hours**
Mapping Occupancy Grid Mapping, Simultaneous Localization and Mapping (SLAM), Introduction to GraphSLAM and FastSLAM Text Book Ref. Sebastian Thrun et.al. – Chapter 9,10,11,13, Text Book Ref. Bruno Siciliano et.al – Chapter 46	
UNIT – V	**7 Hours**
Planning and Control Markov Decision Processes(MDP) , Partially Observable Markov Decision Processes(POMDP), Exploration- Basic Exploration Algorithms, Greedy Techniques, Monte Carlo Exploration Basics of Reinforcement Learning for Robotics Introduction to Reinforcement learning, survey and introduction of reinforcement learning in Robotics (basics) Text Book Ref. Sebastian Thrun et.al. – Chapter 14,15,17 Chapter 2 J. Kober et.al. Reinforcement Learning in Robotics: A Survey	
Course Outcomes: At the end of the course, the student will be able to: 1. Apply a wealth of techniques and algorithms for the analysis of robots. (L3) 2. Identify factors that influence the robustness of robots in real- situations. (L2) 3. Development of necessary technical foundations for studies in advanced robotics. (L4)	

3. Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	3	3	2	-	2	-	-	-	3	2	-	2	2	-	3
CO2	3	3	2	-	2	-	-	-	3	2	-	2	2	-	3
CO3	3	2	2	-	2	-	-	-	3	2	-	2	2	-	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. Sebastian Thrun, Wolfram Burgard, and Dieter Fox., 2006. Probabilistic Robotics, MIT Press. ISBN:978-0-262-20162-9 (Main Text for Course)
2. Hand book of Robotics 2nd Edition, Bruno Siciliano, Oussama Khatib (Eds.) (Chapter 5 and 46). 2008
3. João Filipe Ferreira · Jorge Dias. Probabilistic Approaches for Robotic Perception Springer (Bayesian Part), 30 August 2013, DOIhttps://doi.org/10.1007/978-3-319-02006-8
4. Reinforcement Learning in Robotics: A Survey (Chapter 2) from J. Kober and J. Peters, Learning Motor Skills, Springer Tracts in Advanced Robotics 97,

REFERENCE BOOKS:

1. State Estimation for Robotics, TIMOTHY D . BARFOOT Cambridge University Press

2. Robin R. Murphy. 2014. Disaster Robotics. The MIT Press. ISBN:978-0-262-02735-9.
3. Sebbane, Y.B. (2022). A First Course in Aerial Robots and Drones (1st ed.). Chapman and Hall/CRC, ISBN 978-1-003-12178-7
4. Peter cork,Robotics, 2017,Vision and Control (2nd ed.),springer tracts in advanced Robotics.
5. Simon J.D. Prince,Computer Vision: Models, Learning, and Inference,Cambridge University press
6. Robin R. Murphy. 2019. Introduction to AI Robotics (Second Edition). MIT Press, Cambridge, MA, USA. ISBN: 978-0-262-03848-5
7. Kevin M. Lynch and Frank C. Park. 2017. Modern Robotics: Mechanics, Planning, and Control., Cambridge University Press, USA. ISBN:978-1-107-15630-2.

E-Resources:

1. https://www.youtube.com/watch?v=ItYJQQJU9lE
2. https://www.youtube.com/watch?v=GlNbLpYdADw
3. https://www.youtube.com/watch?v=fjhGDxlGtJU
4. https://people.eecs.berkeley.edu/~pabbeel/cs287-fa15/
5. https://courses.cs.washington.edu/courses/cse571/22sp/
6. NPTEL: https://www.youtube.com/watch?v=j7BVHy231B0&list=PLyqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH&index=30

Activity Based Learning (Suggested Activities in Class)

-NIL-

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MACHINE LEARNING FOR PATTERN RECOGNITION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:	21AM3509	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Summarize** the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms.
2. **use** the feature extraction techniques on the given data**.**
3. **Make use of** both supervised and unsupervised classification methods to detect and characterize patterns of image, text data.
4. **Apply** the different Neural Network techniques to handle the given problems.
5. **Build** prototype of pattern recognition algorithms that can be used to study algorithm behaviour and performance against real-world data.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**

Introduction to Pattern Recognition, Phases in Pattern Recognition System, Different approaches to Pattern Recognition, Tools and process of finding patterns in data, Pattern Class, pattern recognition examples, Machine perception.

The Sub-problems of Pattern Classification Systems: Feature Extraction, cost of miss classification, Multiple Features, Model complexity, Missing Features, Segmentation and Pattern recognition systems-Two Phases.

Learning and Adaptation: Supervised Learning, Unsupervised Learning, Reinforcement Learning. (Text-1-Chapter 1)

UNIT – II	**08 Hours**

Feature Extraction from The Pattern: Shape Feature Extraction: Chain Code, Differential Chain Code, Splitting Technique. Region Feature Extraction: Texture Feature-Spatial Domain Feature and Transformed Domain Feature.

Bayes Decision Theory: Decision Rule, Class-Conditional Probability Density Function, Bayes' Formula, Generalization of Bayes Theory. Minimum Error Rate Classification: Minimum Risk Classifier, Maximum Likelihood Estimation. (Text 1: Chapter 2 And 3 And Text 2: Chapter 3)

UNIT – III	**08 Hours**

Introduction To Clustering; Different Distance Measures and Criterion Functions for Clustering, Techniques: K-Mean Clustering, Hierarchical Clustering - Agglomerative and Divisive Clustering, DB Scan, Mean Shift Clustering and appropriate Applications. (Text -1-CH:10)

UNIT – IV	**08 Hours**

Introduction To Neural Network: Multilayer Neural Network: Feedforward Operation and Classification, Backpropagation Algorithm. Introduction To Hessian and Jacobian Matrix, Probabilistic Neural Network, Bayesian Neural Network and Convolutional Neural Networks (CNN), Recurrent Neural Network. (Text1: Chapter 6 , Text2:Chapter 5)
UNIT – V **07 Hours**
Image And Speech Based Machine Learning for Pattern Recognition Applications: (Eg. Approaches Like Speech Recognition, Fingerprint Recognition, Character Recognition, Pattern Recognition Approaches). (Case Study).
Course Outcomes: At the end of the course the student will be able to: 1. **Summarize** the fundamentals of pattern recognition. 2. **Make use of** the Feature Extraction techniques for solving problems in pattern recognition. 3. **Distinguish** between Supervised and Unsupervised Classification techniques in Pattern Recognition. 4. **Apply** the different Neural Network techniques to handle the given problems. 5. **Develop** prototype of pattern recognition algorithms that can be used to study algorithm behaviour and performance against real-world data.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI	develop, and test principles of AI concepts on Intelligent Systems
CO1	1	-	-	-	1	-	-	-	2	2	-	-	2	2	2
CO2	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO3	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO4	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO5	3	3	2	-	1	-	-	-	2	2	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Richard O. Duda, peter E. Hart and David G. Stork" Pattern Classification", 2ND Edition, Wiley Interscience, 2012.
2. Christopher M. Bishop," Pattern Recognition and Machine Learning", Springer Science, Business Media, LLC, 2012 .

REFERENCE BOOKS:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Richard O. Duda, peter E. Hart and David G. Stork" Pattern Classification", 2ND Edition, Wiley Interscience, 2007.
3. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, JohnWiley& Sons Inc., New York, 2007.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ee56/

2. https://nptel.ac.in/courses/106106046

Activity Based Learning (Suggested Activities in Class)

1. Quiz.
2. Collaborative Activity is minor project development with a team of 4 students.

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OPERATING SYSTEM WITH UNIX

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:	221AM3510	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. To understand the basic concepts and functions of operating systems.
2. To understand Processes and Threads
3. To analyze Scheduling algorithms.
4. To understand the concept of Deadlocks.
5. To analyze various Memory.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I : OS Overview and System Structure	**06 Hours**

Introduction to operating systems and System structures, Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Computing environments. Operating System Services: User - Operating System interface; System calls; Types of system calls;

System programs; Operating system design and implementation; Operating System structure; Virtual machines.

UNIT – II: Process Management and Process Coordination	**10 Hours**

Process Management: Process concept; Process scheduling; Operations on processes. Multi-threaded Programming: Overview; Multithreading models; Threading issues.

Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms.

Process Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors Deadlocks: Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

UNIT – III: Memory Management	**10 Hours**

Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

UNIT – IV: Fundamentals of UNIX	06 Hours
Salient features, Unix Components, types of shell, Internal and External commands, Files and File Organization- Categories of files, Unix file system, directories, file related commands, Directory related commands, wild cards, Printing and Comparing files. Ownership of files, File attributes File permissions and Manipulations, Standard I/O, Redirection, pipe, filter.	
UNIT – V	**07 Hours**
Vi Editor and Regular expressions, the grep command, The process - parent and child process, process creation, process related commands, Shell Programming - shell script features, shell variables, writing and executing a shell script, positional parameters, Branching control structures- if, case etc., Loop control structures– while, until, for, etc., Jumping control structures – break, continue, exit, etc., Integer and Real arithmetic in shell programs, Debugging scripts.	

Course Outcomes:

At the end of the course the student will be able to:

1. **Explain** OS and different types of OS
2. **Make use of** CPU Scheduling, Synchronization, Deadlock Handling to solve the given problems.
3. **Describe** the process management and memory management techniques in OS.
4. **Summarize** the fundamentals of the UNIX operating system.
5. **Utilise** the UNIX shell programming for handling the given task.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI	develop, and test principles of AI concepts on Intelligent Systems
CO1	2												1		
CO2	3	2							1	1			1		
CO3	3	2							1	1			1		
CO4	2				1								1		
CO5	3				1								1		

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2010.
2. Sumitabha Das., Unix Concepts and Applications., 4thEdition., Tata McGraw Hill.

REFERENCE BOOKS:

1. Operating Systems-Internals and Design Principles, William Stallings, 6th Edition, Pearson Education, 2009.
2. Operating Systems: A Modern Perspective, Gary J. Nutt, Addison-Wesley, 1997.
3. M.G. Venkatesh Murthy: UNIX & Shell Programming, Pearson Education.

E-Resources:

-NIL-

Activity Based Learning (Suggested Activities in Class)

1. Quiz.
2. Group Discussion.

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INDUSTRIAL ROBOTICS (OPEN ELECTIVE)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	21OE0026			03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. Understand the configuration space with specific reference to robotic motion
2. Understand different types of kinematics used in industrial robotics.
3. To understand motion planning in industrial robotics.
4. Understand Computational Motion Planning and Mobility
5. Understand the concept of grasping and manipulation.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I :	**08 Hours**

Introduction Configuration Space: Foundations of Robot Motion-Degrees of Freedom of a Rigid Body-Degrees of Freedom of a Robot-Configuration Space Representation Configuration and Velocity Constraints-Task Space and Workspace.

Rigid-Body Motions: Introduction to Rigid-Body Motions-Rotation Matrices-Angular Velocities-Homogeneous Transformation Matrices.

UNIT – II:	**08 Hours**

Forward Kinematics: Forward Kinematics Example- Velocity Kinematics and Statics: Introduction to Velocity Kinematics and Statics-Space Jacobian-Body Jacobian, Inverse Kinematics: Inverse Kinematics of Open Chains.

UNIT – III:	08 Hours
Kinematics of Closed Chains: Dynamics of Open Chains- Lagrangian Formulation of Dynamics-Understanding the Mass Matrix, Newton-Euler Inverse Dynamics, Trajectory Generation: Point-to-Point Trajectories-Polynomial Via Point Trajectories-Time-Optimal Time Scaling.	
UNIT – IV:	**07 Hours**
Motion Planning: Overview of Motion Planning, Robot Control, Control System Overview-Error Response-Linear Error Dynamics-First-Order Error Dynamics-Second-Order Error Dynamics-Motion Control with Velocity Inputs - Motion Control with Torque or Force Inputs.	
UNIT – V:	**08 Hours**
Grasping and Manipulation: First-Order Analysis of a Single Contact Contact Types: Rolling, Sliding, and Breaking-Multiple Contacts, Force Closure-Duality of Force and Motion Freedoms, Omnidirectional Wheeled Mobile Robots-Controllability of Wheeled Mobile Robots	
Course Outcomes: At the end of the course the student will be able to: 1. Design and Demonstrate Physics-based modeling of robots. (L4) 2. Ability to design path planning algorithms. (L4) 3. Development of necessary technical foundations for studies of advanced robots like soft robots, spherical robots etc (L3)	

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)													PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data storage, data analytics	develop, and test principles of AI concepts on Intelligent Systems
CO1	**3**	**2**	**1**		**2**								**1**		**2**
CO2	**1**	**3**	**2**		**2**								**1**		**2**
CO3	**1**	**2**	**3**		**2**								**1**		**2**

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. Introduction to Robotics - Mechanics and Control, 3rd Edition, 2005, Author: John J. Craig, Publisher. Pearson Education, Inc

2. Kevin M. Lynch and Frank C. Park. 2017. Modern Robotics: Mechanics, Planning,and Control., Cambridge University Press, USA. ISBN:978-1-107-15630-2.

Reference Books:

1. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). Robot Modeling andControl, 2nd Edition. Wiley, ISBN: 978-1-119-52404-5.
2. Peter cork, Robotics, 2017, Vision and Control (2nd ed.), springer tracts inadvanced Robotics.
3. Simon J.D. Prince,Computer Vision: Models, Learning, and Inference, Cambridge University press
4. Ghosal, A. (2015). Robotics: Fundamental concepts and analysis. Oxford: Oxford University Press. ISBN: 978-0-195-67391-3.

E-Resources:

-NIL-

Activity Based Learning (Suggested Activities in Class)

-NIL-

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ARTIFICIAL INTELLIGENCE (OPEN ELECTIVE)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code :21OE0001	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. To provide a strong foundation of fundamental concepts in artificial intelligence.
2. To provide a basic exposition to different types of searching in Artificial intelligence.
3. To provide different knowledge representation, reasoning, and learning techniques.
4. To distinguish the different types of Experts Systems.
5. To design the Expert System based on the concepts of knowledge representation, searching and Reasoning on various applications using modernised AI tools.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**

Introduction: Artificial Intelligence, AI Problems, AI Techniques: supervised learning, unsupervised learning, and reinforcement learning, Different Types of Agents: Simple reflex agents, Model-based reflex agents, Goal-based agents and Utility-based agents; Environment, Problem Space and Search, Defining the Problem as a State Space Search, Problem Characteristics.
Textbook 2: Chapter 1,2

UNIT – II	**08 Hours**

Basic Search Techniques: Solving problems by searching; issues in the design of search programs; uniform search strategies: Breadth first search, Depth first search, Depth limited search, Bidirectional search, Best First search.
Textbook 3: Chapter 3, 4; Textbook 2: Chapter 2, 3

UNIT – III	**08 Hours**

Special Search Techniques: Heuristic Search, greedy best first search, A* search, AO*Algorithm, Hill climbing search, Simulated Annealing search, Adversarial search, Minimax search, Alpha, beta pruning, Genetic Algorithm.
Knowledge Representation: Procedural Vs Declarative Knowledge, Approaches to Knowledge Representation, Forward Vs Backward Reasoning.
Textbook 1: Chapter 5; Textbook 2: Chapter 3, 6

UNIT – IV	**07 Hours**

Symbolic Logic: Propositional Logic, First Order Predicate Logic: Representing Instance and isa Relationships.
Reasoning: Introduction to Monotonic Reasoning and Non-Monotonic Reasoning.

Statistical Reasoning: Bayes Theorem, Certainty Factors, Bayesian Networks, Dempster-Shafer Theory.
Textbook 2: Chapter 7,8

UNIT – V	08 Hours

Experts Systems: Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems: Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Building System Tools, Expert System Shells and Fuzzy Expert systems.
Textbook 1: Chapter 8,9; Textbook 2: Chapter 20,22

Course Outcomes:

At the end of the course the student will be able to:

1. **Summarize** the basic concepts of Artificial Intelligence, AI principles, AI Task domains and applications.
2. **Apply** the different types of searching and knowledge representations techniques to solve the AI problems.
3. **Make use of** the different types of reasoning such as Monotonic Reasoning, Non-Monotonic Reasoning and Statistical Reasoning techniques for making analysis and predictions.
4. **Differentiate** the various types of Experts Systems such as Rule Based, Model Based, Case Based, Hybrid and Fuzzy Expert Systems.
5. **Design** the Expert System based on the concepts of knowledge representation, searching and Reasoning on various applications using modernised AI tools.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data	develop, and test principles of AI concepts on Intelligent Systems
CO1	2				2	1			1	1			2	2	2
CO2	3	2			2	1			1	1			2	2	2
CO3	3	2			2	1			1	1			2	2	2
CO4	3	2			2	1			1	1			2	2	2
CO5	3	3	2		2	1			1	1			2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. Artificial Intelligence, George F Luger, Sixth Edition, Pearson Education Publications, 2014.
2. Artificial Intelligence, Elaine Rich and Knight, McGraw-Hill Publications, 2010.

Reference Books:

1. Artificial Intelligence: A modern Approach, Russell and Norvig, Printice Hall, 2010.
2. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI.
3. Multi Agent systems- a modern approach to Distributed Artificial intelligence, Weiss. G, MIT Press.
4. Artificial Intelligence: A modern Approach, Russell and Norvig, Printice Hall.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2. https://onlinecourses.nptel.ac.in/noc23_ge40/preview

Activity Based Learning (Suggested Activities in Class)

2. Flipped Class Activity on Searching techniques.
3. Problem Solving and Discussion.
4. Role Play
5. Mini Project

Special topic -1 rules and guidelines

For conductions of Special topic-1 for 4th Sem held in academic year 2022-2023

1. **Project Proposal**: Students are typically required to submit a project proposal outlining the objectives, methodology, timeline, and expected outcomes of their project. The proposal may need to be approved by a faculty advisor or a project committee before proceeding.
2. **Ethical Considerations:** Projects involving human subjects, sensitive data, or potentially harmful experiments must adhere to ethical guidelines and regulations. This may involve obtaining informed consent, ensuring participant confidentiality, and obtaining necessary approvals from an ethics review board.
3. **Project Supervision:** A faculty member or an assigned advisor usually provides guidance and supervision throughout the project. They may offer suggestions, monitor progress, and provide feedback to ensure the project stays on track.
4. **Timeline and Milestones:** Projects often have specific timelines and milestones that students must adhere to. This helps in monitoring progress and ensures that the project is completed within the given timeframe. Regular progress reports or presentations may be required to update the project committee or advisor.
5. **Research and Citations:** Depending on the nature of the project, students are expected to conduct thorough research to support their work. It is essential to properly cite all sources using an appropriate referencing style to avoid plagiarism.
6. **Documentation:** Students are usually required to maintain detailed documentation of their project work, including experimental procedures, data collection methods, and analysis techniques. This documentation helps in the evaluation process and is crucial for the final project report.
7. **Presentation and Défense:** Two presentations will be held, first presentations will be conducted after 1st internals and 2nd presentations is at the end of the semester, students may be required to present their work to a project committee or academic panel. This presentation provides an opportunity to showcase their findings, methodology, and conclusions. The committee may ask questions and evaluate the project during a defence session.
8. **Academic Integrity:** Students are expected to adhere to the principles of academic integrity throughout their project. This includes avoiding plagiarism, properly attributing sources, and maintaining high ethical standards in research and data analysis.
9. **Marks distributions:**

Review -I split up for 50 Marks

1. Domain Selection and Literature Survey -15 Marks
2. Problem Statement- 10 Marks
3. Design and proposed methodology -10 Marks
4. Q&A and Presentation skills -10 Marks
5. Weekly Progress report -05 Marks

Review -2 split up for 50 Marks

1. Implementation and Demonstration-15 Marks
2. Result Analysis and Testing- 10 Marks
3. Q&A and Presentation skills - 10 Marks
4. Project Report -10 Marks
5. Paper Writing/Publication -05 Marks

Both the review can be taken for 50marks, **Review-1** can be considered as CIE marks and can be scaleup to 60marks and displayed for students once the Review-1 is completed and **Review-2** can be considered as SEE marks and can be scale down to 40marks and should be kept confidential and displayed at the end of the semester exams results

It is essential to consult the specific guidelines and regulations provided by your university and department, as they may have additional requirements or variations. Your faculty advisor or project committee should also be able to provide guidance and clarification on the rules and regulations that apply to your specific project.

Special topic-1 report generations rules and regulations

1. Project reports should be typed neatly only on one side of the paper with 1.5 or double line spacing on a A4 size bond paper (210 x 297 mm). The margins should be: Left – 1.25″, Right – 1″, Top and Bottom – 0.75″.
2. The total number of reports to be prepared are
    1. One copy to the department
    2. One copy to the concerned guide(s)
    3. All the individuals' copies
3. Before taking the final printout, the approval of the concerned guide(s) is mandatory and suggested corrections, if any, must be incorporated.
4. For making copies dry tone Xerox is suggested.
5. Every copy of the report must contain
    - Inner title page (White)
    - Outer title page with a plastic cover

- Certificate in the format enclosed.

6. An abstract (synopsis) not exceeding 100 words, indicating salient features of the work. (NB: four copies of the abstract are to be submitted to the Department on the date of submission separately)
7. The organization of the report should be as follows
   - Inner title page
   - Abstract or Synopsis
   - Acknowledgments
   - Table of Contents
   - List of table & figures (optional)
   - Usually numbered in roman
8. Chapters (to be numbered in Arabic) containing Introduction-, which usually specifies the scope of work and its importance and relation to previous work and the present developments, Main body of the report divided appropriately into chapters, sections and subsections.
9. The chapters, sections and subsections may be numbered in the decimal form for e.g. Chapter 2, sections as 2.1, 2.2 etc., and subsections as 2.2.3, 2.5.1 etc.
10. The chapter must be left or right justified (font size 16). Followed by the title of chapter cantered (font size 18), section/subsection numbers along with their headings must be left justified with section number and its heading in font size 16 and subsection and its heading in font size 14. The body or the text of the report should have font size 12.
11. The figures and tables must be numbered chapter wise for e.g.: Fig. 2.1 Block diagram of a serial binary adder, Table 3.1 Primitive flow table, etc.
12. The last chapter should contain the summary of the work carried, contributions if any, their utility along with the scope for further work.
13. Reference OR Bibliography: The references should be numbered serially in the order of their occurrence in the text and their numbers should be indicated within square brackets for e.g. [3]. The section on references should list them in serial order in the following format.
14. For textbooks – A.V. Oppenheim and R.W. Schafer, Digital Signal Processing, Englewood, N.J., Prentice Hall, 3 Edition, 1975.
15. For papers – Devid, Insulation design to combat pollution problem, Proc of IEEE, PAS, Vol 71, Aug 1981, pp 1901-1907.
16. Only SI units are to be used in the report. Important equations must be numbered in decimal form for e.g.

V = IZ..... (3.2)

17. All equation numbers should be right justified.

18. The project report should be brief and include descriptions of work carried out by others only to the minimum extent necessary. Verbatim reproduction of material available elsewhere should be strictly avoided. Where short excerpts from published work are desired to be included, they should be within quotation marks appropriately referenced.
19. Proper attention is to be paid not only to the technical contents but also to the organization of the report and clarity of the expression. Due care should be taken to avoid spelling and typing errors. The student should note that report-write-up forms the important component in the overall evaluation of the project
20. Hardware projects must include: the component layout, complete circuit with the component list containing the name of the component, numbers used, etc. and the main component data sheets as Appendix. At the time of report submissions, the students must hand over a copy of these details to the project coordinator and see that they are entered in proper registers maintained in the department.
21. Software projects must include a virus free disc, containing the software developed by them along with the read me file. Read me file should contain the details of the variables used, salient features of the software and procedure of using them: compiling procedure, details of the computer hardware/software requirements to run the same, etc. If the developed software uses any public domain software downloaded from some site, then the address of the site along with the module name etc. must be included on a separate sheet. It must be properly acknowledged in the acknowledgments.
22. Sponsored Projects must also satisfy the above requirements along with statement of accounts, bills for the same dully attested by the concerned guides to process further, They must also produce NOC from the concerned guide before taking the internal viva examination.
23. The reports submitted to the department/guide(s) must be hard bounded, with a plastic covering.
24. Separator sheets, used if any, between chapters, should be of thin paper.

DATA BASE MANAGEMENT SYSTEMS LABORATORY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:	21AM3506	**Credits**	:	01
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P–S	:	0–0–2–0			

Course Learning Objectives:

This course will enable students to:

1. **Designing** and creating relational database systems.
2. **Demonstrate the** queries to extract data from the databases using a structured query language.
3. **Demonstrating MongoDB and Database connectivity and Optimizing** the Database design using Normalization Concepts.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

List of Laboratory/Practical Experiments activities to be conducted:

#	Name of the Experiment
1	**Consider the following schema for Employee Database:** EMP(Fname, SSN, Bdate, Address, Sex, Salary, Mssn,DNO) DEPARTMENT (Dept_name, Dnumber ,mgrssn , mgrstartdate) DEPT_LOCATION (Dnumber,Dlocation) PROJECT(Pname,Pnumber, Plocation, Dnum) WORKS_ON(ESSN,Pno, Hours) DEPENDENT(ESSN,Dname,Sex,Relationship) Write SQL statements to 1. Create table for the database given above , assume appropriate data type for columns specified for each table 2. Add the column Lname and Minit in EMP table 3. Rename table EMP to EMPLOYEE 4. Rename column MSSN to SuperSSN 5. Insert relevant records in all the tables.
2	**Consider the following schema for Employee Database:** EMPLOYEE(Fname,Minit,Lname SSN, Bdate, Address, Sex, Salary, Mssn,DNO) DEPARTMENT (Dept_name, Dnumber ,mgrssn , mgrstartdate) DEPT_LOCATION (Dnumber,Dlocation) PROJECT(Pname,Pnumber, Plocation, Dnum) WORKS_ON(ESSN,Pno, Hours) DEPENDENT(ESSN,Dname,Sex,Relationship)

	Write SQL statements to 1. Display firstname ,date of birth , salary of female employees. 2. Retrieve the name , ssn and address of emplyees whose salary is greater than 50000. 3. Retrieve the name ,ssn and address of male employees whose salary is less than 30000. 4. Retrieve the SSN values of all employees. 5. Retrieve all the imformation from employees and the department, who work in Department No 5. 6. Retrieve the birthday and address of employee whose name is ' Rahul M Singh'
3	**Consider the following schema for Employee Database:** EMPLOYEE(Fname,Minit,Lname SSN, Bdate, Address, Sex, Salary, SUPERSSN,DNO) DEPARTMENT (Dname, Dnumber ,mgrssn , mgrstartdate) DEPT_LOCATION (Dnumber,Dlocation) PROJECT(Pname,Pnumber, Plocation, Dnum) WORKS_ON(ESSN,Pno, Hours) DEPENDENT(ESSN,Dname,Sex,Relationship) Write SQL statements to 1. Retrieve all the information from employee and department who works in Research department 2. Retrieve the name and address of employees who work in research department. 2. Retrieve the details of all the employees who works in department 5 and salary is between 30,000 and 40,000. 3. For every project located in 'Bangalore', list project number , the controlling department number, department managers lastname, address and birthdate. 4. Retrieve the name of employees who have no dependents. 5. Retrieve the social security number of all employees who work on project number 1,2 or 3 . 6. Retrieve the name of all employees who do not have supervisiors.
4	**Consider the following schema for Employee Database:** EMPLOYEE(Fname,Minit,Lname SSN, Bdate, Address, Sex, Salary, SUPETSSN,DNO) DEPARTMENT (Dname, Dnumber ,mgrssn , mgrstartdate) DEPT_LOCATION (Dnumber,Dlocation) PROJECT(Pname,Pnumber, Plocation, Dnum)

	WORKS_ON(ESSN,Pno, Hours) DEPENDENT(ESSN,Dname,Sex,Relationship) Write SQL statements to 1. Find the sum of salaries of all employee, maximum salary, minimum salary and average salary. 2. Find the sum of salaries of employees of 'Research 'department as well as maximum salary ,minimum salary and average salary in this department. 3. Retrieve the total number of employees in the 'Research Department'. 4. Count the number of distinct salary values in the database. 5. Retrieve the names of all employees who have two or more dependents.
6	**Consider the following schema** EMP(EMPNO,ENAME,JOB,MGR,HIREDATE, SAL,COMM,DEPTNO) EMPCHGLOG(SYSDATE, EMPNO,ACTION) 1. Write a trigger (EMP_COMM_TRIG) which calculates the commission of every new employee belonging to department 30 before a record for that employee is inserted into the EMP table. 2. When an employee row is deleted from the EMP table, the trigger (EMP_DEL_TRIG) adds a row to the EMPLOYEE table with a description of the action.
7	1. Write a Program to insert one document into a collection in MongoDB Database 2. Write a program code to perform CRUD operations.

Course Outcomes:

At the end of the course the student will be able to:

1. Identify database language commands to create a simple database **(L2)**
2. Analyze the database using queries to retrieve records **(L4)**
3. Implement CRUD Operation in MongoDB for storage management **(L3)**
4. Design and Implement a Database schema for a given problem domain**(L3)**
5. Develop solutions using database concepts for real-time requirements**(L3)**

Table: Mapping Levels of COs to POs / PSOs															
COs	**Program Outcomes (POs)**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
	Engineering knowledge	Problem analysis	Design	Conduct investigations of	tool usage	The engineer	Environment and sustainabili	Ethics	Teamwork	Communication	Life-long learning	Project management and finance			
CO1	3	3	1						2	2		2		2	
CO2	3	3	1		2				2	2		2		2	
CO3	3	3	2		3				2	2		3		1	
CO4	3	3	3		2				2	2		3		2	
CO5	3	3	3		3				2	2		3		2	

TEXT BOOKS:

1. Elmasri and Navathe, "Fundamentals of Database Systems", Sixth and Seventh Edition, Pearson Education, 2021, 2015.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", First Edition, Pearson Education, Inc. 2012.

REFERENCE BOOKS:

1. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Third Edition, McGraw-Hill, 2003.
2. Silberschatz, Korth and Sudharshan: "Database System Concepts", Seventh Edition, Mc-GrawHill, 2019.
3. C.J. Date, A. Kannan, S. Swamynatham: "An Introduction to Database Systems", Eight Edition, Pearson Education, 2012.

E-Resources:

1. http://nptel.ac.in/courses/106106093/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/lecture-notes/
3. http://agce.sets.edu.in/cse/ebook/DBMS%20BY%20RAGHU%20RAMAKRISHNAN.pdf
4. http://iips.icci.edu.iq/images/exam/databases-ramaz.pdf
5. https://db-class.org/
6. https://www.w3schools.com/mongodb/

Activity Based Learning (Suggested Activities in Class)

1. Collaborative Activity is minor project development with a team of 4 students.

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OOP WITH JAVA LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	: 21AM3507	**Credits**	: 01
Hours/ Week	: 03 Hours	**Total Hours**	: 26 Hours
L–T–P–S	: 3–0–0–0		

Course Learning Objectives:

This course will enable students to:

1. To learn an object-oriented way of solving problems using Java.
2. To write Java programs using multithreading concepts and handle exceptions
3. To write Java programs that connect to a database and be able to perform various operations.
4. To create the Graphical User Interface using AWT Components & Swing Components.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

List of Laboratory/Practical Experiments activities to be conducted

1. Basic programs using data types, operators, and control statements in Java.

Develop a Java application to generate Electricity bills. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff.

If the type of the EB connection is domestic, calculate the amount to be paid as follows:

- First 100 units - Rs. 1 per unit
- 101-200 units - Rs. 2.50 per unit
- 201 -500 units - Rs. 4 per unit
- >501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

- First 100 units - Rs. 2 per unit
- 101-200 units - Rs. 4.50 per unit
- 201 -500 units - Rs. 6 per unit
- > 501 units - Rs. 7 per unit

2. Write a Java program to move all 0's to the end of an array. Maintain the relative order of the other (non-zero) array elements.

3. Object Oriented Programming Concepts: Problem on the use of constructors, inheritance, method overloading & overriding, polymorphism and garbage collection

4. Programs involving: Exception handling, Multi-threading in Java

Write a Java program to create multiple Exceptions.

Write a Java program to create multiple threads in Java. Explain all thread methods with examples.

5. Programs involving: Packages, Interfaces in Java

For a library management system design BookList, MemberList and Transaction packages. Booklist package will have the support to store book information in the list like book id, title, total number of

copies purchased, and number of copies currently available. One can add book in list (verifying uniqueness of book id), change the attribute values (particularly, increase/decrease copies purchased, available as and when required), display particular book information (for a book id) and also total list. MemberList package will provide the service for maintaining member information. Member information includes member id (unique), name, date of birth and number of books currently issued to him. There is a limit on number of books one can have at a point of time (it is same for all members). Transaction package maintains a list of transaction. A transaction entry in the list keeps member id, book id of the book being issued. Supports are to be provided to modify the entries. An entry with member id 'xxxx' can be used for adding a new entry.
Using the packages, develop a system that can do the following:
i) Add new book in booklist ii) Add more copies for a book iii) Show all book details iv) Show details of a book v) Add member in the list vi) show all members vii) show details of a member viii) Issue a book (check book validity and availability, check member validity and eligibility to get a book, once passes through the validations add an entry into transaction list and update counts in corresponding booklist and memberlist entries) ix) book return book (check the validity of corresponding issue with book id and member id and once passes through the validations update the transaction entry by marking member id as 'xxxx' and update counts in corresponding booklist and memberlist entries)
Consider the list as arrays. While working with arrays it is to be ensured that use of indices out of the range is reported.

6. Programs involving: Input and Output in Java

Consider the packages designed in previous question. Design an interface to ensure that the library management must have the option i) add book ii) search book iii) view all book iv) add member v) search a member vii) view all members viii) issue book ix) return book. Design the system by implementing the interface.

7. GUI Programming in Java

(a) Create a program using java swing to demonstrate a table with the following fields: name, roll number, department. Use JTable
(b) To creates User Interface to perform Integer Divisons. The user enters two numbers in text fields, Num1 and Num2.The division of Num1 and Num2 is displayed in the result field when the divide button clicked. If Num1 or Num2 were not integer, the program would throw a NumberFormatException, If Num2 is Zero, and the program would throw an Athematic Exception. Display the Exception in message box.

8. Programs involving : Database connectivity in Java

Write a program to implement Create, Retrieve operations for the registration of Student details using JDBC,HSQLDB.

9. Mini Project

Course Outcomes:

At the end of the course, the student will be able to:

1. Develop simple Java programs that make use of classes and objects
2. Write Java application programs using OOP principles and proper program structuring.
3. Make use of inheritance and interfaces to develop Java application
4. Model exception handling, and multi-threading concepts in Java
5. Create the Graphical User Interface-based application programs by utilizing event handling features and Swing in Java
6. Develop a Java program that connects to a database and is able to perform various operations.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)	PSOs

	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI	develop, and test principles of AI concepts on Intelligent Systems
CO1	**3**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	-
CO2	**3**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	-
CO3	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	-
CO4	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**1**	**1**	-
CO5	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**-**	**1**	**2**	-
CO6	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**2**	**2**	**-**	**-**	**1**	**2**	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Bahrami A.; Object Oriented Systems Development using the Unified Modeling Language; McGraw Hill; 1999.
2. Schildt; Herbert. Java The Complete Reference; 11th Edition. Tata: McGraw-Hill Osborne Media, 2019.
3. Jim Keogh; J2EE: The Complete Reference; McGraw Hill Education in 2002.

REFERENCE BOOKS:

1. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
2. Y. Daniel Liang, Introduction to Java Programming, 7th edition, Pearson, 2013.
3. N. Singh, S. S. Chouhan and K. Verma, "Object Oriented Programming: Concepts, Limitations and Application Trends," *2021 5th International Conference on Information Systems and Computer Networks (ISCON)*, Mathura, India, 2021, pp. 1-4, doi: 10.1109/ISCON52037.2021.9702463.

E-Resources:

https://nptel.ac.in/courses/106105191

Activity-Based Learning (Suggested Activities in Class)

1. Workshops/Seminars (AIML Projects based on Java)
2. Quiz based on Programming

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SYLLABUS – VI Semester / III Year

COMPILER DESIGN AND SYSTEM SOFTWARE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3601	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Understand the basic system software components such as assembler, loader, linkers, compilers.**
2. **Provide an understanding of the fundamental principles in compiler design**
3. **Discuss the techniques of scanning, parsing & semantic elaboration well enough to build or modify front end.**
4. **Illustrate the various optimization techniques for designing various optimizing compilers.**

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and role playing.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning/Seminars) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.

UNIT – I	**08 Hours**

Introduction to System Software, ASSEMBLERS

Introduction to System Software, Machine Architecture of SIC and SIC/XE. ASSEMBLERS: Basic assembler functions: A simple assembler, Assembler algorithm and data structures, Machine dependent assembler features: Instruction formats and addressing modes – Program relocation, Machine independent assembler features: Literals, Symbol-defining statements, Expressions, Program blocks **(Text book 1: chapter 1 & 2)**

UNIT – II	**08 Hours**

LOADERS AND LINKERS

Basic loader functions: Design of an Absolute Loader, A Simple Bootstrap Loader, Machine dependent loader features: Relocation, Program Linking, Algorithm and Data Structures for Linking Loader, Machine-independent loader features: Automatic Library Search, Loader Options, Loader design options: Linkage Editors, Dynamic Linking **(Text book 1: chapter 3)**

UNIT – III	**08 Hours**

COMPILERS

Introduction: Language Processors, Structure of compiler, The science of building a compiler, Applications of compiler technology. LEXICAL AND SYNTAX ANALYSIS: Role of lexical Analyzer, Specification of Tokens, Lexical Analyzer generator Lex. SYNTAX ANALYSIS I: Role of Parser, Syntax error handling, Error recovery strategies, Writing a grammar: Lexical vs Syntactic Analysis, Eliminating ambiguity, Left recursion, Left factoring. **(Text book 2: chapter 1 & 4)**

UNIT – IV	**08 Hours**

SYNTAX ANALYSIS II

Top down parsing: Recursive Descent Parsing, First and follow, LL (1), –Bottom up parsing: Shift Reduce Parsing, Introduction to LR parsing Simple LR: Why LR Parsers, Items and LR0 Automaton, The LR Parsing Algorithm. SYNTAX-DIRECTED TRANSLATION: Syntax-Directed Definitions: Inherited and Synthesized Attributes, Evaluation orders for SDDs: Dependency graphs, Ordering the evaluation of Attributes, S-Attributed Definition, L-Attributed Definition, Application: Construction of Syntax Trees. **(Text book 2: chapter 4 & 5)**

UNIT – V	**07 Hours**

INTERMEDIATE CODE GENERATION

Three Address Code: Addresses and Instructions, Quadruples, Triples, indirect triples. CODE GENERATION: Issues in the design of code generator, Basic Blocks, Optimization of Basic Blocks, The Code Generation Algorithm, Peephole optimization. MACHINE INDEPENDENT OPTIMIZATION: The Principal Sources of Optimization **(Text book 2: chapter 6)**

Course Outcomes:

At the end of the course the student will be able to:

1: Outline the knowledge of architecture of a hypothetical machine, structure and design of assembler.(L2)

2: Analyze how linker and loader create an executable program from an object module created by assembler. (L4)

3: Apply the major phases of compilation for Lex tool & YAAC tool. (L3)

4: Develop the parsers and experiment with knowledge of different parsing techniques and grammar transformation methods. (L3)

5:Apply the syntax and semantics of programming languages using formal attributed grammars. (L3)

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI concepts	develop, and test principles of AI concepts on Intelligent Systems
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	2	-	-	1	-	-	-	-	-	-	-	-	1	-
CO4	2	3	-	3	1	-	-	-	-	-	-	-	-	1	-
CO5	2	3	-	3	1	-	-	-	-	-	-	-	-	1	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2006.

2. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers – Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2007.

REFERENCE BOOKS:

1. V. Raghavan, Principles of Compiler Design||, Tata McGraw Hill Education Publishers, 2010.
2. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann Publishers Elsevier Science, 2004. 3. D.M.Dhamdhere, Systems Programming and operating systems, Second Revised edition, Tata McGraw Hill.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2. https://nptel.ac.in/courses/106108113

Activity Based Learning (Suggested Activities in Class)

1. Presentation
2. Group Discussion on various Complier phases

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NATURAL LANGUAGE MODELS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3602	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

- **To understand the algorithms available for the processing of linguistic information and computational properties of natural languages**
- **To conceive basic knowledge on various morphological, syntactic and semantic NLP task**
- **To understand machine learning techniques used in NLP,**
- **To write programs in Python to carry out natural language processing**

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and role playing.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning/Seminars) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.

UNIT – I	**08 Hours**
Past, present, and future of NLP; Classical problems on text processing; Necessary Math concepts for NLP; Regular expressions in NLP. Parts of Speech and Morphology, Phrase Structure, Semantics and Pragmatics, Corpus-Based Work: Getting Set Up, Looking at Text, Marked-up Data Text processing: lemmatization, stop word, tokenization, stemming, Spelling errors corrections–Minimum edit distance, Bayesian method	
UNIT – II	**09 Hours**
Words & Sentences, N-grams: Simple unsmoothed n-grams; smoothing, backoff, spelling correction using N-grams, Metrics to evaluate N-grams. Parts of Speech tagging: Word classes, POST using Brill's Tagger and HMMs; Information Extraction: Introduction to Named Entity Recognition and Relation Extraction WordNet and WordNet-based similarity measures, Concept Mining using Latent Semantic Analysis	
UNIT – III	**09 Hours**
Sequence to sequence & Language Modelling, Word embedding: skip-gram model, CBOW, GloVe, BERT; Sequence to sequence theory and applications, Attention theory and teacher forcing; Language Modelling: Basic ideas, smoothing techniques, Language modeling with RNN and LSTM	
UNIT – IV	**09 Hours**
Generative AI and Natural Language processing: History of generative AI,ChatGPT technical overview, Generative pre-trained Transformer – I, II & III	
UNIT – V	**07 Hours**
Advanced Topics and Hands-on Practices Python libraries supporting NLP; Hands-on Data collection - from social network platforms, pdfs, word files, JSON, HTML	

Parsing text using regular expression; scraping data from web; Text processing: convert to lowercase, remove punctuation, remove stop words, standardizing text, tokenising, stemming, lemmatising. Applications: Spam detection, consumer complaint classification, Semantic Analyser, Dialogue processing (Chatbots), Text summarization, Text Categorization.

Course Outcomes:

At the end of the course the student will be able to:

1: Extract information from text automatically using concepts and methods from natural language processing (NLP) including stemming, n-grams (l2)

2: Categorizing words in the text using n-grams, Part-of-speech tagging, information extraction (L3)

3: Apply Machine learning Algorithms to Character-level Language Modeling(L4)

4: Apply machine learning algorithms for text data processing. (L4)

5: Create scripts and applications in Python to carry out natural language processing(L5)

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data	develop, and test principles of AI concepts on Intelligent Systems
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	2	2	-	2	-	-	-
CO3	3	2	1	-	1	-	-	-	2	2	-	2	-	-	-
CO4	3	1	-	-	1	-	-	-	2	2	-	2	2	-	-
CO5	3	2	2	-	2	-	-	-	2	2	-	2	3	2	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. Daniel Jurafsky and James H. Martin. 2009. Speech and Language Processing: An Introduction to Natural Language Processing, Speech Recognition, and Computational Linguistics. 2nd edition. Prentice-Hall.
2. Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.
3. Tiwary, U. S., & Siddiqui, T. (2008). Natural language processing and information retrieval. Oxford University Press, Inc.
4. Kao, Anne, and Steve R. Poteet, eds. Natural language processing and text mining. Springer Science & Business Media, 2007.

Reference Books:

1. Akshay Kulkarni, Adarsha Shivananda, "Natural Language processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python". ISBN-13 (pbk): 978-1-

4842-4266-7 ISBN-13 (electronic): 978-1-4842-4267-4 https://doi.org/10.1007/978-1-4842-4267-4
2. Palash Goyal, Sumit Pandey, Karan Jain, Deep Learning for Natural Language Processing - Creating Neural Networks with Python. ISBN-13 (pbk): 978-1-4842- 3684-0 ISBN-13 (electronic): 978-1-4842-3685-7, https://doi.org/10.1007/978-1-4842-3685-7

E-Resources:

-NIL-

Activity Based Learning (Suggested Activities in Class)

1. Collaborative Activity is minor project development with a team of 4 students.

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DEEP LEARNING AND COMPUTER VISION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3603	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. To understand the major architectures of Deep Networks.
2. To become familiar with specific, widely used Deep learning networks.
3. To understand and analyze the fundamental concepts of Computer Vision.
4. To learn to use deep learning tools and framework for solving real-life problems related to images and signals.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**

Introduction to Neural Networks: Single layer and Multilayer NN, training neural networks, activation functions, loss functions, Model Selection. Introduction to Deep Learning, Principles of Deep Networks and Building blocks of deep networks Backpropagation in neural network.
Text 2: Chapter 2&3

UNIT – II	**09 Hours**

Data Manipulation and Data Preprocessing, Deep neural network, Optimization for Training Deep Models. Convolutional Neural Networks (CNNs) - Biological inspiration, Mapping of Human Visual System and CNN. Convolution operation, Convolutional Layers, Padding and Stride, Batch normalization and layers, Subsampling, Pooling.
(Text2: Chapter 4) (Text 1: Chapters 2, 4)

UNIT – III	**08 Hours**

Introduction to Computer Vision, Camera Models and Calibration: Camera Projection Models – Orthographic, Affine, Perspective, Projective models. Projective Geometry, Camera Internal and External Parameters, Lens Distortion Models- Local Feature Detector s and Descriptors: Hessian corner detector, Harris Corner Detector, LOG detector, DOG detector. **(Text3: Chapters 1, 4, 5, 8)(Text4: Chapter 4)**

UNIT – IV	**08 Hours**

Pose Estimation, Stereo vision, Epipolar Geometry, Rectification and Issues related to Stereo, SIFT, PCA-SIFT, SURF, HOG, Image segmentation.
(Text3: Chapters 11, 15) (Text4: Chapters 5, 8, 12)

UNIT – V	06 Hours
Unsupervised Pretrained Networks (UPNs)- Autoencoders, Deep Belief Networks (DBNs), Introduction to RNN, LSTM, GAN, Introduction to Transfer Learning, Deep Learning Applications in computer vision: object recognition, object detection, video analytics, action recognition. **(Text2: Chapters 4, 5) (Text3: Chapters 18, 19)**	

Course Outcomes:

At the end of the course the student will be able to:

1. **Implement** and **analyze** single and multi-layer neural network frameworks, and CNN building blocks (L4).
2. **Design** and **implement** deep learning models for image processing applications. **Evaluate** the models on real data sets (L5).
3. For a stereo system with multiple cameras, **solve** the correspondence and 3D reconstruction problem applying epipolar geometry concept(L3).
4. **Build** model for feature extraction and image segmentation from a given image (L6).
5. **Develop** deep learning model for object recognition and object detection from a given image. **Recognize** actions from a given video clip. **Compare** and **contrast** among CNN and UPNs regarding their performances (L4).

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Develop,deploy and prototype AI Subsystems	AI concepts to solve real world business	AI concepts on Intelligent Systems
CO1	3	2	2	-	2	-	-	-	2	2	-	-	2	2	2
CO2	3	3	2	2	3	-	-	-	2	2	-	-	2	2	2
CO3	3	3	1	2	1	-	-	-	2	2	-	-	2	2	2
CO4	3	3	2	2	3	2	-	-	2	2	-	-	3	2	2
CO5	3	3	3	3	3	2	-	-	2	2	-	-	3	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola, "Dive into Deep Learning", Amazon Science, 2020.
2. Josh Patterson and Adan Gibson, "Deep Learning a Practitioners Approach", July, 2018.
3. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.
4. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2nd Edition, 2022.

REFERENCE BOOKS:

1. Goodfellow, Yoshua Bagnio, Aaron Courville, Deep Learning, 2016.
2. Michael Nielsen, Neural Networks and Deep Learning, 2016.
3. Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.
4. Manas Kamal Bhuyan, "Computer vision and Image Processing Fundamentals and Applications", © 2020 by Taylor & Francis Group.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs62/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs58/preview

Activity Based Learning (Suggested Activities in Class)

1. Better comprehending the concepts of Computer Vision ad Deep Learning, hands-on sessions and group discussion regarding related state-of-the-art research papers.

2. Collaborative Activity is minor project development with a team of maximum 4 students.

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EXPLAINABLE ARTIFICIAL INTELLIGENCE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3606	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. To understand the basic building block of Explainable AI and interpretable machine learning
2. To understand the inner workings of AI and consequent outcomes.
3. To bring transparency to AI systems by translating, simplifying, and visualizing its decisions.
4. To discover unknown correlations with causal relationships in data.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and role playing.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning/Seminars) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.

UNIT – I : Introduction to Interpretability and Explainability	**07 Hours**
Black-Box problem, Goals, Porphyrian Tree , Expert Systems , Case-Based Reasoning, Bayesian Networks , Types of Explanations, Trade-offs, Taxonomy, Flowchart for Interpretable and Explainable Techniques (TextBook 1: 1.1 to 1.9)	
UNIT – II: Pre-model Interpretability and Explainability	**08 Hours**
Data Science Process and EDA, Exploratory Data Analysis, Feature Engineering-Feature Engineering and Explainability , Feature Engineering Taxonomy and Tools. (TextBook 1: 2.1 to 2.3)	
UNIT – III: Model Visualization Techniques and Traditional Interpretable Algorithms	**08 Hours**
Model Validation, Evaluation, and Hyperparameters, Model Selection and Visualization, Classification Model Visualization, Regression Model Visualization, Clustering Model Visualization, Interpretable Machine Learning Properties, Traditional Interpretable Algorithms-Linear Regression. (TextBook- 3.1 to 3.6, 3.7.2)	
UNIT – IV: Model Interpretability: Advances in Interpretable	**08 Hours**

Machine Learning	
Interpretable vs. Explainable Algorithms, Ensemble-Based-Boosted Rulesets, Explainable Boosting Machines (EBM), RuleFit, Skope-Rules, Iterative Random Forests (iRF), Decision Tree Based-Optimal Classification Trees, Optimal Decision Trees, Scoring System (TextBook 1: 4.1-4.4,4.6)	
UNIT – V: Explainable Deep Learning	**08 Hours**
Applications, Tools and Libraries, Intrinsic, Perturbation- LIME, Occlusion, RISE, Prediction Difference Analysis, Meaningful Perturbation, Gradient/Backpropagation Activation Maximization, Class Model Visualization, Saliency Maps, DeepLIFT, DeepSHAP, Deconvolution, Guided Backpropagation, Integrated Gradients, Layer-Wise Relevance Propagation, Excitation Backpropagation, CAM Textbook 1: 6.1 to 6.4 , 6.5.1 to 6.5.11	
Course Outcomes: At the end of the course the student will be able to: 1: Show familiarity with concepts within Explainable AI and interpretable machine learning (L3) 2: Demonstrate comprehension of current techniques for generating explanations from black-box machine learning methods (L3) 3: Implement explainable deep learning algorithms and solve real-world problems L4)	

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data analytics and AI	develop, and test principles of AI concepts on Intelligent Systems
CO1	**3**	**2**	**1**										2		2
CO2	**2**	**3**	**2**										2		2
CO3	**2**	**2**	**2**										2		2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. Uday Kamath , John Liu, "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning", Springer, 2021.

Reference Books:

1. Christoph Molnar , “Interpretable Machine Learning: A Guide for Making Black Box Models Explainable”, Second Edition Leonida Gianfagna, Antonio Di Cecco, “Explainable AI with Python” , 2021

E-Resources:

-NIL-

Activity Based Learning (Suggested Activities in Class)

-NIL-

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MACHINE LEARNING FOR HEALTHCARE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3607	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Summarize** the different types of medical data and its Medical Standards, Challenges.
2. **Explain** the different techniques to handle the image and clinical data.
3. **Apply** Modelling techniques, Reinforcement Learning and Natural Language Processing for healthcare data.
4. **Utilize** the suitable Machine Learning and Deep Learning algorithms for various types of healthcare applications**.**
5. **Get the idea** to build a chatbot and develop a project using the appropriate case study in the healthcare.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**
Knowing Healthcare Industry: Introduction to healthcare informatics, Introduction to Machine Learning and Deep Learning in Healthcare, Medical Standards and Coding Types, Health Level Seven (HL7;) Global Healthcare Challenges and Trends; Past-Present-Future of AI&ML in Healthcare, Electronic Medical Records (EMR), Electronic Health Records (EHR) - Dataflow of EHR, Difference between EHR and EMR.	

UNIT – II	**08 Hours**
Advanced Analytics in Health Care: Overview of Clinical Data, Data Types; Data handling techniques – Imputation technique for handling missing data; Synthetic Minority Oversampling Technique for handling imbalanced data, Different types of Data Analysis techniques, Risk Stratification; Survival Modelling; Disease progression Modelling.	

UNIT – III	**08 Hours**
Medical Image Diagnostics and its Preprocessing: Biomedical Imaging Modalities - Computed Tomography, Magnetic Resonance Imaging, Positron Emission Tomography; Biomedical Signal: Electrocardiogram (ECG), Electroencephalogram (EEG), Segmentation – Thresholding	

and Region based Segmentation, Image Registration; ML applications in medical Ology space (cardiology, oncology).
UNIT – IV **08 Hours**
AI/ML and NLP for healthcare: Automating clinical workflow, Regulation of AI/ML, Challenges in deploying ML model, NLP for Healthcare, Re-inforcement learning in healthcare applications, Wearable devices and Medical Bots.
UNIT – V **07 Hours**
Applications of Machine learning models (Linear regression, SVM, Random Forest) and Deep learning models (CNN, RNN….) for the Healthcare area (Case study)
Course Outcomes: At the end of the course the student will be able to: **1. Explain** the different types of Medical data and its Medical Standards, Challenges**.** 2. **Utilize** the appropriate techniques to handle the image and clinical data. 3. **Make use of the** Modelling techniques, Reinforcement Learning and Natural Language Processing for various healthcare applications **4. Apply** the suitable Machine Learning and Deep Learning algorithms for various types of healthcare applications**.** 5. **Build** a chatbot and develop a project using the appropriate case study in the healthcare.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data	develop, and test principles of AI concepts
CO1	2	1	-	-	1	-	-	-	2	2	-	-	2	2	2
CO2	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO3	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO4	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO5	3	3	2	-	1	-	-	-	2	2	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. SumeetDua, U. RajendraAcharya, PrernaDua , Machine Learning in Healthcare nformatics,Intelligent Systems Reference Library 56, Springer Nature 2014.
2. Sergio Consoli, Diego ReforgiatoRecupero, Milan Petkovic, Data Science for Healthcare Methodologies and Applications.

REFERENCE BOOKS:

1. Thomas M. Deserno, Fundamentals of Bio-Medical Image processing, Biological and Medical Physics, Biomedical Engineering, Springer, ISBN 978-3-642-15816-2, 2011.

2. Silberschatz, Korth and Sudharshan: "Database System Concepts", Seventh Edition, Mc-GrawHill, 2019.
3. C.J. Date, A. Kannan, S. Swamynatham: "An Introduction to Database Systems", Eight Edition, Pearson Education, 2012.

E-Resources:

1. https://stellar.mit.edu/S/course/HST/sp19/HST.956/
2. https://www.coursera.org/learn/fundamental-machine-learning-healthcare.
3. https://www.coursera.org/learn/introduction-clinical-data

Activity Based Learning (Suggested Activities in Class)

1. Group discussion on different Health Care Problems.
2. Collaborative Activity is minor project development with a team of 4 students.

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DIGITAL SIGNAL PROCESSING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3608	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. To describe signals mathematically and understand how to perform mathematical operations on signals.
2. It will provide knowledge of Digital filter.
3. To discuss word length issues ,multi rate signal processing and application.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I : Basic elements of digital signal Processing	**08 Hours**
Concept of frequency in continuous time and discrete time signals –Sampling theorem – Discrete time signals. Discrete time systems –Analysis of Linear time invariant systems –Ztransform –Convolution and correlation.	
UNIT – II: Introduction to DFT	**09 Hours**
Efficient computation of DFT Properties of DFT – FFT algorithms – Radix-2 and Radix-4 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms – Use of FFT algorithms in Linear Filtering and correlation.	
UNIT – III: Structure of IIR	**09 Hours**
System Design of Discrete time IIR filter from continuous time filter – IIR filter design byImpulse Invariance. Bilinear transformation – Approximation derivatives – Design of IIR filter in the Frequency domain.	
UNIT – IV: Symmetric & Anti-symmetric FIR filters	**09 Hours**
Linear phase filter – Windowing techniques – rectangular, triangular, Blackman and Kaiser windows – Frequency sampling techniques – Structure for FIR systems.	
UNIT – V: Finite word length effects in FIR and IIR digital filters	**07 Hours**

Quantization, round off errors and overflow errors. Multi rate digital signal processing:

Concepts, design of practical sampling rate converters, Decimators, interpolators.

Polyphase de compositions. Application of DSP – Model of Speech Wave Form – Vocoder.

Course Outcomes:

At the end of the course the student will be able to:

1. Illustrate digital signals, systems and their significance.(L2)
2. Analyse the digital signals using various digital transforms DFT, FFT etc.(L2)
3. Design the IIR filters in frequency domain(L3)
4. Design the FIR filters& structure for FIR System(L3)
5. Interpret the finite word length effects on functioning of digital filters.(L3)

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data	develop, and test principles of AI concepts
CO1	3	-	-	1	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO5	1	1	2	-	2	-	-	-	-	-	-	-	-	-	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. "Digital Signal Processing: Principles, Algorithms, and Applications" by John G. Proakis and Dimitris G. Manolakis -
2. "Digital Signal Processing: Fundamentals and Applications" by Li Tan and Jean Jiang

References books:

1. "Digital Signal Processing: A Computer-Based Approach" by Sanjit K. Mitra -
2. "Digital Signal Processing: A Practical Guide for Engineers and Scientists" by Steven W. Smith -
4. "Digital Signal Processing: Principles, Devices, and Applications" by Andreas Antoniou –

E-Resources:

1. https://stellar.mit.edu/S/course/HST/sp19/HST.956/
2. https://www.coursera.org/learn/fundamental-machine-learning-healthcare.
3. https://www.coursera.org/learn/introduction-clinical-data

Activity Based Learning (Suggested Activities in Class)

1. Assignment & Journal / Conference paper.
2. Collaborative Activity is minor project development with a team of 4 students.

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REINFORCEMENT LEARNING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3609	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. Use Reinforcement Learning Methods for the agents to learn an optimal, or nearlyoptimal, policy that maximizes the "reward function" or other user-provided reinforcement signal .
2. Apply such Reinforcement Learning mechanisms to various learning problems.
3. Learn about several algorithms that can learn near optimal policies based on trial and error interaction with the environment---learning from the agent's own experience

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I :	**08 Hours**
Introduction: Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope, History of Reinforcement Learning, Probability concepts - Axioms of probability, Notion of random variables, PMF, PDFs, CDFs. Two Random Variables, Pairs of Discrete Random Variables, The Joint cdf of X and Y, The Joint pdf of two continuous random variables, Independence of two Random variables Textbook 1: Ch 1.1 to 1.4; Textbook 2: 2.2,3.1,3.2,4.1 to 4.2, 5.1 to 5.5 RBT: L1, L2	
UNIT – II:	**08 Hours**
Finite Markov Decision Processes: The Agent-Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation Textbook 1: Ch 3.1 to 3.9 RBT: L1, L2, L3	
UNIT – III:	**07 Hours**
Dynamic Programming : Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming Textbook 1: Ch 4.1 to 4.8 RBT: L1, L2, L3	
UNIT – IV:	**08 Hours**

Monte Carlo Methods : Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, O-policy Prediction via Importance Sampling, Incremental Implementation, O-Policy Monte Carlo Control, Importance Sampling on Truncated Returns Textbook 1: Ch 5.1 to 5.8 RBT: L1, L2, L3
UNIT – V: Finite word length effects in FIR and IIR digital filters **08 Hours**
Temporal Difference Learning : TD Prediction , Advantages of TD Prediction Methods, Optimality of TD(0) , Sarsa: On-Policy TD Control , Q-Learning: Off-Policy TD Control, n-Step TD Prediction , The Forward View of TD(λ) ,The Backward View of TD(λ) , Equivalences of Forward and Backward Views. Textbook 1: Ch 6.1 to 6.5 , 7.1 to 7.4 RBT: L1, L2, L3
Course Outcomes: At the end of the course the student will be able to: 1. Understand Temporal-Difference learning and Monte Carlo as two strategies for estimating value functions from sampled experience.(L2) 2. Understand the importance of dynamic programming in a model.(L2) 3. Implement and apply the TD algorithm, for estimating value functions (L3) 4. Understand the connections between Monte Carlo and Dynamic Programming and TD. (L2)

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data	develop, and test principles of AI concepts
CO1	**3**	**2**	**1**		**2**								**1**		**2**
CO2	**1**	**3**	**2**		**2**								**1**		**2**
CO3	**1**	**2**	**3**		**2**								**1**		**2**
CO4	**3**	**2**	**1**		**2**								**1**		**2**
CO5															

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, 2nd Edition
2. Alberto Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, 3rd Edition

REFERENCE BOOKS:

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective ,The MIT Press, 2012
2. Kyriakos G. Vamvoudakis, Yan Wan, Frank L. Lewis, Derya Cansever, Handbook of Reinforcement Learning and Control,1st ed. 2021 Edition, ISBN-13: 978-3030609894

E-Resources:

-NIL-

Activity Based Learning (Suggested Activities in Class)

-NIL-

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INDUSTRIAL ROBOTICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3610	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

6. Understand the configuration space with specific reference to robotic motion
7. Understand different types of kinematics used in industrial robotics.
8. To understand motion planning in industrial robotics.
9. Understand Computational Motion Planning and Mobility
10. Understand the concept of grasping and manipulation.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

7. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
8. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
9. Show ***Video/animation*** films to explain the functioning of various concepts.
10. Encourage ***Collaborative*** (Group Learning) Learning in the class.
11. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
12. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I :	**08 Hours**

Introduction Configuration Space: Foundations of Robot Motion-Degrees of Freedom of a Rigid Body-Degrees of Freedom of a Robot-Configuration Space Representation Configuration and Velocity Constraints-Task Space and Workspace.

Rigid-Body Motions: Introduction to Rigid-Body Motions-Rotation Matrices-Angular Velocities-Homogeneous Transformation Matrices.

UNIT – II:	**08 Hours**

Forward Kinematics: Forward Kinematics Example- Velocity Kinematics and Statics: Introduction to Velocity Kinematics and Statics-Space Jacobian-Body Jacobian, Inverse Kinematics: Inverse Kinematics of Open Chains.

UNIT – III:	08 Hours
Kinematics of Closed Chains: Dynamics of Open Chains- Lagrangian Formulation of Dynamics-Understanding the Mass Matrix, Newton-Euler Inverse Dynamics, Trajectory Generation: Point-to-Point Trajectories-Polynomial Via Point Trajectories-Time-Optimal Time Scaling.	
UNIT – IV:	**07 Hours**
Motion Planning: Overview of Motion Planning, Robot Control, Control System Overview-Error Response-Linear Error Dynamics-First-Order Error Dynamics-Second-Order Error Dynamics-Motion Control with Velocity Inputs - Motion Control with Torque or Force Inputs.	
UNIT – V:	**08 Hours**
Grasping and Manipulation: First-Order Analysis of a Single Contact Contact Types: Rolling, Sliding, and Breaking-Multiple Contacts, Force Closure-Duality of Force and Motion Freedoms, Omnidirectional Wheeled Mobile Robots-Controllability of Wheeled Mobile Robots	
Course Outcomes: At the end of the course the student will be able to: 4. Design and Demonstrate Physics-based modeling of robots. (L4) 5. Ability to design path planning algorithms. (L4) 6. Development of necessary technical foundations for studies of advanced robots like soft robots, spherical robots etc (L3)	

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data storage, data analytics	develop, and test principles of AI concepts on Intelligent Systems
CO1	**3**	**2**	**1**		**2**								**1**		**2**
CO2	**1**	**3**	**2**		**2**								**1**		**2**
CO3	**1**	**2**	**3**		**2**								**1**		**2**

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

Text Books:

1. Introduction to Robotics - Mechanics and Control, 3rd Edition, 2005, Author: John J. Craig, Publisher. Pearson Education, Inc

2. Kevin M. Lynch and Frank C. Park. 2017. Modern Robotics: Mechanics, Planning,and

Control., Cambridge University Press, USA. ISBN:978-1-107-15630-2.

Reference Books:

5. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). Robot Modeling andControl, 2nd Edition. Wiley, ISBN: 978-1-119-52404-5.
6. Peter cork, Robotics, 2017, Vision and Control (2nd ed.), springer tracts inadvanced Robotics.
7. Simon J.D. Prince,Computer Vision: Models, Learning, and Inference, Cambridge University press
8. Ghosal, A. (2015). Robotics: Fundamental concepts and analysis. Oxford: OxfordUniversity Press. ISBN: 978-0-195-67391-3.

E-Resources:

-NIL-

Activity Based Learning (Suggested Activities in Class)

-NIL-

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INTRODUCTION TO IOT AND EMBEDDED COMPUTING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3611	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. Understand the fundamental concepts and principles of the Internet of Things (IoT) along with security challenges and privacy considerations in IoT and explore measures to mitigate risks.
2. To understand the embedded systems including design techniques, control driven architectures, and use of Internet for communication.
3. Acquire an understanding of different communication protocols used in IoT and gain practical experience in setting up IoT communication networks.
4. To understand the methodologies to implement the software systems for embedded computing and methods of programming them.
5. Develop skills in designing and developing IoT applications using appropriate tools and frameworks to articulate IoT concepts and project outcomes.
6. Enhance teamwork and collaboration skills through group projects and discussions.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I :	**08 Hours**

Introduction: Definition, Characteristics and Architecture of IOT Devices, Trends in the Adoption of IoT in modern applicants, Risks, Privacy, and Security. Sensor Networks, Sensors and actuators, Analog/Digital Conversion,

UNIT – II:	**10 Hours**

Communication Protocols, Embedded Computing Systems, Cloud Computing. Communication stack for IoT, Machine to machine communication (M2M), Introduction to various protocols such as Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), 6LoPAN

UNIT – III:	**08 Hours**
Routing protocols, autonomous routing, hierarchical architectures and routing protocols to connect with infrastructure networks. Software development systems, embedded software, programming environments for IoT software development.	
UNIT – IV:	**07 Hours**
Fundamentals of Python Programming & raspberry Pi: Introduction to python programming, working with functions, classes, REST full Web services, Client Libraries, Intrdocution & programming Raspberry Pi3, Integrating input-output devices with Raspberry Pi3.	
UNIT – V:	**08 Hours**
IOT Platform, Cloud Computing Platforms for IoT Development: IOT platform Architecture (IBM Internet of things & Watson Platform); API Endpoints for platform Services; Devices Creation & Data Transmission; Introduction to NODE-RED and Application deployment. Arduino Programming IDE, Use Cases: Home Automation (e.g., Smart Lighting), City Applications (e.g., Smart Parking Smart Lighting), Environment (e.g.,Pollution Monitoring, Weather Monitoring), Agriculture (e.g., Smart Irrigation) etc	

Course Outcomes:

At the end of the course the student will be able to:

1. Outline the basics of Embedded Systems & IOT.(L2)
2. Make use of Cloud computing in IOT, Summarize IOT Standars, Communication technologies and protocols.(L2)
3. Summarize of routing protocols and Software development systems(L3)
4. Work with Raspberry Pi using Python Programming. (L2)
5. Analyse the IOT Architecture and NODE-RED, implement real time projects usings the tools and techniques of IOT Platform. (L6)

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data storage, data analytics	develop, and test principles of AI concepts on Intelligent Systems
CO1	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	**-**	**-**	-	2	-	-	-	-	-	-	-	-	-	-
CO3	**3**	**1**	**-**	1	-	1	-	-	-	-	-	-	-	-	-
CO4	**3**	**2**	**2**	1	2	-	-	-	-	-	-	-	1	1	1
CO5	**3**	1	2	1	2	-	-	-	-	-	-	-	1	1	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. ArshdeepBahga, Vijay Madisetti, "Internet of things: A hands-on Approach", 1st Edition VPT, 2014
2. K.V.K.K. Prasad, "Embedded Real Time Systems: Concepts, Design and Programming", 1st Edition, Dreamtech Publication, 2014.
3. Adrian McEwen, Hakim Cassimally, "Designing the Inernet of Things", Wiley Publications, 2013
4. Jeeva Jose, "Internet of Things", Khanna Book Publishing Company, 2021.
5. Samuel Greengard, "The Internet of Things", 1st Edition, MIT Press, 2015.

Reference Books:

1. Peter Waher, "Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3", 1st Edition, Packt Publishing Ltd, 2018
2. Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, "IoT: Building Arduino-Based Projects", 1st Edition, Packt Publishing Ltd, 2016.
3. Jonathan W Valvano, "EmbeddedMicrocomputer Systens: Real-Time Interfacing", 3rd Edition, Thomson Engineering, 2012.

E-Resources:

1. **https://onlinecourses.nptel.ac.in/noc22_cs53/preview**
2. **https://nptel.ac.in/courses/106105166**

Activity Based Learning (Suggested Activities in Class)

1. Case Study: real time projects with maximum of 4 Members in a group.

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ADVANCED DATA SCIENCE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3612	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Summarize** the fundamental concepts of data science and different types of Data Distribution.
2. **Utilize** the given data and perform hypothesis testing, Parametric and Non-Parametric Tests.
3. **Make use** of the different visualization techniques to find out the distribution of data set.
4. **Analyse** the Univariate and Bivariate Data using different graphical techniques.
5. **Apply the** classification techniques on the given data.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**09 Hours**

Introduction to Data Science and its applications, Data Science Life Cycle, Data Architecture and its components, Statistics vs Data Mining vs Data Analytics vs Data Science; Understanding data: Introduction, Types of Data, Types of Data Distribution: Normal distribution, Poisson Distribution, Binomial Distribution, Uniform distribution, Basics of R Programming.

Textbook 1: Chapter 2, Textbook 3: Chapter 8

UNIT – II	**08 Hours**

Introduction to Hypothesis Testing, Steps involved in Hypothesis Testing, One and Two-Sided Tests, Type 1 and Type II Errors, One and Two Sample Estimation Problems, Confidence Interval, Introduction to Parametric Test: T-Test, F-Test, Z-Test, ANOVA. Introduction to Non-Parametric test: Wilcoxon Mann-Whitney U-Test, Kruskal Wallis H-Test, Chi-square Test.

Textbook 3: Chapter 10

UNIT – III	**07Hours**

Univariate and Bivariate Data Analysis: Univariate Data Analysis –Description and summary of data set, measure of central tendency Interquartile Range, Concepts on Symmetry of Data, Skewness and Kurtosis, Introduction to Bivariate Distributions, Association between two Nominal Variables, Contingency Tables, Chi-Square

calculations, Scatter Plot and its causal interpretations, Relationship between two ordinal variables – Spearman Rank correlation, Kendall's Tau Coefficients.

Textbook 3: Chapter 6 and 7 ; Textbook 5: Chapter 3

UNIT – IV	08 Hours

Graphical Representation: Introduction to graphical representation of data, dot plot, stem and leaf plot, bar chart, stacked bar chart, multiple bar chart, percentage bar chart, histogram, symmetric histogram, Pie chart and its legends, Box Plot, Contour plot, Star plot, qq plot, Scree Plot, Dendrogram (cluster analysis), Interpretation of dendrogram, Heat map, Tree map.

Textbook 3: Chapter 2 and 3

UNIT – V	07 Hours

Classification Techniques: Introduction to classification techniques, Conditional probability, odds ratio, Moving on to logistic regression from linear regression, Estimation using the Maximum Likelihood Method, Making sense of logistic regression parameters, Wald test, Likelihood Ratio Test statistic, Decision Tree (Information Gain and Gini Index) and Pruning a Tree, Ensemble Methods – Bagging and Boosting.

Textbook 5: Chapter 6

Course Outcomes:

At the end of the course the student will be able to:

1. **Understand** the fundamental concepts of data science and different types of Data Distribution.
2. **Utilize** the given data and perform hypothesis testing, Parametric and Non-Parametric Tests.
3. **Make Use of** the Univariate and Bivariate Data Analysis techniques for handling the given data.
4. **Make use of** the different visualization techniques to find out the distribution of data set.
5. **Apply** the classification techniques on the given data.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI Engineering	Apply the knowledge gained pertaining to data storage, data	develop, and test principles of AI concepts on Intelligent Systems
CO1	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	1	-	-	-	2	2	2
CO3	3	2	-	-	-	-	-	-	1	-	-	-	2	2	2
CO4	3	2	-	-	-	-	-	-	1	-	-	-	2	2	2
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Doing Data Science, Cathy O'Neil, Rachel Schutt, Straight Talk from The Frontline. O'Reilly, 2013.
2. Hand book of Data Visualization – Chun-houh Chen, Wolfgang Härdle, Antony Unwin, Springer Publication.

3. Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R. Christian Heumann · Michael Schomaker, Springer 2017.
4. SC Gupta and VK Kapoor, "Fundamentals of mathematical statistics", Sultan Chand & Sons Publication, New Delhi, 2014.
5. Learning Predictive Analytics with Python– Ashish Kumar, PACKT Publishing, 2016.

REFERENCE BOOKS:

1. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015.
2. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016.

E-Resources:

1. https://nptel.ac.in/courses/106106179
2. https://nptel.ac.in/courses/111104146

Activity Based Learning (Suggested Activities in Class)

1. Flipped class Activity on data visualization and data analysis techniques.
2. Problem Solving and Discussion.

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DEEP LEARNING (OPEN ELECTIVE)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	21OE0039	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. To understand the basic building blocks and general principles that allows one to design Deep learning algorithms
2. To become familiar with specific, widely used Deep learning networks
3. To introduce building blocks of Convolution neural network architecture
4. To learn to use deep learning tools and framework for solving real-life problems

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT 1:Introduction to Deep Learning	**08 Hours**

Introduction to Neural Networks:Single layer and Multilayer NN, training neural networks, activation functions, loss functions, Model Selection.

Introduction to Deep Learning, Principles of Deep Networks and Building blocks of deep networks.

(Text 2: Chapter 2&3)

UNIT – II:	**7 Hours**

Mathematical background for Deep learning- Data Manipulation and Data Preprocessing, Linear Algebra, Calculus, Probability.

(Text 1: Chapter 2)

UNIT – III:	**08 Hours**

Forward Propagation, Backward Propagation, and Computational Graphs Layers and Blocks, shallow neural network, deep neural network, Optimization for Training Deep Models.

(Text 1: Chapter 4)

UNIT – IV:	**08 Hours**

Convolutional Neural Networks (CNNs) - Biological inspiration, Mapping of Human Visual System and CNN. Convolution operation, Convolutional Layers, Padding and Stride, Batch normalization and layers, Subsampling, Pooling. (Text2: Chapter 4)

UNIT – V:	**08 Hours**

MODULE 5

Unsupervised Pretrained Networks (UPNs)- Autoencoders, Deep Belief Networks (DBNs) ,Introduction to Generative Adversarial Networks (GANs).

Deep Learning Applications in Healthcare and other areas(Case study)

Course Outcomes:

At the end of the course the student will be able to:

1. Understand Building blocks of deep networks and Neural networks (L2)
2. Understand the need and significance of mathematical fundamentals in Deep Learning to solve real-time problems. (L2)
3. Identify and Apply the deep learning algorithms which are more Appropriate for various types of learning tasks in various domains (L3)
4. Develop deep learning algorithms and solve real- world problems deep learning tools and framework (L6)

Table: Mapping Levels of COs to POs / PSOs

COs	**Program Outcomes (POs)**												**PSOs**		
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data storage, data analytics	develop, and test principles of AI concepts on Intelligent Systems
CO1	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	**-**	**-**	-	2	-	-	-	-	-	-	-	-	-	-
CO3	**3**	**1**	**-**	1	-	1	-	-	-	-	-	-	-	-	-
CO4	**3**	**2**	**2**	1	2	-	-	-	-	-	-	-	1	1	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola, "Dive into Deep Learning", Amazon Science, 2020

2. Josh Patterson and Adan Gibson, “Deep Learning a Practitioners Approach”, July, 2018.
3. “Neural Networks: A Comprehensive Foundation,”S. Haykin, 2ndEd, Prentice Hall of India, 2003.

Reference Books:

1. Tom Mitchell, Machine Learning, McGraw-Hill, 1997
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, The MIT Press, 2016
3. François Chollet, “Deep Learning Python”, Manning Publications, 2018
4. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems”, O'Reilly Media; 1 edition (April 9, 2017)

E-Resources:

Activity Based Learning (Suggested Activities in Class)

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COMPILER DESIGN AND SYSTEM SOFTWARE LABORATOTY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3604	**Credits**	:	01
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P–S	:	0–0–2–0			

Course Learning Objectives:

This course will enable students to:

- **Experiment on the basic techniques of compiler construction and tools that can used to perform syntaxdirected translation of a high-level programming language into an executable code.**
- **Know the implementation of assemblers, loaders and various parsing techniques.**
- **Learn how to optimize and effectively generate machine codes.**

List of Laboratory/Practical Experiments activities to be conducted

1a. Program to count the number of characters, words, spaces and lines in a given input file.

1b. Program to recognize and count the number of identifiers in a file.

2a. Program to count the numbers of comment lines in a given C program. Also eliminate them and copy the resulting program into separate file.

2b. Program to recognize whether a given sentence is simple or compound.

3a. Program to count no of:
i.+ve and –ve integers
ii. +ve and –ve fractions

3b. Program to count the no of „scanf‟ and „printf‟ statements in a C program. Replace them with “readf‟ and “writef‟ statements respectively

4.Program to evaluate arithmetic expression involving operators +,-,*,/

5. Program to recognize a valid variable which starts with a letter, followed by any number of letters or digits.

6. Program to recognize the strings using the grammar (an b n ;n>=0)

7. C Program to implement Pass1 of Assembler

8. C Program to implement Absolute Loader

9. C program to find the FIRST in context free grammar

10.C Program to implement Shift Reduce Parser for the given grammar
E →E+E
E→E*E
E→(E)
E → id

11. C Program to implement intermediate code generation for simple expression

Course Outcomes:

At the end of the course the student will be able to:

1: Identify patterns, tokens & regular expressions for lexical analysis.

2: Develop LEX and YACC programs for lexical and syntax analysis phases of Compiler

3: Implement the pass 1 of two pass assembler and absolute loader algorithm

4: Implement the bottom up parsing technique.

5: Implement front end of the compiler by means of generating intermediate codes

Table: Mapping Levels of COs to POs / PSOs															
Cos	**Program Outcomes (POs)**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	**Apply the principal concepts of AI Engineering**	**Apply the knowledge gained pertaining to data storage, data analytics and AI**	**develop, and test principles of AI concepts on Intelligent Systems**
CO1	2	-	-	-	2	-	-	-	-	-	-	2	-	1	-
CO2	2	-	-	-	2	-	-	-	-	-	-	2	-	1	-
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-	1	-
CO4	2	-	-	-	2	-	-	-	-	-	-	2	-	1	-
CO5	1	-	-	-	-	-	-	-	-	-	-	2	-	1	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOKS:

1. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2006.

2. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers – Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2007.

REFERENCE BOOKS:

1. V. Raghavan, Principles of Compiler Design||, Tata McGraw Hill Education Publishers, 2010.
2. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann Publishers Elsevier Science, 2004.
3. D.M.Dhamdhere, Systems Programming and operating systems, Second Revised edition, Tata McGraw Hill.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs07/preview
2. https://nptel.ac.in/courses/106108113

Activity Based Learning (Suggested Activities in Class)

1. Collaborative activity is minor project development with a group of 4 students.

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DEEP LEARNING AND COMPUTER VISION LAB

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	:	20AM3605	**Credits**	:	01
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **Apply** Deep learning models such as ANN for Regression and LSTM for performing prediction and classification on the given datasets.
2. **Perform** classification using Convolutional Neural Network for the given image data.
3. **Compare** the performance of different Machine Learning Techniques on the given text data.
4. **Use** searching and computer vision techniques on the given dataset.
5. **Build** a project using AI/ML and Computer Vision Techniques.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. ***Demonstration*** to explain the techniques used to solve the problems.
4. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

1. Analyze the performance of ANN regression on the housing dataset.

2. Analyze the performance of CNN on the image dataset.
   a. Load the dataset as input.
   b. Change the hyper-parameter (Varying with different convolutional and pooling layer) of classification model and analyze its performance.
   c. Evaluate and compare the model performance by using metrics – classification accuracy and Binary Cross Entropy Loss.

3. Perform Text Classification using LSTM model.

4. Classify the given text segment as ‘positive’ or ‘negative’ statement using Naïve Bayes Classifier.

5. Implement simple Generative Adversarial Network on image Dataset.

6. Write a program to find number of steps to solve 8-puzzle in python.

7. Implement the different filtering techniques for noise removal based on spatial and frequency domain using OpenCV.

8. Implement the Harris Corner Detector algorithm without the inbuilt OpenCV() function.

9. Write a program to compute the SIFT feature descriptors of a given image.

10. Write a program to detect the specific objects in an image using HOG.

Course Outcomes:

At the end of the course the student will be able to:

6. **Utilize** Deep learning models such as ANN for Regression and LSTM for performing prediction and classification on the given datasets.
7. **Make use of** the Convolutional Neural Network for the given image data**.**
8. **Compare** the performance of different Machine Learning Techniques on the given text data.
9. **Make use of** the searching techniques to solve the 8 Puzzle Problem and **Utilize** the different types of computer vision techniques such as filtering, feature extraction and feature descriptors on the image dataset.
10. **Develop** a project using AI/ML and Computer Vision Techniques.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Apply the principal concepts of AI	Apply the knowledge gained pertaining to data storage, data	develop, and test principles of AI concepts on Intelligent
CO1	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO2	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO3	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO4	3	2	-	-	1	-	-	-	2	2	-	-	2	2	2
CO5	3	3	2	-	1	-	-	-	2	2	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Python: Deeper Insights Into Machine Learning by David Julian, John Hearty, and Sebastian Raschka, 2016.
2. Deep Learning by Ian Goodfellow and YoshuaBengio and Aaron Courville (MIT press), 2016.
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.

REFERENCE BOOKS:

1. Neural Networks and Machine Learning – by Simon Haykin, Third Edition, Pearson Education, 2014.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, CL Engineering, 2013.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs93/
2. https://www.coursera.org/learn/deep-learning-computer-vision

Activity Based Learning (Suggested Activities in Class)

1. Group discussion on Computer Vision and Natural Language Processing Applications.
2. Collaborative Activity is minor project development with a team of 4 students.

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SCHOOL OF ENGINEERING

Dayananda Sagar University

School of Engineering

Devarakaggalahalli, Harohalli, Kanakapura Road, Ramanagara Dt., Bengaluru- 562112
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence & Machine Learning)

SCHEME
FOR
BACHELOR OF TECHNOLOGY (B.Tech)

COMPUTER SCIENCE & ENGINEERING
(Artificial Intelligence & Machine Learning)

7TH & 8th Sem / 4TH Year

(With effect from 2021-25)

Department of CSE (AI &ML)

VII SEM – ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
1	121	21AM47XX	PROFESSIONAL ELECTIVE-IV	CR	3	-	-	-	3	-	AS INDICATED IN ELECTIVE LIST
2	121	21AM47XX	PROFESSIONAL ELECTIVE-V	CR	3	-	-	-	3	-	AS INDICATED IN ELECTIVE LIST
3	121	21OEXXXX	OPEN ELECTIVE-III	CR	3	-	-	-	3	*	AS INDICATED IN ELECTIVE LIST
4	121	21AM4701	CAPESTONE PROJECT-PHASE:1	CR	-	-	6	-	3	-	
5	121	21AM4702	SKILL ENHANCEMENT COURSE (ADVANCED JAVA)	CR	1	-	2	-	2	-	
					10	-	**5**	-	**14**		

PC – PROGRAM CODE, CC – COURSE CODE, CR – CREDIT, AU – AUDIT, L – LECTURE, T – TUTORIAL, P – PRACTICAL, S/P – SEMINAR/PROJECT, C – NO. OF CREDITS

VII SEM-PROFESSIONAL ELECTIVES – II &III

CID* - NPTEL COURSE ID

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
Professional Elective-IV											
1	121	21AM4703	ADVANCE DEEP LEARNING	CR	3	-	-	-	3	*	
2	121	21AM4704	SPEECH PROCESSING & NLU	CR	3	-	-	-	3	*	
3	121	21AM4705	UG RESEARCH PROJECT -1	CR	-	-	-	6	3	*	
Professional Elective-V											
1	121	21AM4706	BIG DATA ANALYTICS	CR	3	-	-	-	3	*	
2	121	21AM4707	GPU ARCHITECTURE AND PROGRAMMING	CR	3	-	-	-	3	*	
3	121	21AM4708	CLOUD COMPUTING	CR	3	-	-	-	3	*	
4	121	CID*	MOOC COURSE	CR	3	-	-	-	3	*	
Open Elective-III											
1	121	21OE0052	RESPONSIBLE AI & ETHICS	CR	3	-	-	-	3	*	

VIII SEM – ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
1	121	21AM48XX	PROFESSIONAL ELECTIVE-VI	CR	3	-	-	-	3	-	AS INDICATED IN ELECTIVE LIST
2	121	21AM4801	CAPSTONE PROJECT -Phase: 2	CR	-	-	9	-	6	-	
3	121	21AM4802	INTERNSHIP	CR	-	-	6	-	3	-	
					3	-	**13**	-	**12**		

PC – PROGRAM CODE, CC – COURSE CODE, CR – CREDIT, AU – AUDIT, L – LECTURE, T – TUTORIAL, P – PRACTICAL, S/P – SEMINAR/PROJECT, C – NO. OF CREDITS

VIII SEM-PROFESSIONAL ELECTIVES – II &III

SL	PC	CC	COURSE TITLE	CR / AU	SCHEME OF TEACHING					PREREQUISITE	
					L	T	P	S/P	C	SEM	Course code
Professional Elective-VI											
1	121	21AM4803	GENERATIVE AI	CR	3	-	-	-	3	*	
2	121	21AM4804	FINANCIAL TECHNOLOGY (FINTECH)	CR	3	-	-	-	3	*	
3	121	21AM4805	UG RESEARCH PROJECT -2	CR	-	-	-	6	3	*	

ADVANCED DEEP LEARNING
(Professional Elective -IV)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	: 21AM4703	**Credits**	: 03
Hours / Week	: 03 Hours	**Total Hours**	: 39 Hours
L–T–P–S	: 3–0–0–0		

Course Learning Objectives:

This course will enable students to:

1. To **understand** the building blocks and working principles of advanced Deep learning models
2. **Design** deep learning models to address novel challenges in practical applications.
3. **Make use of** regularization, training optimization, and hyperparameter selection on deep learning models.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**

INTRODUCTION TO RNN: Basics of RNN, RNN's Computational Graph across Time, RNN's For Sequence Modelling- Language Modelling, Back Propagation Through Time, Standard RNN Gradient Flow, LSTM Network

UNIT – II	**08 Hours**

REGULARIZATION AND OPTIMIZATION OF DEEP NEURAL NETWORKS:

Hyperparameter Tuning of RNN, Regularization- Different types of regulations, Regularization techniques- Lasso Regularization, Ridge Regularization, Elastic Net Regularization, Optimization, optimization techniques- Batch and Minibatch Algorithms. Adam, Challenges in Neural Network Optimization, Auto differentiation.

UNIT – III	**08 Hours**

DEEP LEARNING MODELS:

ResNet- Types, YOLO-object detection with YOLO, Fast R-CNN-components and classification, Faster R-CNN-components and classification, RCNN vs Fast R-CNN vs Faster R-CNN, Attention models-BERT, GPT.

UNIT – IV	08 Hours

GENERATIVE MODELS:

Generative Modelling-Hidden Markov Models (HMMs), Gaussian mixture model, Autoencoders, Variational Autoencoders, Latent Perturbations, Variational autoencoders vs Generative modeling, Federated Learning.

UNIT – V	07 Hours

SUCCESS STORIES AND LIMITATIONS OF USING DL:

Limitations and New Frontiers, Bias and Fairness, Taming Dataset Bias, Success Stories from Industry Domains

APPLICATIONS OF RNN:

Video Analysis and Generation, Time-Series Forecasting, Real-Time Language Translation, Gesture and Motion Recognition.

Course Outcomes:

At the end of the course, the student will be able to:

1. Identify and **apply** the learnt deep learning algorithms on specific tasks in various domains
2. **Implement** deep learning algorithms and solve real-world problems in various domains
3. **Use** learnt models for solving a few real-life problems.
4. **Analyze** the Applications of Deep Learning Work in teams toimplement/simulate applications of CNN and RNN
5. **Apply** new deep learning models to address novel challenges in practical applications

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	Engineering	Problem analysis	Design	Conduct investigations of complex	tool usage	The engineer andsociety	Environment and	Ethics	teamwork	Communication	Life-long learning	Project management	Cognitive Outcome	Skill & Design Outcome
CO1	3	1	2		3	1			3	2		2	3	
CO2	3	2	2	2	3	1		2	3	2	2	2	3	2
CO3	3	3	3		3	1			3	2		2	3	
CO4	3	3			3	2			3	2		2	3	2
CO5	3	1	2		3	1			3	2		2	3	

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Aston Zhang, Zachary C. Lipton, Mu Li, And Alexander J. Smola, "Dive Into Deep Learning", April 2021
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press,2016.

REFERENCE BOOKS:

1. Palash Goyal Sumit Pandey Karan Jain, "Deep Learning For Natural Language Processing : Creating Neural Networks With Python", Apress, 2018
2. UmbertoMichelucci, "Applied Deep Learning A Case-Based Approach To Understanding Deep Neural Networks", 2018
3. Aureilien Geron, Hands-On Machine Learning With Scikit-Learn & Tensorflow:Concepts, Tools, And Techniques To Build Intelligent Systems, O'Reilly, 2017
4. Josh Patterson, "Deep Learning: A Practitioner's Approach", O'Reilly Media; 1 Edition(August 19, 2017)

E-Resources:

1. Deep Learning A-Z™: Hands-On Artificial Neural Networks | Udemy
2. Deep Learning by deeplearning.ai | Coursera

Activity Based Learning (Suggested Activities in Class)

1. The Applications of Deep Learning using group discussion.
2. Collaborative Activity is minor project development with a team of 4 students.

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Dayananda Sagar University

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Kudlu Gate, Hosur Road, Bengaluru 560068

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

SPEECH PROCESSING AND NATURAL LANGUAGE UNDERSTANDING
(Professional Elective -IV)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	21AM4704	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. Overview and language modeling.
2. Word level and syntactic analysis
3. Extracting Relations from Text: From Word Sequences to Dependency Paths, Semantic Role Labeling
4. Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models
5. Information Retrieval and Lexical Resources

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**

Overview: Necessary Math concepts for NLP; Words & Sentences, N- grams, Part of Speech tagging and challenges of Language and Grammar-Processing Indian Languages- NLP Applications, Information Retrieval. Language Modeling: Various Grammar- based Language Models, Statistical Language Model. Introduction to Speech Processing.

TEXT BOOK 1, TEXT BOOK 2 : (CHAPTER 4, CHAPTER 5)

UNIT – II	**08 Hours**

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Sub sequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation, Word Matching, Latent Semantic Analysis, and Topic Models.

Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling.

TEXT BOOK 3: Chapter 2 and Chapter 4

UNIT – III	**08 Hours**

The Encoder-Decoder Model with RNNs,Self-Attention Networks: Transformers,Transformers as Language Models, Bidirectional Transformer Encoders, Chatbots & Dialogue Systems ,Properties of Human Conversation, The Dialogue-State Architecture, Evaluating Dialogue Systems.

TEXT BOOK 1 :CHAPTER 10,11,15

UNIT – IV	08 Hours
Speech production process - speech sounds and features - Phonetic Representation of Speech – representing-speech in time and frequency domains - Short-Time Analysis of Speech - Short- Time Energy and Zero-Crossing Rate - Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT)- Speech Spectrum - Cepstrum - Mel-Frequency Cepstrum Coefficients - Hearing and Auditory Perception - Perception of Loudness - Critical Bands - Pitch Perception **TEXT BOOK 4:** ***CHAPTER 9,***	

UNIT – V	07 Hours
Case study on Linear Predictive Coding (LPC) method of speech compression used to reduce the bit rate in digital speech transmission systems. **TEXT BOOK 5**	

Course Outcomes:

At the end of the course the student will be able to:

1. **Apply** Boolean, Vector-space, and Probabilistic models to retrieve information from a given text.
2. From a given text, **distinguish** relations among the sentences and words. **examine** dependency path from Word Sequences.
3. From a given text, **interpret** the semantic texts and **examine** the meaning of the text.
4. **Formulate** correlation between a given speech at a given time applying Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT).
5. **Construct** NLP model for speech compression using LPC.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineeringknowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer andsociety	Environment and sustainability	Ethics	teamwork	Communication	Life-long learning	Project managementand finance	Cognitive Outcome	Skill & Design Outcome
CO1	3	2	2	-	-	-	-	-	2	2	-	-	2	2
CO2	3	3	2	2	3	-	-	-	2	2	-	-	2	2
CO3	3	3	2	2	2	-	-	-	2	2	-	-	2	2
CO4	3	3	2	2	3	-	-	-	2	2	-	-	3	2
CO5	3	3	3	3	3	2	-	-	2	2	-	-	3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Elsa Harrington, Speech and Language Processing: Computational Linguistics and Natural Language Processing, 2022.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2nd Edition, Prentice Hall, 2013.
3. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
4. Anne Kao and Stephen R. Poteet (Eds), “Natural Language Processing and Text Mining”, Springer Verlag London Limited, 2007.
5. James Allen, “Natural Language Understanding”, 2nd edition, Benjamin/Cummings publishing company, 1995.

REFERENCE BOOKS:

1. Raju, Kavitha. (2014). Speech Based Voice Recognition System for Natural Language Processing. International Journal of Computer Science and Information Technogy.
2. M. Omar, S. Choi, D. Nyang and D. Mohaisen, "Robust Natural Language Processing: Recent Advances, Challenges, and Future Directions," in *IEEE Access*, vol. 10, pp. 86038-86056, 2022, doi: 10.1109/ACCESS.2022.3197769.
3. B. D. Shivahare, A. K. Singh, N. Uppal, A. Rizwan, V. S. Vaathsav and S. Suman, "Survey Paper: Study of Natural Language Processing and its Recent Applications," 2022 2nd International Conference on Innovative Sustainable Computational Technologies (CISCT), Dehradun, India, 2022, pp. 1-5, doi: 10.1109/CISCT55310.2022.10046440.
4. Olivier Galibert, Jeremy Leixa, Gilles Adda, Khalid Choukri, and Guillaume Gravier. 2014. The ETAPE speech processing evaluation. In Proceedings of the Ninth International Conference on Language Resources and Evaluation (LREC'14), pages 3995–3999, Reykjavik, Iceland. European Language Resources Association (ELRA).
5. A. Celesti, M. Fazio, L. Carnevale and M. Villari, "A NLP-based Approach to Improve Speech Recognition Services for People with Speech Disorders," 2022 IEEE Symposium on Computers and Communications (ISCC), Rhodes, Greece, 2022, pp. 1-6, doi: 10.1109/ISCC55528.2022.9912940.

6. Santosh Kumar Behera, Mitali M Nayak, Natural Language Processing for Text and Speech Processing: A Review Paper, International Journal of Advanced Research in Engineering and Technology, 11(11), 2020, pp. 1947-1952.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs45/preview

Activity Based Learning (Suggested Activities in Class)

1. Better Understanding the concept of Sampling and Semantic Role Labeling Quantization of Speech and using group discussion.
2. Collaborative Activity is minor project development with a team of 4 students.

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Dayananda Sagar University

School of Engineering

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

UG RESEARCH PROJECT-I
(Professional Elective -IV)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	21AM4705	**Credits**	:	03
Hours / Week	:	0	**Total Hours**	:	Hours
L–T–P–S	:	0–0–0–6			

Course Learning Objectives:

This course will enable students to:

1. **To identify** key research questions within a field to carryout research in a team.
2. **To identify** and summarize the literature review of the relevant field.
3. **To demonstrate** relevant referencing and inculcate new skills in various aspects of academic writing.
4. **To demonstrate** the knowledge and understanding of writing the publication/report.
5. **To showcase** the strong evidence on the clarity of the argument, understanding of theselected domain area and presentation of its technical information.
6. **To detail description** of the process of carrying out the independent research in written document along with results and conclusions with reference to the existing literature.
7. **To analyze** and synthesize the new research findings.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only the traditional lecture method but a different type of teaching method that may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show Video/animation films to explain the functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

COURSE CONTENT:

The research topic proposed by both the guide and the student team should be approved by the department chairman to proceed further. A degree of industrial input and involvement will be encouraged, and can be facilitated through existing academic-industrial collaborations or by addressing specific topics that are of interest to industrial partners.

All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from conception to completion.

The following criteria will be checked by the department chairman to approve for the research proposal:

a. Department staff as course guide

1. Abilityto provide research direction to the student in the chosen field of interest
2. Ability to design an appropriate research strategy and methodology to carry out the research by student

3. Ability to provide and evaluate the strong literature review document for the chosen research topic
4. Ability to train students on research paper / technical writing skills
5. Conduct reviews in regular time period and submit the evaluation to department chairman

b. Student Team

1. To be dedicated and committed to work on a new research topic by learning new technical skills
2. To have fair knowledge on what is product development or research topic
3. To have constant interaction with allocated guide by providing weekly updates
4. To be committed to complete the project and submitting the technical paper within the stipulated time framed by the university

Evaluation:

There will be CIA evaluation as well as the Semester end evaluation of the work done. Itwill be done by a committee of senior researchers of the Department.

Course Outcomes:

At the end of the course the student will be able to:

1. Develop the research project by selecting an appropriate research problem.
2. Compare the papers relevant to the selected problem domain.
3. Construct the model and perform the model evaluation and analysis.
4. Draft of the Publication or Demonstration of the Proof-of- concept product.
5. Draft of patent application.

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineeringknowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer andsociety	Environment and sustainability	Ethics	teamwork	Communication	Life-long learning	Project managementand finance	Cognitive Outcome	Skill & Design Outcome
CO1	3	2	2	-	2	-	-	2	-	3	2	2	3	3
CO2	2	1	-	-	-	-	-	2	-	3	2	2	1	1
CO3	3	3	3	2	3	1	-	2	-	3	2	2	3	3
CO4	3	3	3	2	1	-	-	2	-	3	2	1	2	2
CO5	3	3	3	2	1	-	-	2	-	3	2	1	2	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

BIG DATA ANALYTICS
(Professional Elective -V)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	21AM4706	**Credits**	:	03
Hours / Week	:	0	**Total Hours**	:	Hours
L–T–P–S	:	0–0–0–6			

Course Learning Objectives:

This course will enable students to:

1. **Explain** the fundamental concepts of big data and analytics.
2. **Make Use of** the Hadoop Distributed File System components and Hadoop Daemons for storing large data sets of structured or unstructured data across various nodes.
3. **Develop** a MapReduce paradigm for the analysis of Big Data of different applications.
4. **Execute** the commands using Pig Hadoop ecosystem tools.
5. **To analyze and interpret** the data by executing the queries using Hive Hadoop Ecosystem tools.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the student's understanding.

UNIT – I :	**07 Hours**

INTRODUCTION TO BIGDATA: Understanding Big Data, Types of Data: Structured, Unstructured and Semi-structured, Different sources of Data Generation, Different V's: Volume, Variety, Velocity, Veracity, Value, Traditional RDBMS approach.

Phases of Big Data Analytics, Types of Data Analytics, Apache Hadoop, Need for the Hadoop, Apache Hadoop Architecture, How Does Hadoop Work? Advantages of Hadoop, Apache Hadoop Ecosystem.

Textbook 1: Chapter 1

UNIT – II:	**09 Hours**

Hadoop Distributed File System: Hadoop Distributed File System, Features of HDFS, HDFS Architecture, Commands and description of HDFS, Hadoop File system, Replication factor, Name Node, Secondary Name Node, Job Tracker, Task tracker, Data Node, FS Image, Edit-logs, Check-pointing Concept, HDFS federation, HDFS High availability, Architectural description for Hadoop Cluster, Hadoop – File Blocks and Replication Factor, Read operation in HDFS, Write operation in HDFS.

Textbook 1 :Chapter 3

UNIT – III:	**08 Hours**

Processing Unit:

MapReduce, Internal architecture, Record Reader, Mapper Phase, Reducer Phase, Sort and Shuffle Phase, Data Flow, Counters, Combiner Function, Partition Function, Joins, Map Side Join, Reduce Side Join, writing a simple MapReduce program to Count Number of words, YARN, YARN Architecture, YARN Components, Resource Manager, Node Manager, Application Master, Difference between Hadoop 1.x and 2.x Architecture.

Textbook 1 Chapter 6

UNIT – IV:	08 Hours

Apache Pig

Apache Pig, Pig on Hadoop, Pig Latin, Local Mode and MapReduce Mode, Pig's Data Model, Scalar, Complex, Load, Dump, Store, Foreach, Filter, Join, group, Order by, Distinct, Limit, Sample, Parallel, User Defined Function. Using different Join Implementations, Co-group, Union, Cross, Nonlinear Data flows, Controlling Executions, Parameter Substitutions, and Program for Word Count Job, Comparison Apache Pig and MapReduce.

Textbook 1 Chapter 11

UNIT – V:	08 Hours

Apache Hive

Apache Hive, Features of Apache Hive, History of Apache Hive, Hive Data Types & Files Formats, Creating Managed Table, External Table, Partitioned Table, Dropping Tables, Alter Table, loading data into Managed Table, Inserting Data into Tables from Queries, Dynamic Partitions inserts, Exporting data, SELECT from clauses, WHERE Clauses, GROUP BY Clauses, JOIN Statements, ORDER BY, SORT BY, DISTRIBUTE BY, CLUSTER BY, bucketing, UNION ALL, View, Hive Metastore.

Textbook 1 Chapter 12

Course Outcomes:

At the end of the course the student will be able to:

1. **Summarize** the concept of big data and its phases, architecture, features and compare it with traditional RDBMS.
2. **Make Use of** the Hadoop Distributed File System components and Hadoop Daemons for storing large data sets of structured or unstructured data across various nodes.
3. **Illustrate and develop** a MapReduce paradigm for the analysis of Big Data of various applications.
4. **Make use of** the Pig Hadoop Ecosystem tool for performing data processing operations.
5. **Apply** Hive Hadoop Ecosystem tool for performing data processing operations and to store the data in Hive Meta store .

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineeringknowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer andsociety	Environment and sustainability	Ethics	teamwork	Communication	Life-long learning	Project managementand finance	Cognitive Outcome	Skill & Design Outcome
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	1	-	-	-	-	-	-	-	1	1
CO3	3	2	1	-	1	-	-	-	-	-	-	-	1	1
CO4	3	2	1	-	2	-	-	-	-	-	-	-	1	1
CO5	3	2	1	-	2	-	-	-	-	-	-	-	1	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. Programming Pig, By: Alan Gates, Published by O'Reilly Media, Inc., 2016.
2. Hadoop: The Definitive Guide, By: Tom White, O'REILLY, 4th Edition,2015.
3. Programming Hive, By: Edward Capriolo, Dean Wampler & Jason Rutherglen, Published by O'REILLY, 2012.

Reference Books:

1. Dirk deRoos, Paul C. Zikopoulos, Bruce Brown, Rafael Coss, and Roman B. Melnyk , "Hadoop for Dummies", A Wiley brand, 2014.
2. Programming Hive, By: Edward Capriolo, Dean Wampler & Jason Rutherglen, Published by O'REILLY, 2012.

E-Resources:

1. https://www.ibm.com/ae-en/analytics/hadoop/big-data-analytics
2. https://www.tableau.com/learn/articles/big-data-analytics

Activity Based Learning (Suggested Activities in Class)

1. Quiz.
2. Collaborative Activity is minor project development with a team of 4 students.

Dayananda Sagar University
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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence & Machine Learning)

GPU ARCHITECTURE AND PROGRAMMING
(Professional Elective -V)
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	: 21AM4707	**Credits**	: 03
Hours / Week	: 03 Hours	**Total Hours**	: 39 Hours
L–T–P–S	: 3–0–0–0		

Course Learning Objectives:
This course will enable students to:

1. To understand the basics of GPU architectures
2. To write programs for massively parallel processors
3. To understand the issues in mapping algorithms for GPUs
4. To introduce different GPU programming models

Teaching-Learning Process (General Instructions)
These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**

Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDAHardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.
(Text Book-1: Chapter 1: 1.1 to 1.4, 1.6, Chapter 2: 2.1,2.2, 2.4)

UNIT – II	**08 Hours**

CUDA PROGRAMMING Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.
(Text Book-1: Chapter 3: 3.1 to 3.3).

UNIT – III	**08 Hours**

PROGRAMMING ISSUES Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.
(Text Book-1: Chapter 5: 5.2,5.3)***(Text Book-2 Chapter 1: 1.1 to 1.5***)

UNIT – IV	**08 Hours**

OPENCL BASICS OpenCL Standard – Kernels – Host Device Interaction – Execution Environment –Memory Model – Basic OpenCL Examples.
(Text Book-1: Chapter 14: 14.1 to 14.5).

UNIT – V	**07 Hours**

ALGORITHMS ON GPU Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.
(Text Book-2: Chapter 20: 20.1 to 20.5, Chapter 21: 21.1 to 21.3, Chapter 22: 22.1 to 22.4)

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Course Outcomes:

At the end of the course the student will be able to:

1. Outline GPU computing architecture.
2. Make use of parallel programming to decompose a problem
3. Demonstrate GPU programming environments.
4. Design programs that make efficient use of the GPU processing power.
5. Experiment with GPU to provide massive acceleration for specialized tasks such as AI.

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineeringknowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer andsociety	Environment and sustainability	Ethics	teamwork	Communication	Life-long learning	Project managementand finance	Cognitive Outcome	Skill & Design Outcome
CO1	3	3	2	-	-	-	-	-	-		-	-	-	-
CO2	3	3	2	-	-	-	-	-	2	2	-	-	-	-
CO3	3	2	1	-	1	-	-	-	2	2	-	-	-	2
CO4	3	1	-	-	1	-	-	-	2	2	-	-	2	2
CO5	3	2	2	-	2	-	-	-	2	2	-	-	3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Learn CUDA Programming - Jaegeun Han, Bharatkumar Sharma Packt Publishing, 27-Sept-2019 - 508 pages.
2. Shane Cook, CUDA Programming: —A Developer's Guide to Parallel Computing with GPUs(Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012
3. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, —Heterogeneous computing withOpenCL, 3rd Edition, Morgan Kauffman, 2015.

REFERENCE BOOKS:

1. Parallel Computing for Data Science (Chapman & Hall/CRC The R Series) 1st Edition

E-Resources:

https://developer.nvidia.com/cuda-toolkit
https://developer.nvidia.com/opencl
https://leonardoaraujosantos.gitbook.io/opencl/ch
apter1https://github.com/topics/opencl
https://github.com/mikeroyal/OpenCL-Guide

Activity Based Learning (Suggested Activities in Class)

1. Group discussion on how to optimize the machine learning algorithms or a whole neural network usingCUDA.
2. Collaborative Activity is minor project development with a team of 4 students.

Prerequisites:

- Basic understanding of CPU scheduling, process and threading and memory handling.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(Artificial Intelligence & Machine Learning)

CLOUD COMPUTING
(Professional Elective -V)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	: 21AM4708	**Credits**	: 03
Hours / Week	: 03 Hours	**Total Hours**	: 39 Hours
L–T–P–S	: 3–0–0–0		

Course Learning Objectives:

This course will enable students to:

1. **Understand** various basic concepts related to cloud computing technologies.
2. **Contrast** various programming models used in cloud computing.
3. **Choose** appropriate cloud model for a given application.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainmentof the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and role-playing.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. Discuss how every ***concept can be applied to the real world*** - and when that's possible,it helps improve the student's understanding.

UNIT – I	**08 Hours**

INTRODUCTION TO CLOUD COMPUTING

Introduction, Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service- Oriented Computing, Utility-Oriented Computing

Text Book 1: Chapter 1

UNIT – II	**08 Hours**

TYPES OF CLOUDS

Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economicsof the Cloud, Open Challenges.

Cloud Definition, Cloud Interoperability and Standards Scalability and Fault ToleranceSecurity, Trust, and Privacy Organizational Aspects.

Text Book 1: Chapter 4

UNIT – III	08 Hours

CLOUD SERVICES AND PLATFORMS

Building Cloud Computing Environments, Application Development, Infrastructure and System Development.
Computing Platforms and Technologies, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka.
Cloud Computing Architecture-Introduction, Cloud Reference Model- Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service.

Text Book 1: Chapter 1, Chapter 4

UNIT – IV	08 Hours

CLOUD APPLICATION PLATFORM-ANEKA

Aneka: Cloud Application Platform, Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid CloudDeployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.

Text Book 1: Chapter 5

UNIT – V	07 Hours

CLOUD PLATFORMS IN INDUSTRY

Concurrent Computing: Thread Programming, Introducing Parallelism for Single MachineComputation.

Cloud Platforms in Industry, Amazon Web Services, Compute Services, Storage Services, Communication Services, Additional Services, Google AppEngine, Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure, Azure CoreConcepts, SQL Azure, Windows Azure Platform Appliance.

Text Book 1: Chapter 9

Course Outcomes:

At the end of the course the student will be able to:

1. **Analyze** the principles and components of cloud computing, demonstrating a comprehensive understanding of its architecture and operation.
2. **Compare and contrast** cloud architecture, computing platforms, and technologies.
3. **Analyze** cloud computing architecture principles to design scalable and resilient systems, utilizing various platforms and technologies.
4. **Examine** the framework, cloud deployment mode, and services in Aneka to gain a comprehensive understanding of its functionalities.
5. **Apply** web services and search engines in the industry by utilizing cloud platforms such as Amazon Web Services and Google AppEngine to leverage compute, storage, and communication services.

Table: Mapping Levels of COs to POs / PSOs														
Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineeringknowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer andsociety	Environment and sustainability	Ethics	teamwork	Communication	Life-long learning	Project managementand finance	Cognitive Outcome	Skill & Design Outcome
CO1	3	2	-	-	-	-	-	-	-	-	-	1		1
CO2	3		-	2	2	-	-	-	-	-	-	1		1
CO3	2	3	2		2	-	-	-	2	-	-	2		1
CO4	3	3	2	-	-	-	-	-	-	-	-	1		1
CO5	2	2	3	-	3	-	-	-	3	-	-	2		1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. 1. Cloud Computing: From Beginning to End", Ray J. Rafaels Rajkumar Buyya, James Broberg, and Andrzej Goscinski, Packt,2022.
2. Cloud Computing: Principles and Paradigms" by Rajkumar Buyya, James Broberg, and Andrzej Goscinski, Wiley in 2020.

REFERENCE BOOKS:

1. Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, Pearson Education,2020.
2. Cloud Computing A Practical Approach, Anthony T Velte et.al, MC Graw Hill publications, 2014.
3. Cloud Computing Principles and Paradigms, Rajkumar Buyya et.al, WileyPublications, 2015.

Activity Based Learning (Suggestion Activities in Class)

- Presentation
- Collaborative Activity is minor project development with a group of 4 students.

RESPONSIBLE AI AND ETHICS
(Open Elective-III)
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	21OE0052	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:
This course will enable students to:

1. **Understand** the impact of analytics and AI/ML on individuals and society.
2. **Identify** the problems associated with Big Data using the appropriate technique.
3. **Apply** AI/ML techniques on identifying fairness and bias issues.
4. **Use** Tools and methods to quantify bias.
5. **Develop** the project using the case study.

Teaching-Learning Process (General Instructions)
These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

7. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
8. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
9. Show ***Video/animation*** films to explain the functioning of various concepts.
10. Encourage ***Collaborative*** (Group Learning) Learning in the class.
11. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
12. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08 Hours**
Data, Individuals, and Society: The power and impact that analytics and AI/ML have on individuals and society, especially concerning issues such as fairness and bias, ethics, legality, data collection and public use.	

UNIT – II	**08 Hours**
Big Data: Components of big data, basic statistical techniques to data scenarios, and understand the issues faced when learning from big data, ranging from data biases, overfitting, causation vs correlation, etc.	

UNIT – III	**08 Hours**
Privacy and Fairness in AI/ML: Use of AI/ML techniques to data scenarios, with a focus on identifying fairness and bias issues found in the design of decision-making systems. Technical approaches to current AI/ML applications such as facial recognition, natural language processing, and predictive algorithms, all while being mindful of its social and legal context.	

UNIT – IV	**08 Hours**
Tools and methods to quantify bias and examine ways to use algorithmic fairness to mitigate this bias, taking into consideration ethical and legal issues associated with it. Knowledge of analytics and AI/ML to transform a current biased data-set into a more objective solution.	

UNIT – V	**07 Hours**

Case Studies :

1. Robustness and beneficial AI
2. Benefits and dangers of super-intelligence
3. Rationality in Advanced Artificial Agents
4. Artificial Morality

COs	Description	Bloom's Taxonomy Level
1	**Analyze** the societal and individual impacts of AI/ML technologies, focusing on ethical, legal, and fairness concerns, and the significance of unbiased data collection and public data use.	**L4**
2	**Apply** basic statistical methods to big data, identifying and addressing issues like data biases, overfitting, and distinguishing between causation and correlation.	**L3**
3	**Compare** AI/ML systems for fairness and bias in decision-making processes, in applications like facial recognition and natural language processing.	**L3**
4	**Utilize** tools and methods to quantify and mitigate bias in datasets, understanding ethical and legal issues, and transforming biased datasets into more objective solutions.	**L3**
5	**analyze** case studies on AI robustness, risks of super-intelligence, rationality in artificial agents, and artificial morality, articulating their implications for future technologies and society.	**L4**

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineering knowledge	Problem analysis	Design	Conduct investigations of	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Cognitive Outcome	Skill & Design Outcome
CO1	1	-	-	-	-	-	-	-	2	2	1	-	2	2
CO2	3	2	-	-	1	-	-	-	2	2	1	-	2	2
CO3	3	2	-	-	1	-	-	-	2	2	-	-	2	2
CO4	3	2	-	-	1	-	-	-	2	2	-	-	2	2
CO5	3	2	-	-	1	-	-	-	2	2	-	-	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Kearns, Michael, and Aaron Roth. The ethical algorithm: The science of socially aware algorithm design. Oxford University Press, 2019.
2. O'neil, Cathy. Weapons of math destruction: How big data increases inequality and threatens democracy. Broadway Books, 2016.

REFERENCE BOOKS:

1. S. J. Russell, D. Dewey, and M. Tegmark, 'Research priorities for robust and beneficial artificial intelligence', AI Magazine, 2015.
2. Bostrom, N. (2014), Superintelligence: Paths, Dangers, Strategies, Oxford University Press, Chapters 2-6.
3. Bostrom, N. (2012). The Superintelligent Will: Motivation and Instrumental Rationality in Advanced Artificial Agents. Minds & Machines 22: 71-85.
4. Allen, C., Smit, I.,Wallach,W. (2005) 'Artificial morality: Top-down, bottom-up, and hybrid approaches', Ethics and Information Technology ; 7, 149-155
5. Lake, B. M., Ullman, T. D., Tenenbaum, J. B., Gershman, S. J. (2017) 'Building machines that learn and think like people', Behavioral and Brain Sciences, e253.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ee56/
2. https://nptel.ac.in/courses/106106046

Activity Based Learning (Suggested Activities in Class)

1. Group Discussion.
2. Collaborative Activity on case studies with a team of 3 students.

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CAPSTONE PROJECT PHASE - I

[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – VII

Subject Code	:	21AM4701	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. **To identify** key research questions within a field to carry out research in a team.
2. **To identify** and summarize the literature review of the relevant field.
3. **To demonstrate** relevant referencing and inculcate new skills in various aspects of academic writing.
4. **To demonstrate** the knowledge and understanding of writing the publication/report.
5. **To showcase** the strong evidence on the clarity of the argument, understanding of the selected domain area and presentation of its technical information.
6. **To detail description** of the process of carrying out the independent research in written document along with results and conclusions with reference to the existing literature.
7. **To analyze** and synthesize the new research findings.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only the traditional lecture method but a different type of teaching method that may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show Video/animation films to explain the functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

COURSE CONTENT:

1. The research topic proposed by both the guide and the student team should be approved by the department chairman to proceed further.
2. A degree of industrial inputand involvement will be encouraged, and can be facilitated through existing academic- industrial collaborations or by addressing specific topics that are of interest to industrial partners.
3. The problem statement should be big enough to be carried out in two phases over the two semesters i.e., VII and VIII semesters in the VI year.
4. All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from conception to completion.
5. The following criteria will be checked by the department chairman to approve for theresearch proposal:

a. Department staff as course guide

1. Ability to provide research direction to the student in the chosen field of interest
2. Ability to design an appropriate research strategy and methodology tocarry out the research by student
3. Ability to provide and evaluate the strong literature review document forthe chosen research topic
4. Ability to train students on research paper / technical writing skills
5. Conduct reviews in regular time period and submit the evaluation todepartment chairman

b. Student Team

1. To be dedicated and committed to work on a new research topic bylearning new technical skills
2. To have fair knowledge on what is product development or research topic
3. To have constant interaction with allocated guide by providing weekly updates
4. To be committed to complete the project and submitting the technical paperwithin the stipulated time framed by the university

Evaluation:

1. Phase-1 comprises of Literature Survey, Problem identification, Objectives and Methodology.
2. There will be CIA evaluation (Project reviews) done by a committee of senior faculty of the Department based on the rubrics
3. Additionally, there will be a Semester end evaluation of the work done that would include an internal Faculty and an external academic expert

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	Identify and Select an Appropriate Research Problem	L1
2	Explain and Summarize Relevant Literature	L2
3	Compare and Critically Analyze Relevant Research Papers	L3
4	Construct a Research Model and Perform Evaluation	L4
5	Create and Draft Publications or Demonstrations	L5

Mapping Levels of COs to POs / PSOs													
COs				Program Outcomes (POs)								PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineering Knowledge	Problem Analysis	Design & Development	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual & Team Work	Communication	Project management and Finance	Life-long Learning	Cognitive Outcome	Skill & Design Outcome
CO1	3	2	2	1	1	1	1	1	2	2	3	2	2	1
CO2	2	2	3	2	2	1	1	1	2	2	3	2	1	2
CO3	3	3	3	2	3	2	2	1	2	2	2	2	2	2
CO4	2	3	2	3	2	1	2	2	2	2	2	3	2	2
CO5	1	1	2	1	2	1	1	1	3	3	2	2	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

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ADVANCED JAVA (SKILL ENHANCEMENT COURSE)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	21AM4702	**Credits**	:	02
Hours / Week	:	03Hours	**Total Hours**	:	26 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

1. Enhance Proficiency in Advanced Object-Oriented Programming
2. Build and Manage Networked and Web-Based Applications
3. Advanced Database Interaction and Transaction Management
4. Ensure Security, Performance, and Maintainability in Java Applications

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** clips to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**08Hours**

Java Server Technologies

The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Javax.servlet Package; Reading Servlet Parameter; The Javax.servlet.http package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking. Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects

UNIT – II	**08Hours**

THE CONCEPT OF JDBC

The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet; Transaction Processing; Metadata, Data types; Exceptions.

UNIT – III	**05Hours**

JavaBeans and Annotations

Creating and Using JavaBeans,Introspection and Customization,Built-in Annotations,Creating Custom Annotations,Annotation Processing

UNIT – IV	**05Hours**

JAVAFX AND GUI PROGRAMMING

JavaFX Overview,Building User Interfaces with JavaFX,Event Handling,Working with Controls and Layouts

Course Outcomes:

At the end of the course the student will be able to:

1. Utilize Tomcat for deploying and managing JSP-based web applications effectively.
2. Retrieve and utilize metadata and manage data types in database operations.
3. Utilize and process annotations efficiently to integrate metadata-driven programming techniques.
4. Implement event handling in JavaFX applications for interactive user experiences.

Table: Mapping Levels of COs to POs / PSOs														
Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineeringknowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer andsociety	Environment and sustainability	Ethics	teamwork	Communication	Life-long learning	Project managementand finance	Cognitive Outcome	Skill & Design Outcome
CO1	2	2	2	2	-	2	-	-	-	1	-	2	3	3
CO2	3	3	3	3	-	2	-	-	-	1	-	2	3	3
CO3	3	3	3	3	-	2	-	-	-	1	-	2	3	3
CO4	3	3	3	3	-	2	-	-	-	1	-	2	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

REFERENCE BOOKS:

1. Head First Java: A Brain-Friendly Guide, Third Edition (Grayscale Indian Edition), by Kathy Sierra, Bert Bates , Trisha Gee,2022
2. Java: The Complete Reference, by Herbert Schildt,2021, McGraw Hill publication, 12th edition,2021
3. "Effective Java" by Joshua BlochRalph,Third Edition,2018

Activity Based Learning (Suggested Activities in Class)

1. Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)
2. Student seminars (on topics of the syllabus and related aspects (individual activity)
3. Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams))
4. Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity))

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GENERATIVE AI
(PROFESSIONAL ELECTIVE -VI)

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VIII

Subject Code	:	21AM4803	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. To provide a strong foundation of fundamental concepts in Generative AI.
2. To provide a basic exposition to different types of Prompt Engineering.
3. Make use of the different Generative AI models such as GPT, attention models and transformers.
4. Make use of the different Language Models for handling text data.
5. To design the Generative AI models for various applications related to handling the texand Image data.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I	**06 Hours**
Introduction to Generative AI, Introduction to Generative AI, Definition and scope of Generative AI, Hierarchy of Generative AI, Overview of generative models and their applications, Importance of Generative AI in various domains, Ethical considerations and challenges.	
UNIT – II	**08 Hours**
Prompt Engineering: Understanding the concept and significance of prompt engineering, Principles of Prompting, Strategies for designing effective prompts, Techniques for Prompt Engineering (Template-based prompts, Rule-based prompts, and Fine-tuning prompts), Best practices for prompt engineering in generative AI, Enhancing Model Outputs.	
UNIT – III	**08 Hours**
Generative AI Concepts: Encoder/decoder architectures as basis for Generative AI, the role of the latent space, Transformer architectures and Attention, Conditional Generative Models, Introduction to GPT and its significance, Architecture and working of GPT models.	
UNIT – IV	**09 Hours**
Language Models and LLM Architectures Introduction to language models and their role in AI, how do large language models work? Difference Between Large Language Models and Generative AI,	

Examples of LLMs (Generative Pre-trained Transformer 3, Bidirectional Encoder Representations from Transformers, Text-to-Text Transfer Transformer, Robustly Optimized BERT Pretraining Approach), Leading language models and their real-life applications.

UNIT – V | **09 Hours**

Case Study of Generative AI and Language Models: using ChatGPT3, BERT, T5, RoBERTa; SRGAN, ESRGAN, Cycle GAN, StyleGAN, text-2-image, GAN in Computer Vision.

Course Outcomes:

At the end of the course the student will be able to:

1. Summarize the fundamental concepts of Generative AI.
2. Utilize the different types of Prompt Engineering to generate the prompts.
3. Make use of the different Generative AI models such as GPT, attention models and transformers to generate text and Image data.
4. Make use of the different Language Models for handling text data.
5. Design the Generative AI models for various applications related to handling the text and Image data.

COs	Program Outcomes (POs)												PSOs	
	Engineering knowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer and society	Environment and sustainability	Ethics	team work	Communication	Life-long learning	Project management and finance	Cognitive Outcome	Skill & Design Outcome
CO1	2	-	-	-			-	-	1	1	-	-	2	2
CO2	3	1	-	-	1	1	-	-	1	1	-	-	2	2
CO3	3	1	-	-	1	1	-	-	1	1	-	-	2	2
CO4	3	1	-	-	1	1	-	-	1	1	-	-	2	2
CO5	3	1	2	-	1	1	-	-	1	1	-	-	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. Generative Deep Learning, 2nd Edition by David Foster, O'Reilly Media, Inc., ISBN: 9781098134181, 2023.
2. Prompt Engineering for Generative AI, James Phoenix, Mike Taylor, O'Reilly Media, Inc.
3. ISBN: 9781098153434, 2024.

Reference Books:

1. Artificial Intelligence: A modern Approach, Russell and Norvig, Printice Hall, 2010.
2. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI.

E-Resources:

1. https://www.datacamp.com/blog/what-is-prompt-engineering-the-future-of-ai-communication
2. https://www.promptengineering4u.com/learning/techniques/template-based-prompting#h.2n56pv37pv0c

Activity Based Learning (Suggested Activities in Class)

1. Flipped Class Activity on Searching techniques.
2. Problem Solving and Discussion.
3. GPT (Generative Pre-trained Transformer) Pre-training and fine-tuning processes.
4. Mini Project

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Financial Technology (FinTech)
(PROFESSIONAL ELECTIVE -VI)
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VIII

Subject Code	:	21AM4804	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:
The course will enable the students to:

1. Recall the fundamentals of machine learning in finance for risk assessment and investment optimization.
2. Identify the key concepts and future trends in payment technologies, emphasizing security and efficiency.
3. Apply knowledge of blockchain and cryptocurrency to explain their roles and applications in financial systems.
4. Relate the methods of raising capital through credit tech, coin offerings, and crowdfunding.
5. Utilize innovations in investment technology driven by artificial intelligence to enhance portfolio management and risk analysis.

Teaching-Learning Process (General Instructions)
These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only the traditional lecture method but a different *type of teaching method* that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.

UNIT – I : Fundamentals of AI&ML in Finance	**08 Hours**

Introduction to Fundamentals of Machine Learning in Finance - Support Vector Machines –Tree based Classifiers – PCA & concepts of Dimension Reduction – Clustering Algorithms - Sequence Modeling - Neural Architecture for Sequential Data
Suggested Readings:
Finance, AI Methodologies

UNIT – II : Payment Technologies	**08 Hours**

Fintech Innovations - Digital Wallets – Payment like consumer-to-business (C2B), consumer-to-consumer (C2C), and business-to-business (B2B) - Social-Network-Based Payment Innovations - Credit Card network and Transactions - PayTech in India - M-Pesa: Business Model

Suggested Readings:
FinTech Island stories.

UNIT – III : Blockchain and Cryptocurrency in Finance	**08 Hours**

Introduction to Blockchain and Cryptocurrency - Network and Data Processing – Blockchain Consensus - Crypto Mining - Buying and Selling Cryptocurrencies - Crypto Risk Factors
Suggested Readings:
Scoping Out Ethereum, Cryptocurrency Market

UNIT – IV : Capital Understanding and Raising	**08 Hours**

Credit Analysis and Scoring - Data Analysis – Concept of Crowdfunding - Equity Based Models -job satisfaction – job enrichment- leadership – Communication – effective communication – Communication and IT.
Suggested Readings:
Banking, Eqity

UNIT – V : Innovations in Investment Technology	**07 Hours**

Building an Efficient Portfolio - Diversified Investments - Exchange Traded Funds - Stock Selection: Fundamental Analysis - AI/ML in investment management
Suggested Readings:
Robots in the Stock Market.

Course Outcomes:

At the end of the course the student will be able to:

1. Gain a solid understanding of machine learning fundamentals in finance, enabling effective risk assessment and investment optimization.
2. Develop insights into the future landscape of payment technologies, with a focus on enhancing security and efficiency in financial transactions.
3. Acquire knowledge of blockchain and cryptocurrency mechanisms, facilitating comprehension of their applications within financial systems.
4. Explore various methods of raising capital, including credit tech, coin offerings, and crowdfunding, to support entrepreneurial endeavors and financial ventures.
5. Utilize innovative investment technologies powered by artificial intelligence to enhance portfolio management strategies and quantitative analysis for improved decision-making.

COs	**Program Outcomes (POs)**											**PSOs**	
	Engineering knowledge	**Problem analysis**	**Design**	**Conduct investigations of complex problems**	**tool usage**	**The engineer and society**	**Environment and sustainability**	**Ethics**	**team work**	**Communication**	**Life-long learning**	**Project management and finance**	Cognitive Outcome	Skill & Design Outcome
CO1	3	3						2				2	2	2
CO2	3	2	2		2			2			1	2	2	1
CO3	3	2						2				1	2	1
CO4	3	2	2		2			2			1	2	2	2
CO5	3	1						2				2	2	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. Dixon, Matthew F., Igor Halperin, and Paul Bilokon. Machine learning in finance. Vol. 1170. Berlin/Heidelberg, Germany: Springer International Publishing, 2020.
2. Choi, Paul Moon Sub, and Seth H. Huang, eds. Fintech with artificial intelligence, big data, and Blockchain. Springer, 2021.
3. Bazarbash, Majid. Fintech in financial inclusion: machine learning applications in assessing credit risk. International Monetary Fund, 2019.
4. Ng, Jeffrey, and Subhash Shah. Hands-On Artificial Intelligence for Banking: A practical guide to building intelligent financial applications using machine learning techniques. Packt Publishing Ltd, 2020.

Reference Books:

1. Liermann, Volker, and Claus Stegmann, eds. The impact of digital transformation and FinTech on the finance professional. Palgrave Macmillan, 2019
2. Boukherouaa, E., et al. "Powering the Digital Economy: Opportunities and Risks of Artificial Intelligence in Finance. Departmental Papers." (2021).

E-Resources:

1. https://www.coursera.org/learn/fundamentals-machine-learning-in-finance?specialization=machine-learning-reinforcement-finance
2. https://www.coursera.org/specializations/financialtechnology#courses

Activity Based Learning (Suggested Activities in Class)

1. Flipped Class Activity
2. Problem Solving and Discussion.
3. Mini Project

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UG RESEARCH PROJECT-II

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VIII

Subject Code	:	21AM4805	**Credits**	:	03
Hours / Week	:	0	**Total Hours**	:	Hours
L–T–P–S	:	0–0–0–6			

Course Learning Objectives:

This course will enable students to:

1. **To identify** key research questions within a field to carryout research in a team.
2. **To identify** and summarize the literature review of the relevant field.
3. **To demonstrate** relevant referencing and inculcate new skills in various aspects of academic writing.
4. **To demonstrate** the knowledge and understanding of writing the publication/report.
5. **To showcase** the strong evidence on the clarity of the argument, understanding of theselected domain area and presentation of its technical information.
6. **To detail description** of the process of carrying out the independent research in written document along with results and conclusions with reference to the existing literature.
7. **To analyze** and synthesize the new research findings.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only the traditional lecture method but a different type of teaching method that may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show Video/animation films to explain the functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

COURSE CONTENT:

The research topic proposed by both the guide and the student team should be approved by the department chairman to proceed further. A degree of industrial input and involvement will be encouraged, and can be facilitated through existing academic-industrial collaborations or by addressing specific topics that are of interest to industrial partners.

All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from conception to completion.

The following criteria will be checked by the department chairman to approve for the research proposal:

a. Department staff as course guide

1. Abilityto provide research direction to the student in the chosen field of interest
2. Ability to design an appropriate research strategy and methodology to carry out the research by student
3. Ability to provide and evaluate the strong literature review document for the chosen research topic
4. Ability to train students on research paper / technical writing skills
5. Conduct reviews in regular time period and submit the evaluation to department chairman

b. Student Team

1. To be dedicated and committed to work on a new research topic by learning new technical skills
2. To have fair knowledge on what is product development or research topic
3. To have constant interaction with allocated guide by providing weekly updates
4. To be committed to complete the project and submitting the technical paper within the stipulated time framed by the university

Evaluation:

There will be CIA evaluation as well as the Semester end evaluation of the work done. Itwill be done by a committee of senior researchers of the Department.

Course Outcomes:

At the end of the course the student will be able to:

1. Develop the research project by selecting an appropriate research problem.
2. Compare the papers relevant to the selected problem domain.
3. Construct the model and perform the model evaluation and analysis.
4. Draft of the Publication or Demonstration of the Proof-of- concept product.
5. Draft of patent application.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence & Machine Learning)

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineeringknowledge	Problem analysis	Design	Conduct investigations of complex problems	tool usage	The engineer andsociety	Environment and sustainability	Ethics	teamwork	Communication	Life-long learning	Project managementand finance	Cognitive Outcome	Skill & Design Outcome
CO1	3	2	2	-	2	-	-	2	-	3	2	2	3	3
CO2	2	1	-	-	-	-	-	2	-	3	2	2	1	1
CO3	3	3	3	2	3	1	-	2	-	3	2	2	3	3
CO4	3	3	3	2	1	-	-	2	-	3	2	1	2	2
CO5	3	3	3	2	1	-	-	2	-	3	2	1	2	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

CAPSTONE PROJECT PHASE - II

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VIII

Subject Code	:	21AM4801	**Credits**	:	06
Hours / Week	:	9	**Total Hours**	:	78 Hours
L–T–P–S	:	0–0–0–24			

Course Learning Objectives:

This course will enable students to:

1. **To identify** key research questions within a field to carry out research in a team.
2. **To identify** and summarize the literature review of the relevant field.
3. **To demonstrate** relevant referencing and inculcate new skills in various aspects of academic writing.
4. **To demonstrate** the knowledge and understanding of writing the publication/report.
5. **To showcase** the strong evidence on the clarity of the argument, understanding of the selected domain area and presentation of its technical information.
6. **To detail description** of the process of carrying out the independent research in written document along with results and conclusions with reference to the existing literature.
7. **To analyze** and synthesize the new research findings.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only the traditional lecture method but a different type of teaching method that may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show Video/animation films to explain the functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

COURSE CONTENT:

1. The research topic proposed by both the guide and the student team should be approved by the department chairman to proceed further.
2. A degree of industrial inputand involvement will be encouraged, and can be facilitated through existing academic- industrial collaborations or by addressing specific topics that are of interest to industrial partners.
3. The problem statement should be big enough to be carried out in two phases over the two semesters i.e., VII and VIII semesters in the VI year.
4. All projects will be closely supervised by the Project Guide with ongoing feedback and guidance at all stages of the project from conception to completion.
5. The following criteria will be checked by the department chairman to approve for theresearch proposal:

a. Department staff as course guide

1. Ability to provide research direction to the student in the chosen field of interest
2. Ability to design an appropriate research strategy and methodology tocarry out the research by student
3. Ability to provide and evaluate the strong literature review document forthe chosen research topic
4. Ability to train students on research paper / technical writing skills
5. Conduct reviews in regular time period and submit the evaluation todepartment chairman

b. Student Team

1. To be dedicated and committed to work on a new research topic bylearning new technical skills
2. To have fair knowledge on what is product development or research topic
3. To have constant interaction with allocated guide by providing weekly updates
4. To be committed to complete the project and submitting the technical paperwithin the stipulated time framed by the university

Evaluation:

1. The problem statement selected in Capstone Project Phase - I (VII semester) will be carried in the VIII semester.
2. Phase 2 comprises of the detailed design, implementation, and testing results during the internal and external review.
3. Each Project team needs to submit the technical paper or patent or participate in hackathons and project exhibitions as well as apply for various state and national funding agencies within the stipulated time frame by the university
4. There will be CIA evaluation (Project reviews) done by a committee of senior faculty of the Department.
5. Additionally, there will be a Semester end evaluation of the work done that would include an internal Faculty and an external academic expert.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	Identify and Select an Appropriate Research Problem	L1
2	Explain and Summarize Relevant Literature	L2
3	Compare and Critically Analyze Relevant Research Papers	L3
4	Construct a Research Model and Perform Evaluation	L4
5	Create and Draft Publications or Demonstrations	L5

Mapping Levels of COs to POs / PSOs													
COs				Program Outcomes (POs)								PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	Engineering Knowledge	Problem Analysis	Design & Development	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual & Team Work	Communication	Project management and Finance	Life-long Learning	Cognitive Outcome	Skill & Design Outcome
CO1	3	2	2	1	1	1	1	1	2	2	3	2	2	1
CO2	2	2	3	2	2	1	1	1	2	2	3	2	1	2
CO3	3	3	3	2	3	2	2	1	2	2	2	2	2	2
CO4	2	3	2	3	2	1	2	2	2	2	2	3	2	2
CO5	1	1	2	1	2	1	1	1	3	3	2	2	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

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RESEARCH INTERNSHIP/ INDUSTRY INTERNSHIP/IN-HOUSE INTERNSHIP

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VIII

Subject Code	:	21AM4802	**Credits**	:	03
Hours / Week	:	-	**Total Hours**	:	78 Hours
L–T–P–S	:	0–0–0–6			

Course Learning Objectives:

This course will enable students to:

1. To expose students to the industrial environment
2. To create competent professionals for the industry.
3. To provide possible opportunities to learn, understand and sharpen the real time technical/managerial skills required at the job
4. To work on a problem assigned by a mentor at industry, prepare action plan and complete within time limit
5. To learn, create/prepare report for Project/research as used in industry with productive and efficient way
6. To strengthen industry-institute linkage and increase employability of the students

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only the traditional lecture method but a different type of teaching method that may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
3. Show Video/animation films to explain the functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher-order Thinking questions in the class.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

COURSE CONTENT:

1. The course includes 16 weeks of on-job training on current industry-relevant problem through supervised self-learning approach.
2. The internship is an individual activity.
3. The student should obtain approval from the chairman/supervisor to pursue.
4. A student shall submit a brief proposal about the work to be carried out in the internship, to a coordinator within 3 weeks, after starting the internship.
5. A comprehensive report is required to be prepared and submit to the department at the end of the semester.
6. A certificate shall be attached with this report duly signed by the competent authority of the

industry for the successful completion of the internship.

7. An attendance report shall also be attached with this report.
8. The CIA evaluation will be done by faculty mentor or Industry Supervisor.
9. There is no SEE Exam for this course.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	Comprehend the modern tools used in the field of AIML and engineering for product development.	L2
2	Demonstrate ethical conduct and professional accountability while working in a team for the benefit of society	L3
3	Analyze the resources requirement and planning to facilitate the project success	L4
4	Assess and adapt technical skills on industry environment	L5
5	Apply the modern industry practice for internship	L3

Mapping Levels of COs to POs / PSOs

				Program Outcomes (POs)									PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
COs	Engineering Knowledge	Problem Analysis	Design & Development	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual & Team Work	Communication	Project management and Finance	Life-long Learning	Cognitive Outcome	Skill & Design Outcome
CO1	3	2	2	1	1	1	1	1	2	2	3	2	2	1
CO2	2	2	3	2	2	1	1	1	2	2	3	2	1	2
CO3	3	3	3	2	3	2	2	1	2	2	2	2	2	2
CO4	2	3	2	3	2	1	2	2	2	2	2	3	2	2
CO5	1	1	2	1	2	1	1	1	3	3	2	2	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

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