DAYANANDA SAGAR UNIVERSITY

SCHOOL OF ENGINEERING

SCHOOL OF ENGINEERING

TEACHING SCHEME

B.Tech. PROGRAMME– 2025-26 BATCH

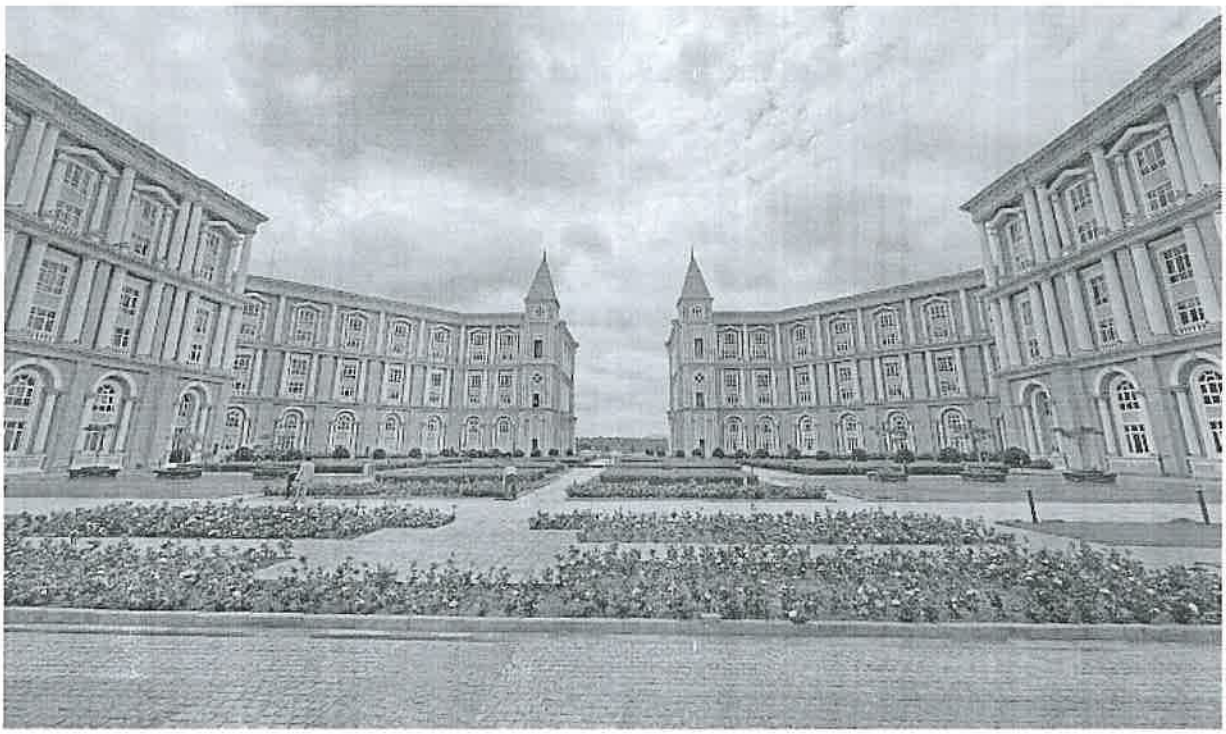
Academic Year 2025-26

Devarakaggalahalli, Harohalli,
Kanakapura Road,
Bengaluru South District – 562 112

Dayananda Sagar University
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DAYANANDA SAGAR UNIVERSITY

SCHOOL OF ENGINEERING



Vision and Mission of DSU

VISION

- To be a centre of excellence in education, research & training, innovation & entrepreneurship and to produce citizens with exceptional leadership qualities to serve national and global needs.

MISSION

- To achieve our objectives in an environment that enhances creativity, innovation and scholarly pursuits while adhering to our vision.

DAYANANDA SAGAR UNIVERSITY Bangalore 560 114

DAYANANDA SAGAR UNIVERSITY

SCHOOL OF ENGINEERING

Vision and Mission of School of Engineering

VISION

- Transform lives through excellence in engineering education, research and innovation with an emphasison sustainability, inclusive technologies and globalneeds.

MISSION

- Design and deliver contemporary engineering curricula to address regional and global needs while emphasizing ethics, values, integrity and regional relevance.
- Carryout high impact academic research, industry projectsand innovation activities with active student engagement toadvance science and engineering knowledge and state-of-the-art industry practices.
- Develop regional and national leaders to advance the society and economy.

Definitions / Descriptions

Definition of Credit:	
1 Hour Lecture (L) Per Week	01 Credit
1 Hour Tutorial (T) Per Week	01 Credit
1 Hour Practical (P) / Project (J) Per Week	0.5 Credit

Course code and Definition:	
BSC	Basic Science Courses
ESC	Engineering Science Courses
HASSC	Humanities Arts and Social Sciences Courses
IPCC	Integrated Professional Core Course
PCC	Professional Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
AEC	Ability Enhancement Courses
INT	Internship
PROJ	Project Work

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SCHOOL OF ENGINEERING

SCHEME 2025 – 2026 Batch

I-SEMESTER (CHEMISTRY CYCLE)											
S.N	Course Type & Code	Course Title	Teaching Hours / Week				Examination				Credits
			L	T	P	J	Contact Hours	CIE Marks	SEE Marks	Total Marks	
1	25EN1101	LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS	3	1	0	0	4	60	40	100	4
2	25EN1102	ENGINEERING GRAPHICS AND DESIGN THINKING	2	1	2	0	5	60	40	100	4
3	25EN1103	CHEMISTRY FORCOMPUTER SCIENCE CLUSTER	2	1	2	0	5	60	40	100	4
4	25EN1104	CHEMISTRY FOR ECE	2	1	2	0	5	60	40	100	4
5	25EN1105	CHEMISTRY FOR MECHANICAL CLUSTER	2	1	2	0	5	60	40	100	4
6	25EN1106	CHEMISTRY FOR CSME	2	1	2	0	5	60	40	100	4
7	25EN1107	ENGINEERING SCIENCE COURSE – I for Computer science Cluster Object Oriented Programming	3	0	0	0	3	60	40	100	3
8	25EN1108	ENGINEERING SCIENCE COURSE – I for ECE Introduction to Electrical Engineering	3	0	0	0	3	60	40	100	3
9	25EN1109	ENGINEERING SCIENCE COURSE – I for Mechanical Cluster Introduction to Electrical and Electronics Engineering	3	0	0	0	3	60	40	100	3
10	25EN1110	TECHNICAL ENGLISH	2	0	0	0	2	100	-	100	2
11	25EN1111	ENVIRONMENTAL SCIENCE	2	0	0	0	2	100	-	100	2
12	25EN1112	KANNADA KALI / MANASU	1	0	0	0	1	50	-	50	1
13	25EN1113	COGNITIVE AND TECHNICAL SKILLS -I							-		P/F
	TOTAL		15	3	4	0	22	490	160	650	20

L – Lecture, T – Tutorial, P – Practical, J – Project, CIE – Continuous Internal Evaluation, SEE- Semester End Examinations.

ENGINEERING SCIENCE COURSE – I:
Computer Science Cluster: Object Oriented Programming
ECE: Introduction to Electrical Engineering
Mechanical Cluster: Introduction to Electrical and Electronics Engineering

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I-SEMESTER (PHYSICS CYCLE)											
S.N	Course Type & Code	Course Title	Teaching Hours / Week				Examination				Credits
			Lecture	Tutorial	Practical	Project	Contact Hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P	J					
1	25EN1101	LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS	3	1	0	0	4	60	40	100	4
2	25EN1114	C PROGRAMMINGFOR PROBLEM SOLVING	2	1	2	0	5	60	40	100	4
3	25EN1115	PHYSICS FOR COMPUTER SCIENCE CLUSTER	3	0	2	0	5	60	40	100	4
4	25EN1116	PHYSICS FOR ECE	3	0	2	0	5	60	40	100	4
5	25EN1117	PHYSICS FOR MECANICAL CLUSTER	3	0	2	0	5	60	40	100	4
6	25EN1109	ENGINEERING SCIENCE COURSE – II for Computer Science cluster Introduction to Electrical and Electronics Engineering	3	0	0	0	3	60	40	100	3
7	25EN1118	ENGINEERING SCIENCE COURSE – II for ECE Introduction to Electronics Engineering	3	0	0	0	3	60	40	100	3
8	25EN1119	ENGINEERING SCIENCE COURSE – II for Mechanical cluster Engineering Mechanics	3	0	0	0	3	60	40	100	3
9	25EN1120	INTRODUCTION TO SUSTAINABLE ENGINEERING	2	0	0	0	2	100	-	100	2
10	25EN1121	BIOLOGY FOR ENGINEERS	2	0	0	0	2	100	-	100	2
11	25EN1122	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	1	0	0	0	1	50	-	50	1
12	25EN1113	COGNITIVE AND TECHNICAL SKILLS – I							-		P/F
	TOTAL		15	2	4	0	22	490	160	650	20

L – Lecture, T – Tutorial, P – Practical, J – Project, CIE – Continuous Internal Evaluation, SEE- Semester End Examinations.

ENGINEERING SCIENCE COURSE – II:
Compute Science Cluster: Introduction to Electrical and Electronics Engineering
ECE: Introduction to Electronics Engineering
Mechanical Cluster: Engineering Mechanics

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II-SEMESTER (CHEMISTRY CYCLE)											
S.N	Course Type & Code	Course Title	Teaching Hours / Week				Examination				Credits
			L	T	P	J	Contact Hours	CIE Marks	SEE Marks	Total Marks	
1	25EN1201	SINGLE AND MULTIVARIATE CALCULUS	3	1	0	0	4	60	40	100	4
2	25EN1102	ENGINEERING GRAPHICS AND DESIGN THINKING	2	1	2	0	5	60	40	100	4
3	25EN1103	CHEMISTRY FORCOMPUTER SCIENCE CLUSTER	2	1	2	0	5	60	40	100	4
4	25EN1104	CHEMISTRY FOR ECE	2	1	2	0	5	60	40	100	4
5	25EN1105	CHEMISTRY FOR MECHANICAL CLUSTER	2	1	2	0	5	60	40	100	4
6	25EN1106	CHEMISTRY FOR CSME	2	1	2	0	5	60	40	100	4
7	25EN1107	ENGINEERING SCIENCE COURSE – I for Computer science Cluster Object Oriented Programming	3	0	0	0	3	60	40	100	3
8	25EN1108	ENGINEERING SCIENCE COURSE – I for ECE Introduction to Electrical Engineering	3	0	0	0	3	60	40	100	3
9	25EN1109	ENGINEERING SCIENCE COURSE – I for Mechanical Cluster Introduction to Electrical and Electronics Engineering	3	0	0	0	3	60	40	100	3
10	25EN1110	TECHNICAL ENGLISH	2	0	0	0	2	100	-	100	2
11	25EN1111	ENVIRONMENTAL SCIENCE	2	0	0	0	2	100	-	100	2
12	25EN1112	KANNADA KALI / MANASU	1	0	0	0	1	50	-	50	1
13	25EN1202	COGNITIVE AND TECHNICAL SKILLS -II							-		P/F
	TOTAL		15	3	4	0	22	490	160	650	20

L – Lecture, T – Tutorial, P – Practical, J – Project, CIE – Continuous Internal Evaluation, SEE- Semester End Examinations.

ENGINEERING SCIENCE COURSE – I:
Computer Science Cluster: Object Oriented Programming
ECE: Introduction to Electrical Engineering
Mechanical Cluster: Introduction to Electrical and Electronics Engineering

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SCHOOL OF ENGINEERING

II-SEMESTER (PHYSICS CYCLE)											
S.N	Course Type & Code	Course Title	Teaching Hours / Week				Examination				Credits
			Lecture	Tutorial	Practical	Project	Contact Hours	CIE Marks	SEE Marks	Total Marks	
			L	T	P	J					
1	25EN1201	SINGLE AND MULTIVARIATE CALCULUS	3	1	0	0	4	60	40	100	4
2	25EN1114	C PROGRAMMINGFOR PROBLEM SOLVING	2	1	2	0	5	60	40	100	4
3	25EN1115	PHYSICS FOR COMPUTER SCIENCE CLUSTER	3	0	2	0	5	60	40	100	4
4	25EN1116	PHYSICS FOR ECE	3	0	2	0	5	60	40	100	4
5	25EN1117	PHYSICS FOR MECANICAL CLUSTER	3	0	2	0	5	60	40	100	4
6	25EN1109	ENGINEERING SCIENCE COURSE – II for Computer Science cluster Introduction to Electrical and Electronics Engineering	3	0	0	0	3	60	40	100	3
7	25EN1118	ENGINEERING SCIENCE COURSE – II for ECE Introduction to Electronics Engineering	3	0	0	0	3	60	40	100	3
8	25EN1119	ENGINEERING SCIENCE COURSE – II for Mechanical cluster Engineering Mechanics	3	0	0	0	3	60	40	100	3
9	25EN1120	INTRODUCTION TO SUSTAINABLE ENGINEERING	2	0	0	0	2	100	-	100	2
10	25EN1121	BIOLOGY FOR ENGINEERS	2	0	0	0	2	100	-	100	2
11	25EN1122	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	1	0	0	0	1	50	-	50	1
12	25EN1202	COGNITIVE AND TECHNICAL SKILLS – II							-		P/F
	TOTAL		15	2	4	0	22	490	160	650	20

L – Lecture, T – Tutorial, P – Practical, J – Project, CIE – Continuous Internal Evaluation, SEE- Semester End Examinations.

ENGINEERING SCIENCE COURSE – II:
Compute Science Cluster: Introduction to Electrical and Electronics Engineering
ECE: Introduction to Electronics Engineering
Mechanical Cluster: Engineering Mechanics

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SEMESTER 1

LINEAR ALGEBRA & DIFFERENTIAL EQUATIONS

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

SEMESTER – I

Course Code	:	25EN1101	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	52 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** 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. **Explain** the course algebraically as well as geometrically.
4. **Solve** problems in cryptography, computer graphics and wavelet transforms.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
- **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
- Show **Video/animation** films to explain functioning of various concepts.
- Encourage **Collaborative** (Group Learning) Learning in the class.
- To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
- Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**10 Hours**

INTRODUCTION:

System of Linear equations, Row reduction and echelon form, Rank of a matrix by row echelon form, Gauss elimination, Inverse of a matrix by Gauss Jordan LU.

UNIT – II	**10 Hours**

Vector spaces – Subspaces, Linear independence – Span - Bases and Dimensions -Finite dimensional vector spaces, Dimensions, finite dimensional vector spaces.

UNIT – III	12 Hours
Linear transformation - Matrices of linear transformations, Vector space of linear transformations – Inner Product, Orthogonal Vectors – Projections, Gram- Schmidt Orthogonalization process.	
UNIT – IV	**08 Hours**
Introduction to Eigenvalues and Eigenvectors, Diagonalization of a Matrix.	
UNIT – V	**12 Hours**
Linear second order ordinary differential equation with constant coefficients, Solutions of homogenous and non-homogenous equations, Method of variation of parameters, Solutions of Cauchy-Euler and Cauchy-Legendre differential equations	

Course Outcome	Description
At the end of the course the student will be able to:	
1	Apply the abstract concepts of matrices and system of linear equations using decomposition methods.
2	Explain 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	Implement the concept of linear transforms and orthogonality in computer graphics and imaging.
5	Make use of techniques for solving differential equation in dynamical systems.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	0	2	0	0	0	0	0	0			
CO2	3	3	2	0	2	0	0	0	0	0	0			
CO3	3	3	3	0	2	0	0	0	0	0	0			
CO4	3	3	3	0	2	0	0	0	0	0	0			
CO5	3	3	2	0	2	0	0	0	0	0	0			

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

TEXT BOOKS:

[1] D C Lay, S R Lay and JJ McDonald, Linear Algebra and its Applications, Pearson India, Fifth edition, 2016.

[2] Gilbert Strang, Linear Algebra and its Applications, 4th Edition, Thomson Brooks/Cole, Second Indian Reprint 2007.

[3] Bernard Kolman and David, R. Hill, Introductory Linear Algebra- An applied first course, 9th Edition, Pearson Education, 2011.

[4] George B. Thomas, D. Weir and J. Hass, Thomas' Calculus, 13th edition, Pearson, 2014.

[5] Erwin Kreyszig, Advanced engineering mathematics, Wiley, London, 1972.

REFERENCE BOOKS:

[1] Gilbert Strang, Introduction to Linear Algebra, 5th Edition, Cengage Learning, 2015.
[2] B S Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.
[3] Stephen Andrilli and David Hecker, Elementary Linear Algebra, 5th Edition, Academic Press 2016.
[4] Robert C Busby, Contemporary linear algebra, Howard Anton, Wiley, 2003.
[5] Farin and Hansford, Practical Linear Algebra, CRC Press, 2013.

E-Resources:

- https://nptel.ac.in/courses/111101115
- https://nptel.ac.in/courses/111108066
- Linear Algebra Basics | Coursera
- https://nptel.ac.in/courses/111108081
- https://nptel.ac.in/courses/111106100
- Differential Equations for Engineers Course (HKUST) | Coursera

Activity Based Learning (Suggested Activities in Class)

1. Introduce the concept of matrix transformations, such as translation, rotation, scaling, and reflection. Provide visual examples and interactive tools that allow students to manipulate shapes and observe the effects of different transformation matrices.
2. Using real-life scenarios or word problems to make the activity of solving linear equations using matrix method.
3. Some real-world scenarios that can be modelled using ODEs, such as population growth, radioactive decay, or chemical reactions that can be discussed and solve using appropriate methods.
4. Real world problem solving and puzzles using group discussion.
5. Demonstration of solution to a problem through experiential learning.

ENGINEERING GRAPHICS & DESIGN THINKING
[As per Choice Based Credit System (CBCS) scheme]

Semester-I/II

Course Code	:	25EN1102	**Credits**	:	04
Hours / Week	:	05 Hours	**Total Hours**	:	26+13+26 = 65 Hours
L–T–P–S	:	2–1–2–0			

Course Learning Objectives:

This Course will enable students to:

1. Create awareness and emphasize the need for Engineering Graphics & design thinking through Manual Sketching & AutoCAD Software
2. Learn using professional CAD software for construction of geometry
3. Understand the concepts of orthographic and isometric projections
4. Draw orthographic projection of lines and solids by Manual Sketching & AutoCAD Software
5. Draw development of surfaces of solids & isometric projections of solids
6. Create simple engineering 3D components using design thinking methods
7. Work in a team for creating conceptual design of products
8. Learn application of CAD techniques for Innovation methods and tools on real world problem through fusion 360 Software

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
- **Interactive Teaching**: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
- Show **Video/animation** films to explain functioning of various concepts.
- Encourage **Collaborative** (Group Learning) Learning in the class.
- To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
- Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**05 Hours**

Fundamentals of Engineering Graphics & Projections
(Manual & Computer Sketching)

Principles of Engineering Graphics and their significance, lettering & dimensioning, Scaling, Principle of Orthographic Projections, Introduction to AutoCAD, Basic commands. Projection of points, Projection of straight lines inclined to both the principal planes

(First Angle Projection only and Using AutoCAD Software)
(For CIA only-Continuous Internal Assessment)

UNIT – II	18 Hours

Projection of Solids & Development of Surfaces
(Manual & Computer Sketching)
Classification of solids, Projection of regular solids like prisms, pyramids, cylinder & cone inclined to both the planes
(change of position method, First Angle Projection only and Using AutoCAD Software) (**For CIA only)**
Development of lateral surfaces of regular solids – Prisms, pyramids cylinders and cones (Using AutoCAD Software) (**For SEE Only- Semester End Exam)**

UNIT – III	18 Hours

Isometric Projections
(Manual & Computer Sketching)
Principles of Isometric Projection, Isometric Scale, Isometric View, Isometric projection of combination of two solids.
Conversion of Isometric Views to Orthographic Views & vice versa
(Using Auto CAD software)
(For SEE Only)

UNIT – IV	08 Hours

Introduction to Design Thinking & Innovation
(Mini Project-Group)
Empathize and Define, Ideate and Create, Prototype and Test, Iterate and Refine, Product development cycle, Use of Diagrams and Maps in Design Thinking, Storytelling, Innovation- aesthetics, usability, and product appearance, Creativity and Idea Generation, solving problems, Value creation, Exercises and case-based discussions (**For CIA only)**

UNIT – V	16 Hours

CAD techniques for Design Thinking & Innovation
(Computer Sketching)
Introduction to CAD & engineering design, Top-down design, bottom-up design, create 3D models and technical drawings, Multiview drawings, Modelling with Autodesk Fusion-Part objects & assembly drawings (Using Fusion 360 software)
(For SEE Only)

LAB COMPONENT

Note: Problems to be solved in first quadrant system.
Manual & Computer Sketching problems in sketch book and also take print out of the problems.
Following are practical/laboratory experiments to be carried out:

1. Usage of various commands in AutoCAD software and few exercises on the above commands
2. Practice Problems on Projections of Lines and Solids using Manual Sketching & AutoCAD Software
3. Solve Problems on Development of Surfaces using AutoCAD software
4. Practice problems on Isometric Projections -Combination of solids
5. Solve Isometric Projections to orthographic Projections and vice versa problems using

AutoCAD software

6. Mini Project Group work on Introduction to Design Thinking for Innovations
7. 3D models and technical drawings
8. Modelling with Autodesk Fusion-Simple Part objects & assembly drawings

Course Outcome	Description
At the end of the course the student will be able to:	
1	Make use of instruments, dimensioning & tolerance principles, conventions and standards related engineering drawing
2	Construct orthographic projections of lines and solids
3	Develop lateral surfaces of solids and construct isometric projections of solids
4	Apply the design thinking principles for innovative product development
5	Make use of AutoCAD & Fusion 360 software for modelling engineering components

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	0	0	0	0	0	0	0	0	0	3	0	2
CO2	2	1	0	0	0	0	0	0	0	0	0	3	0	2
CO3	2	1	0	0	0	0	0	0	0	0	0	3	0	2
CO4	2	1	0	0	0	0	0	0	0	0	0	3	0	2
CO5	3	1	0	0	0	0	0	0	0	0	0	3	0	2

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

TEXT BOOKS:

[1] Engineering Drawing, Bhatt N.D., 54th Edition, Charotar Publishing House, Gujarat, India, 2023

[2] Engineering Drawing & Graphics+Autocad, K Venugopal, Fifth Edition, New Age International Publishers, 2011.

[3] Engineering Design- A Project Based Introduction, C. L. Dym and Patrick Little, John Wiley & Sons, 2022 Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978- 1 -56990-582-1.

[4] Design Thinking: A Comprehensive Textbook, Shalini Rahul Tiwari, Rohit Rajendra Swarup, Wiley,2024

REFERENCE BOOKS:

[1] A Textbook of Computer Aided Engineering Drawing, Gopalakrishna, K. R. and Sudheer Gopala Krishna, Subash Publishers, Bangalore, India, 2017

[2] Engineering Drawing with Introduction to AutoCAD, Dhananjay. A. J, Tata McGraw-Hill Publishing Company Ltd, 2018

[3] Product Design and Development, Karl T Ulrich, Steven D Eppinger, Seventh Edition,

McGraw-Hill Education, 2020

E-Resources:

- https://archive.nptel.ac.in/courses/112/102/112102304/
- https://nptel.ac.in/courses/112103019
- https://fractory.com/engineering-drawing-basics/
- https://www.tutorialspoint.com/design_thinking/index.htm
- https://archive.nptel.ac.in/courses/107/101/107101086/

Activity-Based Learning (Suggested Activities in Class)

1. Activity which makes students to apply the concepts learned in the course to the practical engineering graphics will be discussed in class.
2. Activity provides space to students giving responsibility for their own design & engineering drawing methods for the products
3. Activity that makes the students for the development of skill set in computer drafting
4. Activity that makes the students to have critical thinking, developing a mindset, problem-solving and teamwork in design thinking process.
5. Real world problem solving and puzzles using group discussion.
6. Demonstration of solution to a problem through experiential learning.

CHEMISTRY FOR COMPUTER SCIENCE CLUSTER

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

SEMESTER – I/II

Subject Code	:	25EN1103	**Credits**	:	04
Hours / Week	:	05 Hours	**Total Hours**	:	40 + 26 Hours
L–T–P–S	:	3–0–2–0			

Course Learning Objectives:

- Understand the principles of sensors and energy systems. Apply the concept of sensing for the detection of biological molecules and the concept of energy systems in batteries and solar cells.
- Understand the basic principles of computational chemistry and display systems. Apply computational techniques and modern display technologies used in chemical analysis.
- Understand the electrochemical theory of corrosion of metals and its prevention by metal finishing techniques.
- Understand the synthesis, structure–property relationship, and the applications of polymers and green fuels.
- Understand the environmental impacts of electronic waste and apply strategies for its sustainable management and recycling.

Teaching-Learning Process (General Instructions)

These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.

1. Lecture method: Chalk and talk method, and demonstrations using smart boards may be adopted to achieve the course outcomes.
2. Interactive Teaching: Active learning that includes brainstorming, group work, formulating questions, notetaking, and annotating.
3. Show Videos to explain and illustrate the various concepts.
4. Encourage Collaborative learning in the class.
5. **Problem Based Learning**, may foster students' analytical skills, ability to evaluate, and process the information.
6. Inculcate a culture of research and encourage students to express their own creativity.

UNIT I	Sensors and Analytical Techniques	08 Hours

Sensors: Introduction - Definition and terminologies of Transducer Actuators and Sensors. Introduction, principle and instrumentation of Colorimetric sensors; Potentiometric sensors; **Conductometric sensors**; Electrochemical sensors, and Thermometric Sensor (Flame photometer) Working principle and any four applications of Conductometric sensors (conductometry), and Optical sensors (colorimetry), Electrochemical Sensor for the measurement of Dissolved Oxygen (DO); With brief introduction to different sensors, explain the principle, experimental procedure with electrode reactions.

Electrochemical gas sensors for SOx and NOx; Working principle with electrode reactions
Disposable sensors (DS); Definition, advantages of DS over Classical sensors.
Energy Systems: Introduction to batteries, construction, working and applications of Lithium-ion and Sodium-ion batteries.
Quantum Dot: Sensitized Solar Cells (QDSSC's)- Principle, Properties and Applications (any four).

UNIT- II	Materials for Memory and Display Systems	08 Hours

Memory Devices: Introduction, Basic concepts of electronic memory, History of organic/polymer electronic memory devices. Classification of electronic memory devices (Transistor-Type, Capacitor-Type, Resistor-Type and Charge transfer type Electronic Memory devices), types of organic memory devices.
Display Systems: Photoactive and electroactive materials - Definition and principle.
Optoelectronic devices: Definition, working principle.
Nanomaterials (Silicon Nanocrystals) and organic materials [Light absorbing materials - Polythiophenes (P3HT), Light emitting materials – Poly [9-vinylcarbazole] (PVK)]. Four properties of optoelectronic devices.
Liquid crystals (LC's) - Introduction, classification properties and application in Liquid Crystal Displays (LCD's). Organic Light Emitting Diodes (OLED's) and Quantum Light Emitting Diodes (QLED's) – Properties and applications.

UNIT- III	Introduction to Computational Chemistry	08 Hours

Meaning of Theoretical Chemistry and Computational Chemistry. Models used in Computational Chemistry, Examples of Simple Models (Lewis's Dot Structure, Etc.).
Molecular Structure and Practical calculations using MARVINSKETCH1 and Avogadro2: Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure. Z-matrix, construction of Z-matrix for simple molecules like H_2O, H_2O_2, H_2CO, NH_3 and CO_2.
Online tools: To study the different three dimension hexagonal, BCC and FCC structures and calculating their HOMO and LUMO energy gaps.
Hands-on experience:
(a) ADME screening by using swissadme web server -http://www.swissadme.ch/
(b) Predication toxicity by protox web server - https://tox-new.charite.de/protox_II/

UNIT- IV	Polymer and Green Fuels	08 Hours

Polymers: Introduction, Molecular weight - Number average, weight average, and numerical problems.
Conducting polymers – Preparation, properties, and commercial applications of conducting polymers.PANI (polyaniline), PPy (polypyrrole), and PEDOT (poly(3,4-ethylene dioxythiophene))
Specialty of Polymers for designing computers: Preparation, Properties and Applications. Acrylonitrile-butadiene-styrene (ABS) and polycarbonate (PC), ABS, PC, and PVC.
Green Fuels: Introduction to different types of fuels, and perspective of green fuels.
Photovoltaic cells: Introduction, definition, importance, working of PV cell. Solar grade silicon physical and chemical properties relevant to photo-voltaic, doping of silicon by diffusion technique
Green hydrogen: Introduction to properties of hydrogen pertaining to fuel. Introduction to electrolysis of water. Generation of hydrogen by electrolysis of water and its advantages.

UNIT- V	E-Waste Management	08 Hours

Introduction, sources of e-waste, Composition and Characteristics. Need for e-waste management concerning

global perspective.

Toxic materials used in manufacturing electronic and electrical products and health hazards due to exposure to e-waste.

Recycling and Recovery: Different approaches of recycling (separation, thermal treatments), hydrometallurgical extraction, pyrometallurgical methods and direct recycling.

Extraction of gold and copper from e-waste (Principle and experimental procedure).

Role of stakeholders in the environmental management of e-waste: Who are called stakeholders – a local and global perspective

Role of stakeholders - producers, consumers, recyclers, and statutory bodies.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1.	**Determination** of terminologies of transducer actuators and Sensors to **measure** the Dissolved Oxygen (DO) through experimental procedure with electrode reactions.	L3
2.	**Apply** the Basic concepts of electronic memory, and **studied** the photoactive and electroactive materials definition and principle.	L3
3.	**Implement** the Meaning of theoretical Chemistry and Computational Chemistry to **analyze** the molecular structure and practical calculations using MARVINSKETCH and Avogadro laws.	L3
4.	**Apply** the concept of polymerization for the synthesis of polymers and study their structure-property relationship for commercial applications.	L3
5.	**Demonstrate** the techniques in the purification of sewage water. **Determine** the hardness and oxygen demand of the provided waste water samples.	L2

Table: Mapping Levels of COs to POs

COs	Program Outcomes (POs)										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	1	1	1	0	0	0	0	0	0	0	0
CO2	1	1	1	0	0	0	0	0	0	0	0
CO3	1	1	0	0	0	0	0	0	0	0	0
CO4	1	0	0	0	0	0	0	0	0	0	0
CO5	1	0	0	0	0	0	0	0	0	0	0

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

Suggested Learning Resources:

Text Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

1. Wiley Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2013- 2nd Edition.
2. Engineering Chemistry, Satyaprakash& Manisha Agrawal, Khanna Book Publishing, Delhi
3. A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
4. Essentials of Physical Chemistry, Bahl&Tuli, S.Chand Publishing
5. Applied Chemistry, Sunita Rattan, Kataria 5. Engineering Chemistry, Baskar, Wiley

Reference Books

1. Engineering Chemistry – I, D. Grour Krishana, Vikas Publishing
2. A Text book of Engineering Chemistry, SS Dara & Dr. SS Umare, S Chand & Company Ltd., 12thEdition, 2011.

E-Resources

http://libgen.rs/
https://nptel.ac.in/downloads/122101001/
https://nptel.ac.in/courses/104/103/104103019/
https://ndl.iitkgp.ac.in/
https://www.youtube.com/watch?v=faESCxAWR9k
https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X-9IbHrDMjHWWh
https://www.youtube.com/watch?v=j5Hml6KN4TI
https://www.youtube.com/watch?v=X9GHBdyYcyo
https://www.youtube.com/watch?v=1xWBPZnEJk8https://www.youtube.com/watch?v=wRAo-M8xBHM

Activity Based Learning (Suggested Activities in Tutorial Class)

1. Analyze research problems by reading research articles, group discussion, and presentations.

2. Demonstration of solution to a problem through experiential learning.

3. Demonstrations using real objects, taking students on an educational tour.

CHEMISTRY-LABORATORY

Total: 26 Hrs

Volumetric Analysis and Preparations

1. Detection of Ca^{2+}/Mg^{2+} inhard water by complexometric titration.
2. Determination of oxygen requirement for the oxidation of an industrial wastewater sample.
3. Synthesis of Nylon 6,6 (Condensation Polymer).
4. Estimation of the weight loss of iron by corrosion of an iron nail.
5. Recovery of copper from E-Waste.

Instrumental Methods of Analysis

6. Conductometric estimation of H^+ in a weak and strong acid using standard sodium hydroxide solution.
7. Colorimetric estimation of copper in a given solution
8. Determination of pK_a of given weak acid.
9. Electrolysis of water.

Computational tools to evaluate ADME and toxicity of small molecules

10. *In vitro* analysis to evaluate the halogen-substituted anilines for pharmacokinetics, drug-likeness and medical chemistry using the Swiss ADME tool.
11. *In vitro* analysis to evaluate the toxicity of Aspirin using protox web server.

Reference Books

1. Dayananda Sagar University laboratory manual.
2. J. Bassett, R.C. Denny, G.H. Jeffery, Vogels, Text book of quantitative inorganic analysis, 4th Edition.
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

CHEMISTRY FOR ECE (ELECTRONICS AND COMMUNICATION ENGINEERING)

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

SEMESTER – I/II

Subject Code	: 25EN1104	**Credits**	: 04
Hours / Week	: 05 Hours	**Total Hours**	: 40 + 26 Hours
L–T–P–S	: 3–0–2–0		

Course Learning Objectives:

1. To enable students to acquire knowledge on principles of chemistry for engineering applications.
2. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
3. To provide students with a solid foundation in analytical reasoning required to solve societal problems.

Teaching-Learning Process (General Instructions)

These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.

1. **Lecture method**: Chalk and talk method, and demonstrations using smart boards may be adopted to achieve the course outcomes.
2. **Interactive Teaching: Active learning** that includes brainstorming, group work, formulating questions, notetaking, and annotating.
3. Show **Video**s to explain and illustrate the various concepts.
4. Encourage **Collaborative** learning in the class.
5. **Problem Based Learning**, may foster students' analytical skills, ability to evaluate, and process the information.
6. Inculcate a culture of research and encourage students to express their own creativity.

Unit I	**Chemistry of Electronic Materials**	08 Hours

Polymers: Introduction, Molecular weight - number average, weight average and numerical problems. Conducting polymers – synthesis and conducting mechanism of polyacetylene. Preparation, properties and commercial applications of graphene oxide.

Electrical Engineering Materials: Introduction, principle of conductors, insulators and semiconductors with examples.

Semiconductors: Introduction, production of electronic grade silicon, Czochralski process (CZ) and Float Zone (FZ) methods.

PCB: Electroless plating – Introduction, Electroless plating of copper in the manufacture of double-sided PCB.		
Unit II	**Energy Conversion and Storage**	08 Hours
Batteries: Introduction, classification of batteries. Components, construction, working and applications of modern batteries; Na-ion battery and Lithium ion batteries **Fuel Cells**: Introduction, construction, working and applications of methanol–oxygen fuel cell. **Solar Energy:** Introduction, importance of solar PV cell, construction and working of solar PV cell, advantages and disadvantages. Introduction, construction and working of organic solar cell (OSC) **Green fuel**: Hydrogen energy- types and method of production of hydrogen, hydrogen-production (Photo catalytic water splitting).		
Unit III	**Corrosion Science and E-waste Management**	08 Hours
Corrosion Chemistry: Introduction, electrochemical theory of corrosion, types of corrosion-differential metal and differential aeration. Factors affecting the rate of corrosion. Corrosion control - galvanization, sacrificial anode method and current impression method. **E-waste Management**: Introduction, sources, types, effects of e-waste on environment and human health, methods of disposal, advantages of recycling. Extraction of gold and copper from e-waste.		
Unit IV	**Materials for memory and Display Systems**	08 Hours
Display Systems: Photoactive and electroactive materials used in optoelectronic devices- organic and nanomaterials. Jablonski Diagram. Liquid crystals (LC's) - Introduction, classification, properties and applications in Liquid Crystal Displays (LCD's). Properties and application of Organic Light Emitting Diodes (OLED's) and Quantum Light emitting diodes (QLED's).		
Unit V	**Sensors and Electrode System in Analytical Techniques**	08 Hours
Electrode System: Introduction, types of electrodes. Ion selective electrode – definition, construction, working and applications of glass electrode. Determination of pH using glass electrode. Galvanic Cells and its types. Numerical problems based on EMF of a cell. **Sensors:** Introduction, working principle, types and applications of Electrochemical sensors. **Analytical Techniques:** Introduction, principle and instrumentation of Colorimetric sensors; its application in the estimation of copper. Potentiometric sensors; its application in the estimation of iron. Conductometric sensors; its application in the estimation of weak acid.		

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Identify the terms and principles of Chemistry involved in scientific Engineering and Technology	L3
2	Explain the phenomenon of Chemistry to describe the methods of Engineering processes and Synthesis	L3
3	Solve the problems of Chemistry that are pertinent in socio- economic and environmental issues.	L3

4	Apply the basic concepts of Chemistry in quantification of industrially relevant parameters.	L4
5	Analyze the structure, properties and processes associated with chemical substances in multidisciplinary situations	L3

Table: Mapping Levels of COs to POs

COs	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	
CO1	3	3	3	0	0	0	3	0	0	0	0	
CO2	3	3	3	0	1	0	0	0	0	0	0	
CO3	3	3	2	0	0	0	2	0	0	0	0	
CO4	3	3	1	0	3	0	0	0	0	0	0	
CO5	2	2	3	0	0	1	0	0	0	0	0	

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

Self-study component:

Module 1: Technological importance of metal finishing and distinction between electroplating and electroless plating.
Module 2: Electrodes for electrostatic double layer capacitors, pseudo capacitors, and hybrid capacitor.
Module 3: Recycling of PCB and battery components
Module 4: Properties & electrochemical applications of carbon nanotubes and graphene. Module 5: IR and UV- Visible spectroscopy.

Activity Based Learning (Suggested Activities in Class)

1. Analyze research problems by reading research articles, group discussion, and presentations.
2. Demonstration of solution to a problem through experiential learning.
3. Demonstrations using real objects, taking students on an educational tour.

Text books:

1. Wiley Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2013- 2nd Edition.
2. Engineering Chemistry, Satyaprakash& Manisha Agrawal, Khanna Book Publishing, Delhi
3. A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
4. A Text book of Engineering Chemistry, SS Dara & Dr. SS Umare, S Chand & Company Ltd., 12thEdition, 2011.
5. Text Book of Polymer Science, F.W. Billmeyer, John Wiley & Sons, 4th Edition, 1999.

Web links and Video Lectures (e-Resources):

- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhm wFtznRhuz8L1bb3X- 9IbHrDMjHWWh
- https://www.youtube.com/watch?v=j5Hml6KN4TI
- https://www.youtube.com/watch?v=X9GHBdyYcyo
- https://www.youtube.com/watch?v=1xWBPZnEJk8
- https://www.youtube.com/watch?v=wRAo-M8xBHM

CHEMISTRY- LABORATORY

Volumetric Analysis and Preparations **Total: 26 Hrs**

1. Evaluation of the quality of water in terms of total hardness by complexometric titration.
2. Determination of Chemical Oxygen Demand (COD) of the given industrial wastewater sample.
3. Determination of alkalinity of the given water sample
4. Synthesis of Nylon 6,6 (Condensation Polymer).
5. Estimation of the weight loss of iron by corrosion of an iron nail.
6. Recovery of copper from E-Waste.

Instrumental Methods of Analysis

7. Potentiometric titration–Estimation of FAS using standard $K_2Cr_2O_7$ solution.
8. Conductometric estimation of a mixture of a weak and strong acid using standard sodium hydroxide solution
9. Determination of the viscosity of a given polymer.
10. Colorimetric estimation of copper in a given solution
11. Determination of pK_a of a given weak acid.
12. Electrolysis of water.

Reference Books

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

CHEMISTRY FOR MECHANICAL ENGINEERING CLUSTER

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

SEMESTER – I/II

Subject Code	:	25EN1105	**Credits**	:	04
Hours / Week	:	05 Hours	**Total Hours**	:	40 + 26 Hours
L–T–P–S	:	3–0–2–0			

Course objectives

- To enable students to acquire knowledge on principles of chemistry for engineering applications.
- To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
- To provide students with a solid foundation in analytical reasoning required to solve societal problems.

Teaching-Learning Process (General Instructions)

- These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.
- Lecture method: Chalk and talk method, and demonstrations using smart boards may be adopted to achieve the course outcomes.
- Interactive Teaching: Active learning that includes brainstorming, group work, formulating questions, notetaking, and annotating.
- Show Videos to explain and illustrate the various concepts.
- Encourage Collaborative learning in the class.
- Problem Based Learning, may foster students' analytical skills, ability to evaluate, and process the information.
- Inculcate a culture of research and encourage students to express their own creativity.

UNIT I	Energy Source, Conversion and Storage	08 Hours

Fuels: Introduction, calorific value, determination of calorific value using bomb calorimeter, numerical problems on GCV and NCV.

Green fuels: Introduction, power alcohol, synthesis and applications of biodiesel.

Hydrogen Fuel: Introduction, Blue Hydrogen, Green Hydrogen and other types of Hydrogen fuel

Energy devices: Introduction, construction, working, and applications of Li-ion, Na-ion, Li-MnO_2 battery, methanol-oxygen fuel cell and new technologies.

Photovoltaics: Introduction, Silicon solar cells, thin film solar cells, Emerging photovoltaics – QD solar cells, Perovskite solar cells, Organic solar cells, DSSC and characterization techniques.

UNIT II	Corrosion Science and Engineering	08 Hours

Corrosion: Introduction, electrochemical theory of corrosion, types of corrosion-differential metal and differential aeration stress corrosion. Factors affecting corrosion (EMF, Temperature, pH, relative area of anode and cathode and polarization).

Corrosion control: Corrosion control – Metal coating-anodic coating- galvanization, Inorganic coating-anodization and Cathodic protection-sacrificial anode and impressed current method. Corrosion testing by weight loss method.

Surface modification techniques: Introduction, technological importance. Anodization of metal alloys, Electroplating and Electroless plating: Definition, Electroplating of chromium and electroless plating of nickel, Advantages of electroplating techniques in Automobile and Aerospace industries.

UNIT III	Macromolecules for Engineering Applications	08 Hours

Polymers: Introduction, types of polymerization (Addition and Condensation).Free radical mechanism of addition polymerization by ethylene. Techniques of addition polymerization, molecular weight; number average and weight average, numerical problems. Synthesis, properties and industrial applications of polyvinylchloride (PVC) and polystyrene.

Conducting polymers – synthesis, mechanism and applications of P3HT, Polyaniline, Polypyrole and PEDOT:PSS.

Fibers: Introduction, synthesis, properties and industrial applications of Kevlar and Polyester.

Plastics: Introduction, synthesis, properties and industrial applications of poly(methyl methacrylate) (PMMA) and Teflon.

Polymer composites: Introduction, properties and applications of fiber reinforced polymers composites (FRPC) and carbon based composites.

Polymers for water treatment: Introduction, sources and nature of impurities of water, hardness of water, types of hardness, determination of temporary, permanent and total hardness and numerical problems. Determination of total hardness by EDTA method. Softening of water by Lime-Soda Process, determination of COD, numerical problems.

Polymers for water purification: Ion-exchange membranes and semi permeable membranes for electrodialysis and Reverse osmosis.

UNIT IV	Analytical Techniques and E-Waste management	08 Hours

Analytical techniques: Introduction, principle, instrumentation of potentiometric sensors; its application in the estimation of iron, Conductometric Sensors; Coductometric Titration of strong acid versus strong base, Optical sensors (colorimetry); its application in the estimation of the copper, pH-sensor (Glass electrode); its application in the determination of pH of beverages.

E-wate: Introduction, sources of e-waste, Composition and Characteristics. Need for e-waste management concerning global perspective.
Toxic materials used in manufacturing electronic and electrical products and health hazards due to exposure to e-waste.

Recycling and Recovery: Different approaches of recycling (separation, thermal treatments), hydrometallurgical extraction, pyrometallurgical methods and direct recycling.
Extraction of gold from e-waste (Principle and experimental procedure)

UNIT V	**Materials Science and Engineering**	08 Hours

Introduction: Definition, Importance and classification of materials science and engineering (metals, ceramics, polymers, composites).
Structure of Materials: Crystal structures, Imperfections in crystals, Amorphous structures, Relationship between structure and properties.
Mechanical Properties of Materials: Stress, strain, and elasticity, Mechanical testing methods (tensile, impact, fatigue, etc.). Failure mechanisms (ductile, brittle, creep), Strength and hardness of materials.
Material Processing: Metal casting, forging, and machining.
Ceramic processing (sintering, pressing)
Polymer processing (molding, extrusion)
Composite fabrication Advanced Materials and Applications: Smart materials (shape memory alloys, piezoelectric materials).

Course Outcome	Description	Bloom's Taxonomy Level-
At the end of the course the student will be able to:		
1	Identify the terms and principles of Chemistry involved in scientific Engineering and Technology	L3
2	Explain the phenomenon of Chemistry to describe the methods of Engineering processes and Synthesis	L3
3	Solve the problems of Chemistry that are pertinent in socio-economic and environmental issues.	L3
4	Apply the basic concepts of Chemistry in quantification of industrially relevant parameters.	L4
5	Analyze the structure, properties and processes associated with chemical substances in multidisciplinary situations	L3

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Table: Mapping Levels of COs to POs											
COs	**Program Outcomes (POs)**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	3	3	3	0	0	0	3	0	0	0	0
CO2	3	3	3	0	1	0	0	0	0	0	0
CO3	3	3	2	0	0	0	2	0	0	0	0
CO4	3	3	1	0	3	0	0	0	0	0	0
CO5	2	2	3	0	0	1	0	0	0	0	0

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

Suggested Learning Resources:

Text Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

6. Wiley Engineering Chemistry, Wiley India Pvt. Ltd. New Delhi, 2013- 2nd Edition.
7. Engineering Chemistry, Satyaprakash& Manisha Agrawal, Khanna Book Publishing, Delhi
8. A Text Book of Engg. Chemistry, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd.
9. Essentials of Physical Chemistry, Bahl&Tuli, S.Chand Publishing
10. Applied Chemistry, Sunita Rattan, Kataria 5. Engineering Chemistry, Baskar, Wiley

Reference Books

1. Engineering Chemistry – I, D. GrourKrishana, Vikas Publishing
2. A Text book of Engineering Chemistry, SS Dara & Dr. SS Umare, S Chand & Company Ltd., 12thEdition, 2011.
3. A Text Book of Engineering Chemistry, R.V. Gadag and Nityananda Shetty, I. K. International Publishing house. 2nd Edition, 2016.
4. Text Book of Polymer Science, F.W. Billmeyer, John Wiley & Sons, 4th Edition, 1999.
5. Nanotechnology A Chemical Approach to Nanomaterials, G.A. Ozin& A.C. Arsenault, RSC Publishing, 2005.
6. Corrosion Engineering, M. G. Fontana, N. D. Greene, McGraw Hill Publications, New York, 3rd Edition, 1996.

Web links and Video Lectures (e-Resources):

- http://libgen.rs/
- https://nptel.ac.in/downloads/122101001/
- https://nptel.ac.in/courses/104/103/104103019/
- https://ndl.iitkgp.ac.in/
- https://www.youtube.com/watch?v=faESCxAWR9k
- https://www.youtube.com/watch?v=TBqXMWaxZYM&list=PLyhmwFtznRhuz8L1bb3X- 9IbHrDMjHWWh
- https://www.youtube.com/watch?v=j5Hml6KN4TI
- https://www.youtube.com/watch?v=X9GHBdyYcyo
- https://www.youtube.com/watch?v=1xWBPZnEJk8
- https://www.youtube.com/watch?v=wRAo-M8xBHM

Activity Based Learning (Suggested Activities in Class)

4. Analyze research problems by reading research articles, group discussion, and presentations.

5. Demonstration of solution to a problem through experiential learning.

6. Demonstrations using real objects, taking students on an educational tour.

CHEMISTRY- LABORATORY

Total: 26 Hrs

Volumetric Analysis and Preparations

1. Evaluation of the quality of water in terms of total hardness by complexometric titration.
2. Determination of Chemical Oxygen Demand (COD) of the given industrial wastewater sample.
3. Determination of alkalinity of the given water sample
4. Synthesis of Nylon 6,6 (Condensation Polymer).
5. Estimation of the weight loss of iron by corrosion of an iron nail.
6. Recovery of copper from E-Waste.

Instrumental Methods of Analysis

7. Potentiometric titration–Estimation of FAS using standard $K_2Cr_2O_7$ solution.
8. Conductometric estimation of a mixture of a weak and strong acid using standard sodium hydroxide solution
9. Determination of the viscosity of a given polymer.
10. Colorimetric estimation of copper in a given solution
11. Determination of pK_a of a given weak acid.
12. Electrolysis of water.

Reference Books

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

Chemistry for CSME

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

SEMESTER – I/II

Subject Code	: 25EN1106	**Credits**	: 04
Hours / Week	: 05 Hours	**Total Hours**	: 40 + 26 Hours
L–T–P–S	: 3–0–2–0		

Course Learning Objectives:

1. To enable students to acquire knowledge on the basics of biochemistry for medical engineering applications.
2. To develop an intuitive understanding of biochemistry by emphasizing the related branches of engineering.
3. To provide students with a solid foundation in modelling of molecules.
4. To understand the Principles of Drug Design and scoring function of small molecules.

Teaching-Learning Process (General Instructions)

These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.

7. **Lecture method**: Chalk and talk method, and demonstrations using smart boards may be adopted to achieve the course outcomes.
8. **Interactive Teaching: Active learning** that includes brainstorming, group work, formulating questions, notetaking, and annotating.
9. Show **Video**s to explain and illustrate the various concepts.
10. Encourage **Collaborative** learning in the class.
11. **Problem Based Learning**, may foster students' analytical skills, ability to evaluate, and process the information.
12. Inculcate a culture of research and encourage students to express their own creativity.

Unit I	**Carbohydrates**	08 Hours
Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non- reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). (definition, structure, functions, examples only) Carbohydrates as informational molecules, working with carbohydrates (applications of carbohydrate)		
Unit II	**Amino acids, peptides, proteins and Nucleic acids**	08 Hours

Classification, chemical and physical properties of amino acids. Peptide bond: planarity and dihedral angles, Ramachandran plot. Structural hierarchy of proteins: primary, secondary, super- secondary, tertiary and quaternary structures. Classification of proteins, properties: isoelectric point, zwitterions, and precipitation reactions. Globular and fibrous proteins: Classification, chemical and physical properties. Fatty acids: saturated, unsaturated and essential fatty acids; rancidity, saponification number, iodine number, acid number and Reichert–Meissel number. Chemistry of purine and pyrimidine, nucleosides and nucleotides. Types of DNA: structure and properties of A-, B- and Z-DNA. Denaturation, renaturation. Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers (examples & functions only)		
Unit III	**Introduction to molecular modeling**	08 Hours
Cambridge Structural Database (CSD), Protein Data Bank (PDB), File format and information in PDB and CSD databases; Molecular Modelling: Molecular Graphics, 3-D Models of Organics and Biomolecules, Potential Energy Surfaces; Case Study: Visualization of 3D Models with Gauss View/Avogadro/Chemcraft		
Unit IV	**Introduction to drug design and delivery**	08 Hours
The Principles of Drug Design: The Drug Discovery Pipeline and Costs of Drug Discovery, Lipinski's Rules of 5, Drug Metabolism, Toxicity and Side Effects, ADMET (Absorption, Distribution, Metabolism, Excretion, Toxicity) Models, Drug resistance and promiscuity, Drug Delivery systems, Pharmacophore Modelling and alignment, Lead Optimization, Ligand-Based and Structure-Based Design; Molecular Docking, Introduction, Scoring Functions, Applications of Docking; Case Study: Setting up a Molecular Docking for a simple biomolecule.		
Unit V	**Application of AI/ML in Drug and Materials Design**	08 Hours
Application of AI/ML in Drug and Materials Design: Introduction to Linear Free Energy Relationships, Structure-Activity Relationships and the Similarity Principle, Virtual High-throughput Screening, Feature selection – Genetic Algorithms, Model Validation, Case Study: Modeling with random forests, PLS, SVM and Neural Networks.		

Course Outcome	**Description**	**Bloom's Taxonomy Level-**
At the end of the course the student will be able to:		
1	Identify the terms and principles of Biochemistry involved in Medical Engineering and Technology	L3
2	Explain the phenomenon of Biochemistry to describe the methods of Synthesis and applications in daily life	L3
3	Solve the problems of Biochemistry that are pertinent in socio-economic and environmental issues.	L3
4	Apply the basic concepts of Biochemistry in quantification of industrially relevant parameters.	L4
5	Analyze the structure, properties and processes associated with chemical substances in multidisciplinary situations	L3

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Table: Mapping Levels of COs to POs											
COs	**Program Outcomes (POs)**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	3	3	3	0	0	0	3	0	0	0	0
CO2	3	3	3	0	1	0	0	0	0	0	0
CO3	3	3	2	0	0	0	2	0	0	0	0
CO4	3	3	1	0	3	0	0	0	0	0	0
CO5	2	2	3	0	0	1	0	0	0	0	0

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

Activity Based Learning (Suggested Activities in Class)

7. Analyze research problems by reading research articles, group discussion, and presentations.

8. Demonstration of solution to a problem through experiential learning.

9. Demonstrations using real objects, taking students on an educational tour.

Text books:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10:1-4292- 3414-8.
2. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer L., W.H. Freeman and Company (New York), ISBN:10:1-4292-2936-5, ISBN:13:978-1-4292-2936-4
3. Fundamental of Biochemistry, Voet and Voet- provide necessary details on latest edition Edited by Prof. Hiren K Das (JNU)

Web links and Video Lectures (e-Resources):

- http://libgen.rs/

CHEMISTRY- LABORATORY

Total: 26 Hrs

1. 3D Visualization and Structural Analysis of Carbohydrates Using Avogadro
2. Exploration of Protein Structures Using the Protein Data Bank (PDB) and PyMOL
3. Analysis and Comparison of Molecular File Formats: PDB, MOL, and CIF
4. Molecular Docking of Aspirin with COX Enzyme Using PyRx
5. Drug-Likeness Evaluation Using Lipinski's Rule of Five via SwissADME
6. In Silico Prediction of ADMET Properties Using Online Tools
7. Development of a QSAR Model for Biological Activity Prediction Using Machine Learning
8. Similarity Search and Virtual Screening of Drug Analogs Using PubChem and ChemMine
9. Qualitative Tests for Carbohydrates
10. Isolation of Genomic DNA from Plant Cells
11. Estimation of Protein by Lowry's Method

Reference Books

1. Dayananda Sagar University laboratory manual.
2. J. Evanegeline, Manual of Practical Medical Biochemistry, Jaypee Brothers Medical Publishers (P) Ltd.

ENGINEERING SCIENCE COURSE – I for Computer science Cluster

OBJECT ORIENTED PROGRAMMING

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

SEMESTER – I/II

Course Code Code	:	25EN1107	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–J	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** different programming paradigms, significance of object-oriented programming approach and their applications.
2. **Make use of** Python programming environment to develop programs using conditionals, iterations, functions, strings and files to store and retrieve data in system.
3. **Gain** skills to develop python programs using core data structures like Lists, Tuples, Sets and Dictionaries.
4. **Describe** the concepts of object-oriented concept using class, objects, methods. Polymorphism and different levels of inheritance.
5. **Explain** single and multiple exception handling capabilities in python.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

INTRODUCTION TO OBJECT ORIENTED PROGRAMMING AND PYTHON

Object oriented programming features, Applications, Features of Python, History of Python, variables and identifiers, Data types, input operation, comments, Reserved words, Indentation, Operators and Expressions, Type conversions.

(Text Book-1: Chapter 2: 2.4,2.6 Chapter 3: 3.1,3.2,3.6,3.7,3.8,3.9,3.10,3.11,3. 12,3.16)

DECISION AND LOOP CONTROL STATEMENTS:

Conditional branch statements, Iterative statements, Nested loops, break, continue, pass, The else statement used with loops.

(Text Book-1: Chapter 4: 4.1-4.8)

UNIT – II	**08 Hours**

FUNCTIONS:

Need for functions, Function definition, Function call, Scope, Return statement, Lambda functions, Recursive functions.

(Chapter 5: 5.1 to 5.7, 5.10)

PYTHON STRINGS:

String operations, Immutable, string formatting operator, built-in string methods, string slices, membership operator, comparing strings, Iterating strings.

(Chapter 6: 6.1 to 6.9)

UNIT – III	**09 Hours**

DATA STRUCTURES IN PYTHON:

List: Introduction, create list, Access values in List, update list, Nested lists, Cloning lists, List operations, List methods, updating values in list, list comprehensions, Looping in lists.

Tuple: Introduction, create tuple, Access values in tuple, update tuple, delete elements in tuple, Tuple operations, Tuple assignment, tuples return multiple values, nested tuples, tuple methods, Advantage of tuple over lists.

Sets: Create sets, set operations, update a set, Iterate a set.

Dictionaries: Create dictionary, Add and update item in a dictionary, delete items, sort items, loop over a dictionary, nested dictionaries, dictionary function and methods, difference between list, tuple set and dictionaries.

(Chapter 8: 8.2, 8.4, 8.5, 8.6)

UNIT – IV	**08 Hours**

FILE HANDLING METHODS:

File path, File types, File operations, Rename and delete files.

(Chapter 7: 7.1 to 7.5, 7.7)

USER DEFINED CLASSES & OBJECTS:

Classes, Objects, class method and self- Argument, constructor, destructor, class variables, public and private data members, private methods, Calling methods.

(Chapter 9: 9.1 to 9.10)

UNIT – V	06 Hours

INHERITANCE:

Introduction, inherit classes in python, Polymorphism and method overriding, Types of inheritance
(Text Book: Chapter 10: 10.1 to 10.3)

ERROR AND EXCEPTION HANDLING:

Errors, Handling exceptions, Multiple except blocks, Multiple exceptions, except block without exception, the else clause, finally block, clean- up action
(Text Book: Chapter 12: 12.1 to 12.6, 12.10 to 12.12)

Course Outcomes:

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

1. **Develop** a python program using four conditionals, definite loop, indefinite loop with jump statements.
2. **Develop** a python program using lambda, recursive functions, strings and files to store and retrieve the data from the system
3. **Develop** python programs using core data structures like Lists, Tuples, Sets and Dictionaries
4. **Implement** the concepts of object-oriented concept using class, objects, methods, polymorphism and different levels of inheritance.
5. **Implement** single and multiple exception handling program capability in python

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	2	3		2		1				2		1
CO2	2	2	3		2		1				2		1
CO3	2	2	3		2		1				2		1
CO4	2	2	3		2		1				2		1
CO5	2	2	3		2		1				2		1
AVG	10/15	10/15	15/15		10/15		5/15				10/15		5/15

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

TEXT BOOKS:

1. Reema Thareja, “Python programming: Using problem solving approach”, 2nd Edition, Oxford university press, 2019.

REFERENCE BOOKS:

1. John V Guttag, “Introduction to Computation and Programming Using Python”, The MIT press, 3rd edition, 2021.
2. Tony Gaddis, “Starting out with python”, 4th edition, Pearson, 2019.
3. Allen Downey, Jeffrey Elkner and Chris Meyers, "How to think like a Computer Scientist, Learning with Python", Green Tea Press, 2014.
4. Richard L. Halterman, “Learning to Program with Python”, 2011.
5. Charles Dierbach, “Computer Science Using Python: A Computational Problem-Solving Focus”, John Wiley, 2012.

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through programming.

OBJECT ORIENTED PROGRAMMING EXPERIMENTS for Practice

List of Programming Experiments:

1. Python Program for Data Handling and Expression Evaluation.
2. Python Program for Quadratic Equation Roots and Number Analysis.
3. Python Program for Function Illustration and Module Creation.
4. Python Program for String Operations and Data Validation.
5. Python Program for File Handling and Script Copying.
6. Python Program for Data Structures and Built-in Methods.
7. Python Program for Object-Oriented Concepts and Inheritance.
8. Python Program for catching an error using try and except blocks.

ENGINEERING SCIENCE COURSE – I for ECE

INTRODUCTION TO ELECTRICAL ENGINEERING

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

SEMESTER – I/II

Subject Code	:	25EN1108	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	2–0–1			

Course Learning Objectives:

This course enables students to:

- **Demonstrate** a foundational understanding of electrical quantities, including current, voltage, power, and energy.
- **Apply** fundamental laws of electric circuits, such as Ohm's law and Kirchhoff's laws to evaluate electrical circuits.
- **Explain** fundamental concepts of electro-magnetic circuits.
- **Demonstrate** a foundational understanding of the working principles, construction, and characteristics of DC machines.
- **Illustrate** the construction, operation, and types of transformers, considering their significance in electrical systems.
- **Explain** the structure and components of electrical power system, highlighting their interconnections.
- **Explain** emerging trends of green energy technologies and smart metering.
- **Explain** the importance of earthing, protective devices, and proper wiring for ensuring electrical safety.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
- ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
- Show ***Video/animation*** films to explain functioning of various concepts.
- Encourage ***Collaborative*** (Group Learning) Learning in the class.

- To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
- Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**10 Hours**

Fundamentals laws of Electrical circuit and elements: Electrical charge, potential; current; power and energy; AC and DC current (mathematical treatment); Ohm's law; KCL and KVL in resistive circuits; series and parallel combination of resistors; voltage and current division rule; V-I relationships for inductor and capacitor under AC voltage; impedance and admittance (series RC, RL and RLC); Overview of active power, reactive power and power factor; Introduction to 3 phase systems; Simulation using LTspice software to demonstrate voltage division, current division in resistive circuits. Simulation using LTspice software to show voltage and current waveform for RC and RL circuit.

(TextBook-1: Chapter 1: 1.1 to 1.4, 1.6 to 1.8. Chapter 2: 2.1 to 2.3. Chapter 4: 4.1 to 4.4 Chapter 6: 6.1 to 6.4)

UNIT – II	**10 Hours**

Electromagnetic circuits:

Magnetic circuits: Basics of magnetic circuits (flux, MMF, permeability, reluctance, B and H); Relation between field theory and circuit theory; Faraday's and lenz's laws, Lorentz force; Self and Mutual inductance.

DC machines: Principle of operation of DC generator; generated EMF equation; classification; and applications. (Introductory treatment only); Principle of operation of DC Motor; back EMF; speed and torque; classification; and applications. Losses and efficiency in DC machines.

Transformers: Construction, working principle, induced emf equation; step-up and step down; losses and efficiency.

(TextBook-2: Chapter 7: 7.1 to 7.12; Textbook 1: 10.1, 10.2, 10.4, 10.5, 10.8, 10.9, 10.11 and 10.12; Chapter 8: 8.1, 8.2 and 8.9)

UNIT – III	**06Hours**

Powers system fundamentals: Power system structure; generation sources; green energy; smart meters; power tariff calculations; Electrical safety and standards (IS: 732-2019, IEC: 60446): Colour code of wires for single phase supply, earthing, fuse and MCB. ***(Textbook 1: , Chapter 16: 16.1 to 16.5; Textbook 2: Chapter 24: 24.1 to 24.6)***	
Lab	**13Hours**
Verification of Ohm's Law, KCL and KVL; RC/ RL circuit under AC voltages; Introduction to Simulation Tools (LTSpice); Build and Analyze a Simple Two-Bulb Circuit (Series/Parallel with Switch Control)	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	**Solve** for voltage, current, power and energy in purely R, series RL and RC circuits under DC and AC voltages.	L3
CO2	**Demonstrate** understanding of principle of operation of DC machines and transformers and **solve** for voltage, current and speed of the machine in typical applications.	L3
CO3	**Build** and **analyze** simple electrical circuits under AC and voltages.	L4
CO4	**Demonstrate** understanding of the working principle of power system and the significance of renewable energy sources in electrical engineering, and safety practices.	L2
CO5	Demonstrate proficiency in using simulation software (e.g., LTSpice) to simulate and **solve** for electrical parameters.	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	1	2
CO1	3	3											
CO2	3	3											
CO3	3	3			3								2
CO4	3	2											
CO5	3	3			3						2		2

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

TEXT BOOKS:

1. D.P.Kothari and I.J. Nagrath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill, 2019.

2. B.L. Theraja and A.K. Therja, "A textbook of electrical technology, Vol. I (Basic electrical Engineering)", S. Chand Publishing, 23rd Rev Ed, 2006.

REFERENCE BOOKS:

1. Clayton Paul, Syed A Nasar and Louis Unnewehr, "Introduction to Electrical Engineering", 2nd Edition, McGraw-Hill, 1992.
2. William H Hayt and Jack E Kimberly and Steven M Durbin, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill, 2013.

E-Resources:

- https://nptel.ac.in/courses/108/108/108108076

Activity Based Learning (Suggested Activities in Class):

1. Real world problem solving using group discussion and hands-on activities. E.g., Interfacing different types of sensors using Arduino.
2. Simulation of different electrical circuits. E.g., RL and RC circuits.

ENGINEERING SCIENCE COURSE – I for Mechanical Cluster

INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING

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

SEMESTER – I/II

Subject Code	: 25EN1109	**Credits**	:	03
Hours / Week	: 03Hours	**Total Hours**	:	39 Hours
L–T–P	: 3–0–0			

Course Learning Objectives:

1. To introduce fundamental electrical quantities such as charge, current, voltage, power, and energy, and their relationships in basic circuits.
2. To enable students to apply Ohm's Law and Kirchhoff's Laws to analyze simple resistive, series, and parallel electrical networks.
3. To impart a foundational understanding of AC and DC waveforms, including key parameters like RMS, peak, and average values.
4. To develop conceptual understanding of magnetic circuits and electrical machines, including transformers and DC machines, along with their working principles.
5. To familiarize students with the characteristics and applications of diodes and transistors, particularly in rectifier and switching circuits.
6. To introduce operational amplifiers and their basic configurations such as inverting, non-inverting, and summing amplifiers.
7. To provide a conceptual understanding of digital logic circuits, including logic gates, flip-flops, and binary counters.
8. To provide a high-level overview of microcontroller systems, focusing on block diagram architecture and their role in embedded applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
- **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
- Show **Video/animation** films to explain functioning of various concepts.
- Encourage **Collaborative** (Group Learning) Learning in the class.
- To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
- Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**07 Hours**

Electrical Circuit Fundamentals: Basic electrical quantities such as charge, voltage, current, resistance, power, and energy; Ohm's Law; Kirchhoff's Voltage and Current Laws (KVL and KCL); series and parallel resistor networks; voltage and current division rules; introduction to AC and DC waveforms including RMS, peak, and average values.

UNIT – II	**08 Hours**
Electrical Machines and Power Systems: Magnetic circuits including flux, flux density, magnetomotive force (MMF), and reluctance; working principle, types, and applications of transformers; working principle of DC generators and motors; basics of electrical power generation, transmission, and distribution; introduction to renewable energy sources.	
UNIT – III	**08 Hours**
Semiconductor Devices and its application: Overview of diode construction; diode under no-bias, forward bias, and reverse bias conditions; half-wave and full-bridge rectifiers; construction and operation of npn and pnp BJTs; input and output characteristics of the common-base configuration; regions of transistor operation active, cut-off, and saturation; transistor as a switch.	
UNIT – IV	**08 Hours**
Operational amplifiers: Op-amp symbols and terminals; modes of operation including single-ended, differential, and common mode; properties of ideal and practical op-amps; applications such as inverting amplifier, non-inverting amplifier, summing amplifier, differential amplifier, differentiator, and integrator.	
UNIT – V	**08 Hours**
Digital Electronics and Embedded applications: Binary number system; logic gates and their truth tables—AND, OR, NOT, XOR, NAND, NOR; combination of logic gates and basic numerical operations; sequential logic circuits including JK and D Flip-Flops; application of Flip-Flops in 4-bit binary counters; overview of microcontrollers at the block diagram level.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Demonstrate a clear understanding of the basic principles of electrical and electronic components**, including resistors, diodes, transistors, operational amplifiers, logic gates, and microcontrollers.	L2
2	**Apply basic circuit law's and priciples to analyze electrical circuits**, including resistive networks, AC/DC waveforms, and basic transformer and DC machines	L3
3	**Apply knowledge of semiconductor devices**, such as diodes and transistors, to explain rectification and switching behavior in electronic circuits.	L3
4	**Apply the principles of operational amplifiers** to configure basic circuits such as inverting, non-inverting, and summing amplifiers.	L3
5	**Demonstrate conceptual understanding of digital logic and microcontroller systems**, including logic gate combinations, flip-flops, counters, and block diagram-level microcontroller architecture.	L2

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**
CO1	3	2										2		
CO2	3	3										2	2	
CO3	3	3										2	2	
CO4	3	3										2	2	
CO5	3	2										2		

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

TEXT BOOKS:

1. R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", 11th Ed, Pearson Education, 2013.
2. M. Moris. Mano and Michael D. Ciletti, "Digital Electronics", 4th Ed, Pearson Education, 2006.
3. D.P.Kothari and I.J. Nagrath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill, 2019.
4. B.L. Theraja and A.K. Therja, "A textbook of electrical technology, Vol. I (Basic electrical Engineering)", S. Chand Publishing, 23rd Rev Ed, 2006.

REFERENCE BOOKS:

1. David A Bell, "Electronic Devices and Circuits", 5th Ed, Oxford university press, 2008.
2. Millman & Halkias, "Electronics Devices and Circuits", 2nd Ed, McGraw Hill, 2010.
3. William H Hayt and Jack E Kimberly and Steven M Durbin, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill, 2013.

E-Resources:

1. NPTEL- https://nptel.ac.in/courses/122/106/122106025
2. NPTEL- https://nptel.ac.in/courses/108/108/108108076
3. Virtual Labs- http://vlabs.iitkgp.ac.in/be/

Activity-Based Learning (Suggested Activities in Class):

1. Simulation of different electronic circuits. E.g., Rectifiers and Amplifiers using LtSpice.

TECHNICAL ENGLISH

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

SEMESTERS – I & II

Subject Code	: 25EN1110	**Credits**	:	02
Hours / Week	: 02 Hours	**Total Hours**	:	26 Hours
L–T–P-J	: 01-02- 00-00			

Prerequisites:

Developing Communicative competence: Enhancing the Language competence in the technical discourse and augmenting the strategic competence in the social and professional environment.

Course Learning Objectives:

This course will enable students to:

- To enable students to improve their lexical and grammatical competence.
- To enhance their verbal and nonverbal communication in a professional environment
- To optimize oral and written communication.
- To familiarize the students with employability and job search skills.
- To enhance the students with soft skills
- To inculcate critical thinking

Teaching-Learning Process (General Instructions)

These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.

1. ***Lecture method***: Anecdotes, case studies and Examples from real-life situations may be adopted along with the traditional method of chalk and talk to achieve the course outcome.
2. ***Interactive Teaching: Active learning*** may be adopted which includes brainstorming, Teamwork, focused listening, formulating questions, note-taking, and Role play.
3. ***Collaborative*** learning through Debates and Group Discussion
4. ***Activity-based learning*** to inculcate Critical ***thinking*** – conceptualizing, applying, analyzing, synthesizing, and/or evaluating information from observation, perception, and expression. Minimum three higher-order questions from the real-world context
5. ***Problem-Solving method through*** Activities and discussion / Minimum of three situations to inculcate ***Problem-Solving skills*** and encourage the students to come up with creative ways to solve the problem
6. ***Audio-visual methods*** through language Lab in the teaching of LSRW skills.
7. ***Short films/ Ted talks/ Videos/Animation*** films to explain the functioning of various concepts.
8. ***Flipped learning***
9. ***Peer learning / Peer tutoring***

Module – I	08 Hours

Grammar and Usage, Language and Communication.

(Branches of Grammar and Vocabulary-Difference between hearing and listening. Reading: Extensive and Intensive Speaking: Different aspects of Effective Speaking. Pronunciation Guidelines- - Common Errors of Pronunciation- Presentation Skills Various Techniques for Neutralization of Mother Tongue Influence)

Objective:

- Revising and practicing grammar will help students to optimize their language Competence
- Listening steps up language learning and improves pronunciation
- Reading provides exposure to the chosen field and helps in the coherence of the thought process
- Speaking improves one's ability to construct phrases naturally and spontaneously in everyday discussions, Clarity and comprehensiveness in speech.
- Communicating effectively in the Professional environment, to interact with the Peer group and to involve in collaborate initiatives

Module – II	08 Hours

Research skills: The difference between area and topic, how to arrive at a topic (Critical thinking), Group Discussion: Comprehensive techniques, Organization and presentation, fluency and articulation of ideas

Objective:

- GD helps individuals to achieve the skills of organizing and presenting the ideas and concepts in a cohesive manner and to overcome the inhibition of expression in communication
- Enhancing problem solving skills, communicative techniques, general awareness and self confidence
- Improving verbal and nonverbal communication and to use appropriate body language

Module – III	08 Hours

Technical Writing- Writing and Minutes of the Meeting, Memo and E-mail Etiquette, Designing PowerPoint slides, Referencing Skills for Academic Report Writing, Technical Paper

Objective:

- Familiarizing with email etiquettes and correspondence provides learners to form an excellent first impression, establishing trust and confidence. Meeting minutes allows to access information such as facts, opinions, votes cast, conflicts, attendees, and other crucial elements at the workplace.
- Technical writing techniques enable the knowledge in the relevant domain and creates better content based on the need of the target group
- Following the Academic conventions helps the students to optimize their reference skills and use references to acknowledge the input of other authors and scholars in their work and avoid plagiarism
- Writing technical reports develop competence in creating a legally bound account of efforts and choices and engineering technical report propose a solution to a problem in order to inspire action.

Module – IV	**02 Hours**

Drafting Curriculum Vitae, Resumes, and Cover- Letters.

{Types of Resumes, Preparing Resume, CV and Cover- Letter. Difference between Resume & Curriculum Vitae, Interview Techniques and Etiquette}.

Objective:

- Learning the specifics of designing a CV or Resume helps in the effective presentation of their achievements and skills, and a cover letter is a chance for them to exhibit a few aspects of their personality.

Course Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course, the student will be able to:		
1	Developing language competence **improves** one's ability to construct phrases naturally in everyday discussions and Communication skills and soft skills enhance the self-confidence of students,	L3
2	**Applying** the fundamentals of technical writing techniques provides adequate exposure to the respective domain and creates better content. **Implementing** the technicalities of writing provides better exposure in the domain.	L3

3	**Following** an appropriate style of email reveals the aspect of professionalism. **Develop** technical writing skills to increase the quality of the work and testimony of conduct.	L3
4	**Practicing** communication with greater clarity and ease enable the students to discuss a wide spectrum of topics.	L3
5	Writing resumes or curriculum vitae provides a practice to exhibit their skills and achievements concisely and writing a covering letter enables them to express their personality in the formal context.	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
CO1										2				
CO2										2				
CO3										2				
CO4										2				
CO5										2				

TEXT BOOKS:

1. Dhanavel, S.P. "English and Communication Skills for Students of Science and Engineering". Orient Blackswan Pvt. Ltd., 2009. Print.

2. Meenakshi Raman and Sangeetha Sharma. "Technical Communication-Principles and Practice". 3rd Edition, Oxford University Press, 2009. Print.

3. Murphy R. "English Grammar in Use", Cambridge University Press,2012. Print.

4. N. Krishnaswamy and T. Sri Raman. "Creative English for communication", Macmillan Publication, 2005.

REFERENCE BOOKS:

1. Day. R A. "Scientific English: A Guide for Scientists and Other Professional". 2nd Edition, Hyderabad: Universities Press, 2000. Print.

2. Ashraf Rizvi M. "Effective Technical Communication". McGraw Hill Education, 2017. Print.

3. Eastwood J. "Oxford Practice Grammar". Oxford University Press, 1999. Print.

4. Swan M and Walter C. "Oxford English Grammar Course". Oxford University Press, 2011. Print.

5. Dale, Carnegie. "The Quick and Easy Way to Effective Speaking". JAICO Publishing House, 2019. Print.

6. Chauhan, Gajendra S and Smita, Kashiramka. "Technical Communication". India: Cengage Learning India Private Limited, 2018. Print.

7. Bailey, Stephen. "Academic Writing: A Handbook for International Students". 5th Edition, Routledge, 2017. Print.

8. Kumar, Shiv K and Nagarajan, Hemalatha. "Learn Correct English: Grammar, Composition and Usage". 1st edition, India: Pearson, 2005. Print.

9. Board of Editors. Language and Life: A Skills Approach. Orient BlackSwan, 2018.

10. Sudharshana, NP and C Savitha. English for Engineers. Cambridge University Press, 2018.

11. Kumar, Sanjay and Pushp Lata. English Language and Communication Skills for Engineers. Oxford University Press, 2018.

12. Thomson, A.J. and Martinet, A.V. A Practical English Grammar, OUP, New Delhi: 1986

13. Anne Laws, ―Writing Skills‖, Orient Black Swan, Hyderabad, 2011

14. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

E-Resources:

1. https://gnindia.dronacharya.info/ME/Common-Subjects/Downloads/Technical-Communication/Books/Technical-Communication-Book-9.pdf. Web.

2. https://projects.iq.harvard.edu/files/hks-communications-program/files/ho_murphy_michael-pp-slides_9_30_14.pdf. Web.

3. https://www.youtube.com/watch?v=TR0JZiapxXM. Web.

4. file:///C:/Users/rochn/Downloads/ManualofEnglishGrammarandComposition_10012575.pdf. Web.

5. https://www.youtube.com/watch?v=f5Tao6KHV5w. Web.

6. https://www.sastra.edu/nptel/download/Prof%20GPRagini/pdf_New/Unit%2026.pdf. Web.

7. https://www.hansrajcollege.ac.in/hCPanel/uploads/elearning/elearning_document/English_ communication_chapter_13.pdf. Web.

8. https://www.youtube.com/watch?v=voyGGhlpBR8. Web.

Activity Based Learning (Suggested Activities in Class)

1. Observing and responding appropriately to the real-life situations.
2. Encouraging students to participate in Group discussions.
3. Articulating internal observations precisely and confidently through extempore.
4. Producing sentences easily without any grammatical errors in speaking, writing essays, and creative writing.
5. Conducting mock interviews, to refine their expressions, familiarize

them with the interview techniques, and provide training for the spontaneous response to tricky questions.

6. Directing students for PowerPoint presentations and orienting them towards the higher order skills of expressing their ideas and concepts with cohesion.

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

SEMESTER – I/II

Course Code	: 25EN1111	**Credits**	: 02
Hours / Week	: 02 Hours	**Total Hours**	: 26 hours
L–T–P–S	: 2–0–0–0		

Course Learning Objectives:

- To understand the evolution and diversity in nature.
- To understand the concepts of environment, pollution, energy resources
- To learn water as a resource, rain water harvesting as a method of conversation of water
- To explain solid waste and its management
- To learn environmental Protection Act laws, environmental Impact Analysis and air monitoring

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
- **Interactive Teaching**: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening.
- Show **Video/animation** films to explain functioning of various concepts.
- Encourage **Collaborative** (Group Learning) Learning in the class.
- To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
- Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**06 Hours**

ECOSYSTEMS and BIODIVERSITY: Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Food chains ,food webs and ecological pyramids.

ENVIRONMENT and POLLUTANTS: Definition of environment; Scope and importance of environmental studies; Basic concepts: Xenobiotic, natural & anthropogenic; why are we concerned? Eco-kinetic & Bio-kinetic Properties of a xenobiotic, Dose-Response Relationships; 3 T's, Chronic and acute health effects.

For CIA only

UNIT – II	**06 Hours**

POLLUTION and MANAGEMENT : Air Pollution: Criteria pollutants – Ozone, Particulate Matter, Carbon Monoxide, Nitrogen, Oxides, Sulphur Dioxide, Lead; Acid Rain Cycle. Green house effect. Global warming. Water as a resource; Lentic and Lotic Water Systems; Rain Water

Harvesting; Water pollution: Potable and waste water Pollution and management; Noise pollution-sources and effects of noise; Municipal Solid Waste: Hazardous Waste: Electronic Waste: Biomedical Waste; Solid Waste Management: Landfills, composting Process. **For CIA only**

UNIT – III	**05 Hours**
ENERGY: Energy Types of energy: Conventional sources of energy, fossil fuel, Coal, Solar, wind; Non-conventional Sources of Energy, Biofuels - biomass, biogas. **For CIA**	

UNIT – IV	**05 Hours**
DISASTERS & MANAGEMENT: Definition, Natural (Earthquakes, landslides, floods), Man-made disasters (biological, chemical, nuclear, radiological explosions) – definition, causes and management and/or mitigation strategies; Bhopal & Chernobyl Disasters. **For CIA only**	

UNIT – V	**04 Hours**
ENVIRONMENTAL IMPACT ASSESMENT: Environmental Impact Assessment (EIA); Air pollution monitoring and Ambient Air Quality Standards (AAQS); Environment Protection Act, 1986. Water (Prevention and control of Pollution) Act .Wildlife Protection Act .Forest Conservation Act .Issues involved in enforcement of environmental legislation. Public awareness. **For CIA only**	

Course Outcome	**Description**
At the end of the course the student will be able to:	
1	Critically elucidate the basic concepts that govern environmental quality, ambient air quality standards
2	Compare different Energy resource and their environmental implications
3	Identify different types of pollution, waste streams
4	Identify different natural and manmade disasters and prevention
5	Apply the process of environmental impact assessment and implications of Indian Environment Laws

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**											**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	2	0	0	0	0	0	2	0	0	0	0	3	0	2
CO2	2	0	0	0	0	0	2	0	0	0	0	3	0	2
CO3	2	0	0	0	0	0	2	0	0	0	0	3	0	2
CO4	2	0	0	0	0	0	2	0	0	0	0	3	0	2
CO5	2	0	0	0	0	0	2	0	0	0	0	3	0	2

TEXT BOOKS:

1. Benny Joseph (2005). "Environmental Studies", Tata McGraw – Hill Publishing Company Limited, New Delhi.
2. R. J. Ranjit Daniels and Jagadish Krishnaswamy (2014). "Environmental Studies" (2014), Wiley India Pvt Limited, New Delhi.

REFERENCE BOOKS:

1. P. Aarne Vesilind, Susan M.Morgan, Thomson (2008). "Introduction to Environmental Engineering" (2008), Thomson learning, Second Edition, Boston.
2. R. Rajagopalan (2005). "Environmental Studies – From Crisis to Cure" Oxford University Press, New Delhi.

KANNADA KALI

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

SEMESTER – I/II

Subject Code	:	25EN1112	**Credits**	:	01
Hours / Week	:	01 Hours	**Total Hours**	:	13 Hours
L–T–P–S	:	1–0–0–0			

Course Learning Objectives:

This cource enables students:

1. To introduce Kannada language & culture to Non-Kannada speakers.
2. To train them to communicate in colloquial kannada with connivance.

Teaching-Learning Process (General Instructions)

These are some of the innovative pedagogical approaches to accelerate the attainment of the various course outcomes.

- **Lecture method**: means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
- **Interactive Teaching: Active learning** that includes brainstorming, group work, formulating questions, notetaking, and annotating.
- Show **Video**s to explain and illustrate the various concepts.
- Encourage **Collaborative** learning in the class.

Unit I	04 Hours
Introduction to Karnataka & kannada culture, evolution of Kannada Introduction to Kannada Alphabets, Introduction to Kannada Numbers	
Unit II	09 Hours
Kannada words, Sentences & Phrase making for colloquial communication, Tenses, Pronoun, verbs,	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Developing the ability to understand and speak Kannada, read and write the Kannada script, and communicate effectively in day-to-day situations.	L1
2	Gaining confidence in using the language and interacting with Kannada speakers.	L2
3	Expanding vocabulary and understanding basic Kannada grammar rules.	L3
4	Improving listening comprehension and developing the ability to engage in simple conversations.	L4
5	Learning to read and write the Kannada alphabet and basic words and sentences.	L3

Table:MappingLevelsofCOstoPOs/ PSOs

COs	ProgramOutcomes(POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1										2					
CO2										2					
CO3										2					
CO4										2					
CO5										2					

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

Activity Based Learning (Suggested Activities in Class)

- Using worksheets for tasks like circling the odd one out, drawing objects, or coloring pictures.
- Encouraging group work through activities like rotating through different learning boards with questions, where each group writes their answers and then rotates to the next board.
- Activities involving learning and writing Kannada words.

Text books:

1. Kannada Kali – Dr. Lingadevaru Halemane.
2. Kannada Paatagalu – Editor : Dr. Chandrashekara kambara
3. SLN Sharma & K Shankaranarayana “Basic Gramer”, Navakarnataka Publication.
4. Spoken Kannada. Publication : Kannada Sahitya Parishat Bangalore.

Semester I-Physics cycle

LINEAR ALGEBRA & DIFFERENTIAL EQUATIONS

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

SEMESTER – I

Course Code	:	25EN1101	**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	52 Hours
L–T–P–S	:	3–1–0–0			

Course Learning Objectives:

This Course will enable students to:

5. **Understand** basic concepts of linear algebra to illustrate its power and utility through applications to science and Engineering.
6. **Apply** the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
7. **Explain** the course algebraically as well as geometrically.
8. **Solve** problems in cryptography, computer graphics and wavelet transforms.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
- **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
- Show **Video/animation** films to explain functioning of various concepts.
- Encourage **Collaborative** (Group Learning) Learning in the class.
- To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
- Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**10 Hours**

INTRODUCTION:

System of Linear equations, Row reduction and echelon form, Rank of a matrix by row echelon form, Gauss elimination, Inverse of a matrix by Gauss Jordan LU.

UNIT – II	**10 Hours**

Vector spaces – Subspaces, Linear independence – Span - Bases and Dimensions -Finite dimensional vector spaces, Dimensions, finite dimensional vector spaces.

UNIT – III	**12 Hours**

Linear transformation - Matrices of linear transformations, Vector space of linear transformations – Inner Product, Orthogonal Vectors – Projections,
Gram- Schmidt Orthogonalization process.

UNIT – IV	08 Hours
Introduction to Eigenvalues and Eigenvectors, Diagonalization of a Matrix.	
UNIT – V	**12 Hours**
Linear second order ordinary differential equation with constant coefficients, Solutions of homogenous and non-homogenous equations, Method of variation of parameters, Solutions of Cauchy-Euler and Cauchy-Legendre differential equations	

Course Outcome	Description
At the end of the course the student will be able to:	
1	Apply the abstract concepts of matrices and system of linear equations using decomposition methods.
2	Explain 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	Implement the concept of linear transforms and orthogonality in computer graphics and imaging.
5	Make use of techniques for solving differential equation in dynamical systems.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	0	2	0	0	0	0	0	0			
CO2	3	3	2	0	2	0	0	0	0	0	0			
CO3	3	3	3	0	2	0	0	0	0	0	0			
CO4	3	3	3	0	2	0	0	0	0	0	0			
CO5	3	3	2	0	2	0	0	0	0	0	0			

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

TEXT BOOKS:

[6] D C Lay, S R Lay and JJ McDonald, Linear Algebra and its Applications, Pearson India, Fifth edition, 2016.

[7] Gilbert Strang, Linear Algebra and its Applications, 4th Edition, Thomson Brooks/Cole, Second Indian Reprint 2007.

[8] Bernard Kolman and David, R. Hill, Introductory Linear Algebra- An applied first course, 9th Edition, Pearson Education, 2011.

[9] George B. Thomas, D. Weir and J. Hass, Thomas' Calculus, 13th edition, Pearson, 2014.

[10] Erwin Kreyszig, Advanced engineering mathematics, Wiley, London, 1972.

REFERENCE BOOKS:

[6] Gilbert Strang, Introduction to Linear Algebra, 5th Edition, Cengage Learning, 2015.

[7] B S Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.

[8] Stephen Andrilli and David Hecker, Elementary Linear Algebra, 5th Edition, Academic Press 2016.

[9] Robert C Busby, Contemporary linear algebra, Howard Anton, Wiley, 2003.

[10] Farin and Hansford, Practical Linear Algebra, CRC Press, 2013.

E-Resources:

- https://nptel.ac.in/courses/111101115
  - https://nptel.ac.in/courses/111108066
  - Linear Algebra Basics | Coursera
  - https://nptel.ac.in/courses/111108081
  - https://nptel.ac.in/courses/111106100
  - Differential Equations for Engineers Course (HKUST) | Coursera

Activity Based Learning (Suggested Activities in Class)

- Introduce the concept of matrix transformations, such as translation, rotation, scaling, and reflection. Provide visual examples and interactive tools that allow students to manipulate shapes and observe the effects of different transformation matrices.
- Using real-life scenarios or word problems to make the activity of solving linear equations using matrix method.
- Some real-world scenarios that can be modelled using ODEs, such as population growth, radioactive decay, or chemical reactions that can be discussed and solve using appropriate methods.
- Real world problem solving and puzzles using group discussion.
- Demonstration of solution to a problem through experiential learning.

C PROGRAMMING FOR PROBLEM SOLVING

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

SEMESTER – I/II

Course Code : 25EN1114		**Credits** :	04
Hours/Week : 05 Hours	**Total Hours**	:	26(L) + 13(T) + 26 (P) Hours
L–T–P–J : 2–1-2–0			

Course Learning Objectives:

This Course will enable students to:

1. **Elucidate** the basic architecture and functionalities of C programming language.
2. **Apply** programming constructs of C language to solve the complex problems
3. **Explore** data structures like arrays, structures, unions and pointers in implementing solutions to real world problems
4. **Design** and Develop Solutions to problems using structured programming constructs such as functions.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that possible, it helps improve the students' understanding.

UNIT – I	**07 Hours**

Basics and overview of C: Introduction to Problem Solving using Algorithms and Flowchart: Key features of Algorithms: Sequence, Decision, Repetition with examples. Background, structure of C program, keywords, Identifiers, Data Types, Variables, Constants, Input / Output statements, Operators (Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associativity, Expression Evaluation, Type conversions. Conditional Branching Statements-if and switch statements, iterative statements (loops)-while, for, do-while statements, Loop examples, Nested loops, break, continue, go to statement.

(Text Book-1: Chapter 2 & Chapter 3)

UNIT – II	**05 Hours**

Arrays: Introduction, declaration & initialization of array, reading and writing array elements, Operations on array: Traversal, searching (Linear and Binary search), sorting (Bubble sort and Selection Sort). Declaration and Initialization of two-dimensional arrays. Matrix Operations

(addition, subtraction, multiplication, transpose) using two-dimensional array. **Strings:** Definition, declaration, initialization, and representation. String handling functions and character handling functions. ***(Text Book-1: Chapter 5:5.1 to 5.9 & Chapter 6)***
UNIT – III **06 Hours**
Pointers: Definition and declaration and initialization of pointers. Accessing values using pointers. Accessing array elements using pointers. **Functions:** Definition and declaration. Built-in functions and User-defined functions. Categories of functions with example. Pointers as function arguments, array as function argument, Call-by-value and call-by-reference. Recursion. ***(Text Book-1: Chapter 7: 7.1 to 7.17 & Chapter 4:4.1 to 4.8, 4.10)***
UNIT – IV **04 Hours**
Structures: Purpose and usage of structures. Declaration of structures. Assignment with structures. Structure variables and arrays. Nested structures. Student and employee database implementation using structures. **Unions**: Declaration and initialization of a union. Difference between structures and unions. Example programs. ***(Text Book-1: Chapter 8: 8.1, 8.2,8.6)***
UNIT – V **04 Hours**
Memory allocation in C programs: Dynamic memory allocation, memory allocation process, allocating a block of memory, releasing the used space, altering the size of allocated memory. **Files**: Defining, open, read, write, seek and closing of both textual and random files. ***(Text Book-1: Chapter 7: 7.18 to 7.20 & Chapter 9: 9.1 to 9.5, 9.8)***

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** fundamental programming constructs such as data types, operators, control flow, and loops to develop basic C programs.	L2, L3
2	**Demonstrate** the ability to use one-dimensional and two-dimensional arrays, perform matrix operations, and manipulate strings using standard C functions.	L3
3	**Apply** pointer concepts and function mechanisms including recursion, call-by-value/reference, and arrays as arguments to build modular C programs.	L3
4	**Develop** programs using structures and unions to represent and manage compound data types for real-world applications like employee or student databases.	L3
5	**Implement** dynamic memory allocation techniques and file operations in C for efficient data storage and retrieval.	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**	**1**	**2**
CO1	2	1	2		1							1	
CO2	2	1	2		1							1	
CO3	2	2	1		1							1	
CO4	2	1	2		1							1	
CO5	2	1	2		1							1	

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

TEXT BOOKS:

1. Reema Thareja, "Programming in C". Oxford University Press, Second Edition, 2016.

REFERENCE BOOKS:

1. Brian W. Kernigham and Dennis M. Ritchie, (2012) "The C Programming Language", 2nd Edition, PHI.
2. Behrouz A. Forouzan, Richard F. Gilberg, "Computer Science - A Structured Approach Using C", Cengage Learning, 2007.
3. Vikas Gupta, "Computer Concepts and C Programming", Dreamtech Press 2013.

E-Resources:

1. https://nptel.ac.in/courses/106/105/106105171/ MOOC courses can be adopted for more clarity in understanding the topics and verities of problem-solving methods.
2. https://www.w3schools.com/c/index.php
3. https://www.guvi.in/courses/web-development/c-programming/
4. https://www.tutorialspoint.com/cprogramming/index.htm
5. https://pythontutor.com/

Activity Based Learning (Suggested Activities in Class)

- Demonstration of solution to a problem through designing the Flowchart or any design notations using **draw.io** in the group of four and justify using snippets or algorithms.

C PROGRAMMING FOR PROBLEM SOLVING LABORATORY

Total Contact Hours: 26

List of Laboratory/Practical Experiments activities to be conducted
1. Programming Basics: Swapping Numbers, Simple Interest, and Factorial. 2. Quadratic Equation Solver 3. Number Operations: Palindrome Check and Power Calculation. 4. Fibonacci Series and Greatest Common Divisor (GCD) Calculation. 5. Calculator Emulation 6. String Manipulation 7. Sorting an Array of Integer Elements. 8. Searching an Array of Elements. 9. Pointer Demonstration using Functions. 10. Case Study on Strings and Functions.

PHYSICS FOR COMPUTER SCIENCE CLUSTER (CS Cluster)
[As per Choice Based Credit System (CBCS) scheme]

Course Code	:	25EN1115	**Credits**	:	04
Hours / Week	:	05 Hours	**Total Hours**	:	39(L)+26(P) = 65 Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the fundamental principles of quantum mechanics and apply them to analyze and solve engineering problems in science and technology.
2. Explore the foundational concepts of quantum information and their applications in the emerging field of quantum computing.
3. Learn the principles of quantum optics, including the operation and applications of lasers and optical fiber communication systems in engineering.
4. Comprehend the band structure of solids and analyze the electrical properties and device applications of semiconductors.
5. Understand thin-film phenomena, examine various thin-film fabrication techniques, and distinguish between top-down and bottom-up approaches for synthesizing nanomaterials, with emphasis on their applications in engineering and medicine

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
2. **Interactive Teaching**: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain 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. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

Introduction to Quantum mechanics:

Failure of Classical mechanics, Planck's hypothesis - Principles of quantum Mechanics (Wave-Particle Duality and Uncertainty Principle), Wave function, Eigen function and Eigen values, Schrodinger time independent wave Equation in 1D (Derivation), Application - Particle in a potential well (Derivation), Numericals

UNIT – II	6 Hours
Quantum Information and Computing Introduction to Quantum information, Qubit, Bloch sphere, Superposition, Entanglement, Quantum Gates, Quantum Measurement, Quantum parallelism, Quantum supremacy, Applications: Quantum Key Distribution (QKD), Quantum Sensors.	

UNIT – III	9 Hours
Quantum Optics and Fibre Optic Communication • **Quantum Optics:** Process of absorption, spontaneous and stimulated emission Einstein coefficients (qualitative), Pumping, population inversion, resonators, Laser characteristics, beam quality, characteristics of laser, Types of lasers: construction and working of solid-state (Nd:YAG) and semiconductor laser - Applications of Lasers in engineering. **(5 hours)** • **Fiber Communication:** Basics of optical fibers and light propagation, Numerical aperture, acceptance angle, Step-index and graded-index fibers, Fiber losses: attenuation, dispersion, bending, Applications in communication and sensing. **(4 hours)**	

UNIT – IV	10 Hours
• **Semiconductor Physics:** Classification of Solids, Band structure, Fermi level in intrinsic and extrinsic semiconductors, Fermi-Dirac distribution function, Expression for concentration of electrons in conduction band (Derivation), Intrinsic carrier concentration, Conductivity of semiconductors, Hall effect, Derivation of Hall Coefficient, introduction to quantum hall effect - Numerical. **(6 hours)** • **Semiconductor Devices:** Zener diode: breakdown mechanisms and applications, Light Emitting Diode (LED): working principle and characteristics. Photodiode, Solar Cell and BJT: basic operation and I-V characteristics. **(4 hours)**	

UNIT – V	6 Hours
Thin films and Nano technology • **Thin Films Technology:** Introduction to thin films-Advantages of thin films over bulk materials. Introduction to thin film deposition processes - Physical vapor deposition (Thermal evaporation technique and sputtering technique) process, Applications of Thin films**. [3 hours]** • **Nano Science & Technology:** Introduction to Nano materials, Classification of nano materials, Size dependent properties of materials (Quantum confinement), Top-down and Bottom-up approach- Ball-milling, and Photolithography Process. Applications of Nano technology in medicine and Engineering. **[3 hours]**	

Course Outcome	Description
At the end of the course the student will be able to:	
1	Explain the fundamental postulates of quantum mechanics and apply them to simple physical systems relevant to engineering applications.
2	Analyse basic concepts of quantum information, quantum bits (qubits), and evaluate simple quantum processing and their computational advantages.
3	Illustrate the working principles of lasers and optical fibers, and apply them to modern communication systems and other engineering fields.
4	Interpret the band theory of solids and characterize the electrical behaviour of semiconductors and their applications in devices.

5	Compare various thin-film fabrication techniques, explain nanoscale material synthesis approaches, and evaluate their applications in engineering and medical fields.

Table: Mapping Levels of COs to POs / PSOs													
COs	**Program Outcomes (POs)**											**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO1	2	0	0	0	0	0	0	0	0	0	0	2	
CO2	3	0	0	0	0	0	0	0	0	0	0	3	
CO3	3	0	0	0	0	0	0	0	0	0	0	3	
CO4	2	0	0	0	0	0	0	0	0	0	0	2	
CO5	2	0	0	0	0	0	0	0	0	0	0	2	

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

TEXT BOOKS:

[1] R. Shankar, "Principles of Quantum Mechanics", Springer, 2nd Edition, 1994.
[2] Michael A. Nielsen & Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 10th Anniversary Edition, 2010.
[3] Mark Fox, "Quantum Optics", Oxford University Press, Oxford Master Series in Physics, 3rd Edition, 2022.
[4] K. Thyagarajan & A.K. Ghatak, "Lasers: Fundamentals and Applications", Springer India, 2nd Edition: 2010.

REFERENCE BOOKS:

[1] Gerd Keiser, "Optical Fiber Communications", Springer, 5th Edition, 2021.
[2] Ajoy Ghatak & K. Thyagarajan, "Introduction to Fiber Optics", Cambridge University Press, 1st Edition, 1998.
[3] S.O. Kasap, "Principles of Electronic Materials and Devices", McGraw-Hill Education, 4th Edition, 2018.
[4] Arthur Beiser, "Concepts of Modern Physics", McGraw-Hill Education, 6th Edition, 2003.

E-Resources:

- NPTEL lectures on Quantum Computing & Semiconductor Physics and Devices

Activity-Based Learning (Suggested Activities in Class)

- Use physical models and simulations to visualize key physics principles behind real-world engineering systems, like oscillations, interference, diffraction, etc.
- Role-play or storytelling sessions where students simulate quantum computing logic gates or quantum key distribution protocols.
- Hands-on circuit-building exercises using breadboards to understand working of devices like LEDs, photodiodes, and BJTs.
- Demonstration using optical fibers to show light propagation, total internal reflection, and loss mechanisms.
- Interactive videos and animations to demonstrate thin film deposition methods like CVD, PVD, and sol-gel techniques.
- Regular use of virtual lab platforms (IIT/NPTEL/PhET) to simulate experiments that are otherwise difficult in a physical lab setting.

PHYSICS- COMPUTER SCIENCES LABORATORY

Total Contact Hours: 26

List of Laboratory/Practical Experiments activities to be conducted
1. **I-V Characteristics of a Zener Diode:** I-V characteristics of a Zener Diode in forward and reverse bias conditions
2. **Planck's Constant:** Determination of Planck's Constant using LED
3. **Band Gap Energy:** Determination of the energy gap of an intrinsic semiconductor
4. **Transistor Characteristics:** Input and output characteristics of NPN Transistor in C-E configuration
5. **Diffraction Grating:** Determination of wavelength of a laser light using a diffraction grating
6. **Fiber optic system:** Determination of numerical aperture, acceptance angle, and attenuation of an optical fiber
7. **Four Probe Method:** Determination of resistivity of a material using the Four-probe technique
8. **Hall Effect:** Determination of carrier concentration and mobility of a semiconductor
9. Realization of the Hadamard Gate and its Bloch sphere visualization using Qiskit/QuUniverse Quantum computing programming.
10. Realization of the C-NOT Gate and its Bloch sphere visualization using Qiskit/Quniverse Quantum computing programming.

PHYSICS FOR ECE [As per Choice Based Credit System (CBCS) scheme]					
Course Code	:	25EN1116	**Credits**	:	04
Hours / Week	:	05 Hours	**Total Hours**	:	39(L)+26(P) = 65 Hours
L–T–P–J	:	3–0–2–0			

Course Learning Objectives:

This Course will enable students to:

1. Analyze the solids' band structure, semiconductors' electrical conductivity, and semiconductor devices such as LEDs, photodiodes, and solar cells, as well as their applications in engineering.
2. Devise the fundamental ideas of quantum mechanics that are necessary for thoughtful and addressing engineering challenges in science and technology.
3. Explain the various crystal systems, Miller indices and determine crystal structure using XRD technique.
4. Get the idea of thin-film phenomena, thin-film production techniques, and applications and to expert how to create Nano materials utilizing a top-down and bottom-up approaches, as well as to explore Nano science and technology applications in engineering and medicine.
5. Describe and illustrate the engineering materials, including electronic, electrical, and magnetic materials, as well as dielectric material properties and applications in science and engineering.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
2. **Interactive Teaching**: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show **Video/animation** films to explain 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. Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	09 Hours

Quantum mechanics and Semiconductor Physics

Quantum Mechanics: Foundations of quantum theory, Wave function and its properties, de-Broglie hypothesis, Heisenberg Uncertainty principle. One dimensional time independent Schrodinger wave equation, Eigen values and Eigen functions. Applications: one dimensional motion of an electron in a potential well. Basics of Quantum computing - Concepts of Superposition, Entanglement, Interference and Qubit. [**5 hours**]

Semiconductor Physics: Classification of Solids, 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), Intrinsic carrier concentration, Conductivity of semiconductors, Hall effect, Derivation of Hall Coefficient, Numerical. [**4 hours**]

UNIT – II	**8 Hours**

Engineering materials

Magnetic Materials: - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Classification of magnetic materials: Dia, Para, Ferro, Anti-ferro & Ferri magnetic materials – Hysteresis effect - soft and hard magnetic materials – Applications of magnetic materials in Engineering, Numerical [**4 hours**]

Dielectrics: Introduction-Polarization and Dielectric Constant-Dielectric Susceptibility-Electric Field inside a Dielectric- macroscopic and Microscopic Electric Field-Polarization Mechanisms-Electronic, Ionic and Orientational Polarizations-Internal Fields in Solids-Clausius-Mosotti Equation-Dielectrics in alternating Fields- Applications of dielectric materials as electrical insulators. [**4 hours**]

UNIT – III	**8 Hours**

Introduction to Novel Electronic Materials:

Semiconducting devices for optoelectronic applications: - Principle and working of PN-junction diode, Zener diode, Light Emitting Diode, Photodiode, Solar cell and BJT characteristics. [**3 hours**]

Novel materials: Two-Dimensional (2D) Materials-Graphene and Transition Metal Dichalcogenides (TMDs – e.g., MoS_2, WS_2, Hexagonal Boron Nitride (h-BN); Growth/Preparation of 2D materials employing Chemical Vapor deposition, Topological Insulators (Materials: Bi_2Se_3, Bi_2Te_3) Perovskite Materials, Ferroelectric and Multiferroic Materials, Applications of Electronic materials for device applications [**5 hours**]

UNIT – IV	**08 Hours**

Introduction to Fiber Optic Communication

Introduction to Optical Fibers: Optical Fiber and its components, Principle of Operation- Total Internal Reflection (TIR). Optical Parameters-Critical Angle: Acceptance Angle (θ_a), Numerical Aperture (NA), Types of Optical Fibers based on Materials (Glass Fibers and Plastic Fibers), Based on Modes and Based on Refractive Index Profile: Losses in Optical Fibers. [**3 hours**]

Fiber Optic Communication System-Transmitter, Optical Sources-Light Emitting Diodes (LEDs), Laser Diodes, Transmission Medium, Receiver-Photodetectors (PIN Photodiodes and Avalanche Photodiodes) Fiber Optic Communication system (Basic elements, construction and working) Applications of Optical Fibers in Telecommunications, Medical Imaging, Industrial Automation, and Défense, Numerical Problems [**5 hours**]

UNIT – V	**16 Hours**

Thin Films and Nanotechnology

Thin films technology: Introduction to thin films-Advantages of thin films over bulk materials. Introduction to thin film deposition processes (CVD & PVD) - Physical vapor deposition (Thermal evaporation technique and sputtering technique) process, Applications of Thin films. [**3 hours**]

Nano Science & technology: Introduction to Nano materials, Classification of nano materials, Size dependent properties of materials, Solgel method, Top-down and Bottom-up approach- Ball-milling and Photolithography, Process. Applications of Nano technology in Biology and Engineering. [**3 hours**]

Course Outcome	Description
At the end of the course the student will be able to:	
1	Explain the fundamental postulates of quantum mechanics, Semiconductor Principles and apply them to simple physical systems relevant to engineering applications.
2	Understand the different magnetic and Di-electric materials and their characteristics, Hysteresis effect and Applications of magnetic, dielectric materials in Engineering.
3	Interpret the construction and working of SC devices for Opto-electronic devices. Subsequently understand basic structural characterization of some Novel 2-D and Electronic materials for device applications
4	Illustrate the working principles of optical fibres and apply them to modern communication systems and other engineering fields.
5	Compare various thin-film fabrication techniques, explain nanoscale material synthesis approaches, and evaluate their applications in engineering and medical fields.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2	0	0	0	0	0	0	0	0	0	0	2	
CO2	2	0	0	0	0	0	0	0	0	0	0	2	
CO3	2	0	0	0	0	0	0	0	0	0	0	2	
CO4	1	0	0	0	0	0	0	0	0	0	0	1	
CO5	1	0	0	0	0	0	0	0	0	0	0	1	
CO6	3	0	0	0	0	0	0	0	0	0	0	3	

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

TEXT BOOKS:

[1] Shatendra Sharma & Jyotsna Sharma, **"Engineering Physics", P**earson Education India, 2019.

[2] P. S. Aithal & H. J. Ravindra**, "Textbook of Engineering Physics",** Acme Learning Pvt. Ltd., 2011.

[3] B.K. Pandey & S. Chaturvedi, **"Engineering Physics",** Cengage Learning India, 2012

[4] Gerd Keiser, **"Optical Fiber Communications",** McGraw-Hill Education, 4th Edition, 2008.

REFERENCE BOOKS:

[1] M. Young, **"Optics & Lasers: An Engineering Physics Approach"**, Springer-Verlag**,** 1st Edition, 1997.

[2] K. L. Chopra, **"Thin Film Phenomena",** McGraw Hill, New York, 1st Edition, 1969.

[3] S. O. Pillai, **"Solid State Physics",** New Age International Publishers, Revised Edition, 2018.

[4] **,** M. N. Avadhanulu, P. G. Kshirsagar, T. V. S. Arun Murthy, **"A Textbook of Engineering Physics", S.** Chand Publishing, New Delhi, 11th Edition, 2018.

[5] **Engineering Physics Laboratory Manual,** Department of Physics, DSU, Dayananda Sagar University, Bangalore, Internal Publication, 2025.

E-Resources:

- NPTEL Lectures on Semiconductor Physics and Devices

Activity-Based Learning (Suggested Activities in Class)

1. Activity that makes students to apply the concepts learned in the course to the practical engineering and applied Physics will be discussed in class.
2. Activity offers space to students giving responsibility allowing them to develop their own solving methods for the real time problems
3. Activity that makes the students for the development of skill set in engineering and applied Physics
4. Activity that makes the students to have critical thinking, developing a mindset, problem-solving and teamwork in design thinking process.
5. Real world problem solving and puzzles through group discussions.
6. Demonstration of solution to a problem through experiential learning.

PHYSICS FOR ELECTRONICS LABORATORY

Total Contact Hours: 26

List of Laboratory/Practical Experiments activities to be conducted
1. **I-V characteristics of a Zener Diode:** I–V Characteristics of a Zener diode in forward and reverse bias condition
2. **Four probe techniques:** Measurement of resistivity of a semiconductor using Four probe technique
3. **Dielectric constant:** Determination of dielectric constant of a dielectric material
4. **Fiber Optic system:** Determination of Acceptance angle, NA and Losses in Optical fibers
5. **Band gap energy:** Determination of energy gap of an intrinsic semiconductor
6. **Diffraction grating:** Determination of wavelength of a laser light using diffraction grating
7. **Planck's constant:** Measurement of Planck's constant using LED
8. **LCR series and parallel resonance:** Study the frequency response of a series and parallel LCR circuit
9. **Transistor characteristics:** Input& output characteristics of an NPN transistor in CE configuration
10. **Hall-effect:** Determination of concentration, mobility and conductivity of a Semiconductor

PHYSICS FOR MECHANICAL CLUSTER

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

SEMESTER – I/II

Course Code	: 25EN1117	**Credits**	: 04
Hours/Week	: 05 Hours	**Total Hours**	: 39(L) + 26(P) = 65 Hours
	L–T–P–J	: 3–0-1–1	

Course Learning Objectives:

This Course will enable students to:

1. **Elucidate** the structure, properties, and selection criteria of mechanical and aerospace materials including composites and alloys and explain the fundamental principles of crystallography and wave phenomena relevant to engineering applications.
2. **Apply** the principles of semiconductor physics and device operation to analyze and interpret the characteristics of diodes, LEDs, photodiodes, solar cells, and transistors for practical engineering use.
3. **Explore** modern techniques such as X-ray diffraction, thin-film deposition, and nanoscale material fabrication methods to investigate the structural and functional properties of advanced engineering materials.
4. **Design** simple experiments and interpret data to validate theoretical models in wave mechanics, semiconductor behavior, and material properties using laboratory instruments and virtual simulations

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.

UNIT – I	**08 Hours**

Introduction to Mechanical & Aerospace Materials

- **Composite Materials:** Overview of metallic and non-metallic materials and their structural characteristics, Composite materials- Types – Alloys - Criteria and methods for choosing appropriate materials for Aerospace applications. [**4 hours**]
- **Mechanical Engineering Materials:** Mechanical properties: stress- strain curve for different materials. Introduction to Tensile strength, Compressive strength, Ductility, Toughness, Brittleness, Impact strength, Fatigue, Creep. Testing of engineering materials: Hardness Tests: Brinell and Vickers hardness test & Numericals- [**4 hours**]

(Reference Book-2, Chapter 10, Text Book-2: Chapter 1 & Chapter 2)

UNIT – II	08 Hours

Crystallography

- **Crystallography:** Lattice, Unit cell, Lattice parameters, Crystal systems, Bravais lattices, Packing fraction for SCC, BCC and FCC crystal systems. Introduction to Miller Indices, Determination of Crystal structure by Miller Indices. Expression for Inter-planar distance (Qualitative), X-ray diffraction, Bragg's law and Determination of Crystal structure by Powder method, Applications of XRD in Science and technology, Defects in crystals, Numericals. [**8 hours**]

(Text Book-1: Chapter 3, Reference Book-5: Chapter 4)

UNIT – III	08 Hours

Oscillations and Waves:

- **Free Oscillations**: Basics of SHM, Derivation of differential equation for SHM, Mechanical simple harmonic oscillators (spring constant by series and parallel combination), Equation of motion for free oscillations, Natural frequency of oscillations. [**3 hours**]
- **Damped Oscillations:** Theory of damped oscillations (Derivation), over damping, critical & under damping (only graphical representation), Quality factor. [**2 hours**]
- **Forced Oscillations:** Theory of forced oscillations (Qualitative) and resonance, sharpness of resonance. [**1 hour**]
- **Shock waves:** Mach number, Properties of Shock waves, Construction and working of Reddy shock tube, applications of shock waves, Numericals. [**2 hours**]

(Text Book-6: Chapter 7 & Text Book-2: Chapter 2-4)

UNIT – IV	09 Hours

Semiconductor Physics and Devices:

- **Semiconductor Physics:** Classification of Solids, Band structure, Fermi level in intrinsic and extrinsic semiconductors, Fermi-Dirac distribution function - Expression for concentration of electrons in conduction band (Derivation), Intrinsic carrier concentration, Conductivity of semiconductors, Hall effect, Derivation of Hall Coefficient, Introduction to Quantum Hall effect, Numerical. [**6 hours]**

- **Semiconductor Devices:** Zener diode: breakdown mechanisms and applications**,** Light Emitting Diode (LED): working principle and characteristics. Photodiode and Solar Cell: basic operation and I-V characteristics. [**3 hours**]

(Text Book-1: Chapter 8: 8.1, 8.2,8.6)

UNIT – V	06 Hours

Thin films & Nanotechnology:

- **Thin films technology:** Introduction to thin films-Advantages of thin films over bulk materials. Thin film deposition processes- Physical vapor deposition (Thermal evaporation technique, and sputtering technique) process, Applications of Thin films. [**3 hours**]
- **Nano Science & technology**: Introduction to Nano materials, Classification of nano materials, Size dependent properties of materials, Top-down and Bottom-up approach- Ball-milling and Photolithography & Applications of Nano technology in science and Engineering. [**3 hours**]

(Text Book-1: Chapter 5 & Reference Book-2, Chapter 6)

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Illustrate** the various characteristics of semiconductor materials and different semiconductor devices	L3
2	**Demonstrate** the optical principles of diffraction and interference	L3
3	**Estimation** of moment of inertia for a rigid body	L2
4	**Demonstrate** the frequency response curve for a LCR circuit	L3
5	**Illustrate** the characteristics of a dielectric material	L3
6	**Interpret** the variation of physical parameters graphically and derive conclusions	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	1	2
CO1	3	0	0	0	0	0	0	0	0	0	0	3	
CO2	3	0	0	0	0	0	0	0	0	0	0	3	
CO3	2	0	0	0	0	0	0	0	0	0	0	2	
CO4	1	0	0	0	0	0	0	0	0	0	0	1	
CO5	3	0	0	0	0	0	0	0	0	0	0	3	

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

(Low) TEXT BOOKS:

1. S. O. Pillai, "Solid State Physics", New Age International Publishers, New Delhi, Revised Edition, 2018.
2. N. K. Bajaj, "Waves and Oscillations", Tata McGraw-Hill Education, 1st Edition, 1998.
3. Sergey M. Frolov, Anatoly A. Borisov, "Shock Waves and Explosions", Springer, 1st Edition, 2012.
4. T. Pradeep, "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education, 1st Edition, 2013.
5. K. L. Chopra, "Thin Film Phenomena", McGraw Hill, New York, 1st Edition, 1969.

REFERENCE BOOKS:

1. M. Young, "Optics & Lasers: An Engineering Physics Approach", Springer-Verlag, 1st Edition, 1977.
2. M. N. Avadhanulu, P. G. Kshirsagar, T. V. S. Arun Murthy, "A Textbook of Engineering Physics", S. Chand Publishing, New Delhi, 11th or later, 2018.
3. K. Thyagarajan, "Engineering Physics", McGraw Hill Education, India, 1st Edition, 2016.
4. V. Rajendran, "Engineering Physics", Tata McGraw Hill Education, 1st Edition, 2017.

E-Resources:
NPTEL lectures on Waves and Oscillations &Semiconductor Physics and Devices

Activity Based Learning (Suggested Activities in Class)

Activity: Students build 3D models of SC, BCC, and FCC unit cells using ball-and-stick kits or simulation software. To visually understand crystal structures, calculate packing fraction, and reinforce concepts of crystallography.

PHYSICS FOR ME CLUSTER LABORATORY

Total Contact Hours: 26

List of Laboratory/Practical Experiments activities to be conducted

1. **I-V characteristics of a Zener Diode**
   I–V Characteristics of a Zener diode in forward and reverse bias condition (Module 4)
2. **Four probe techniques**
   Measurement of resistivity of a semiconductor using Four probe technique (Module 4)
3. **Dielectric constant**
   Determination of dielectric constant of a dielectric material (Module 1)
4. **Torsional Pendulum**
   Determination of moment of inertia of a circular disc using torsional pendulum (Module 1)
5. **Band gap energy**
   Determination of energy gap of an intrinsic semiconductor (Module 4)
6. **Diffraction grating**
   Determination of wavelength of a laser light using diffraction grating (Module 3)
7. **Planck's constant**
   Measurement of Planck's constant using LED (Module 4)
8. **LCR series and parallel resonance**
   Study the frequency response of a series and parallel LCR circuit (Module 4)
9. **Transistor characteristics**
   Input and output characteristics of an NPN transistor in C-E configuration (Module 4)
10. **Hall-effect**
    Determination of concentration, mobility and conductivity of a Semiconductor (Module 4)

ENGINEERING SCIENCE COURSE – II for Computer Science cluster

INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING

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

SEMESTER – I/II

Subject Code	:	25EN1109	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

- To introduce fundamental electrical quantities such as charge, current, voltage, power, and energy, and their relationships in basic circuits.
- To enable students to apply Ohm's Law and Kirchhoff's Laws to analyze simple resistive, series, and parallel electrical networks.
- To impart a foundational understanding of AC and DC waveforms, including key parameters like RMS, peak, and average values.
- To develop conceptual understanding of magnetic circuits and electrical machines, including transformers and DC machines, along with their working principles.
- To familiarize students with the characteristics and applications of diodes and transistors, particularly in rectifier and switching circuits.
- To introduce operational amplifiers and their basic configurations such as inverting, non-inverting, and summing amplifiers.
- To provide a conceptual understanding of digital logic circuits, including logic gates, flip-flops, and binary counters.
- To provide a high-level overview of microcontroller systems, focusing on block diagram architecture and their role in embedded applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
- **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
- Show **Video/animation** films to explain functioning of various concepts.
- Encourage **Collaborative** (Group Learning) Learning in the class.
- To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
- Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**07 Hours**

Electrical Circuit Fundamentals: Basic electrical quantities such as charge, voltage, current, resistance, power, and energy; Ohm's Law; Kirchhoff's Voltage and Current Laws (KVL and KCL); series and parallel resistor networks; voltage and current division rules; introduction to AC and DC waveforms including RMS, peak, and average values.

UNIT – II	**08 Hours**

Electrical Machines and Power Systems: Magnetic circuits including flux, flux density, magnetomotive force (MMF), and reluctance; working principle, types, and applications of transformers; working principle of DC generators and motors; basics of electrical power generation, transmission, and distribution; introduction to renewable energy sources.

UNIT – III	08 Hours
Semiconductor Devices and its application: Overview of diode construction; diode under no-bias, forward bias, and reverse bias conditions; half-wave and full-bridge rectifiers; construction and operation of npn and pnp BJTs; input and output characteristics of the common-base configuration; regions of transistor operation active, cut-off, and saturation; transistor as a switch.	

UNIT – IV	08 Hours
Operational amplifiers: Op-amp symbols and terminals; modes of operation including single-ended, differential, and common mode; properties of ideal and practical op-amps; applications such as inverting amplifier, non-inverting amplifier, summing amplifier, differential amplifier, differentiator, and integrator.	

UNIT – V	08 Hours
Digital Electronics and Embedded applications: Binary number system; logic gates and their truth tables—AND, OR, NOT, XOR, NAND, NOR; combination of logic gates and basic numerical operations; sequential logic circuits including JK and D Flip-Flops; application of Flip-Flops in 4-bit binary counters; overview of microcontrollers at the block diagram level.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Demonstrate a clear understanding of the basic principles of electrical and electronic components**, including resistors, diodes, transistors, operational amplifiers, logic gates, and microcontrollers.	L2
2	**Apply basic circuit law's and priciples to analyze electrical circuits**, including resistive networks, AC/DC waveforms, and basic transformer and DC machines	L3
3	**Apply knowledge of semiconductor devices**, such as diodes and transistors, to explain rectification and switching behavior in electronic circuits.	L3
4	**Apply the principles of operational amplifiers** to configure basic circuits such as inverting, non-inverting, and summing amplifiers.	L3
5	**Demonstrate conceptual understanding of digital logic and microcontroller systems**, including logic gate combinations, flip-flops, counters, and block diagram-level microcontroller architecture.	L2

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
CO1	3	2										2		
CO2	3	3										2	2	
CO3	3	3										2	2	
CO4	3	3										2	2	
CO5	3	2										2		

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

TEXT BOOKS:

1. R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", 11th Ed, Pearson Education, 2013.
2. M. Moris. Mano and Michael D. Ciletti, "Digital Electronics", 4th Ed, Pearson Education, 2006.
3. D.P.Kothari and I.J. Nagrath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill, 2019.
4. B.L. Theraja and A.K. Therja, "A textbook of electrical technology, Vol. I (Basic electrical Engineering)", S. Chand Publishing, 23rd Rev Ed, 2006.

REFERENCE BOOKS:

- David A Bell, "Electronic Devices and Circuits", 5th Ed, Oxford university press, 2008.
- Millman & Halkias, "Electronics Devices and Circuits", 2nd Ed, McGraw Hill, 2010.
- William H Hayt and Jack E Kimberly and Steven M Durbin, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill, 2013.

E-Resources:

- NPTEL- https://nptel.ac.in/courses/122/106/122106025
- NPTEL- https://nptel.ac.in/courses/108/108/108108076
- Virtual Labs- http://vlabs.iitkgp.ac.in/be/

Activity-Based Learning (Suggested Activities in Class):

- Simulation of different electronic circuits. E.g., Rectifiers and Amplifiers using LtSpice.

ENGINEERING SCIENCE COURSE – II for ECE

INTRODUCTION TO ELECTRONICS ENGINEERING

[For ECE Branch - As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I/II

Subject Code	: 25EN1118	**Credits**	:	03
Hours / Week	: 03 Hours	**Total Hours**	:	39 Hours
L–T–P	: 3–0–0			

Course Learning Objectives:

This course enables students to

- **Understand** the fundamental principles of diodes and their applications, including the band diagram of insulators, conductors, and semiconductors, diode construction, and V-I characteristics.
- **Analyze** diode circuits under different biasing conditions and comprehend the behavior of diodes in applications such as AND gates, OR gates, rectifiers, and voltage doublers.
- **Understand** how and why clipper and clamper are called wave shaping circuits.
- **Comprehend** the construction, operation, and characteristics of bipolar junction transistors (BJTs), including input and output characteristics, different biasing techniques, and transistor amplification.
- **Calculate** common emitter amplifier circuits with voltage divider bias.
- **Demonstrate** an understanding of operational amplifiers (Op-amps), including their symbols, operation modes, properties, and applications such as amplifiers, comparators, and oscillators.
- **Demonstrate** an understanding of digital electronics, including binary number systems, Boolean algebra, logic gates, sequential logic circuits, and the application of Flip-Flops.
- **Verify** digital circuits and components with basic activities on simulators.
- **Familiarize** themselves with microprocessors and microcontrollers, and understand their architecture and components.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- ***Lecture method*** means it includes not only traditional lecture method, but different
  - *type of teaching methods* may be adopted to develop the course outcomes.
- ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
- Show ***Video/animation*** films to explain functioning of various concepts.
- Encourage ***Collaborative*** (Group Learning) Learning in the class.
- To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
- Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

Semiconductor Diodes: Semiconductor types: intrinsic and extrinsic (n-type and p-type); diode construction; diode under no-bias, forward bias and reverse bias; V-I characteristics of diode; simplified equivalent circuit of practical diode and ideal diode; diode specifications: peak inverse voltage, reverse leakage current and maximum forward current; Zener diode;
(Textbook 1: Chapter 1: 1.1 to 1.7, 1.9, 1.12, 1.15)

UNIT – II	06 Hours
Diode applications: Series diode configuration with DC input, Rectifier Circuits: Half wave and full wave – Bridge Network and Centre tapped, Reservoir and smoothing circuits; Diode clipper – series and parallel; Clamper circuits, Voltage Doubler. (Textbook 1: Chapter 2: 2.3, 2.5, 2.6, 2.7, 2.8, 2.9, 2.12)	

UNIT – II	08 Hours
Transistors: Construction of npn and pnp BJT transistors; transistor operation; input and output characteristics of CB and CE configurations; significance of different regions of operation: active, cut-off and saturation (transistor as a switch); BJT Amplification; transistor amplifying action; numerical on current relations and amplification; Need for biasing: Q-point; types of biasing: fixed, and voltage divider, Introduction to Field Effect Transistor, Construction and Characteristics of JFET, MOSFET (MOS) (Depletion and Enhancement) Type, Transfer Characteristic. (Textbook 1: Chapter 3: 3.1 to 3.5, Chapter 4: 4.1 to 4.5, Chapter 6.1 and 6.2)	

UNIT – III	08 Hours
Operational amplifiers: Op-amp symbols, terminals and operation: single mode, differential mode and common mode; basic properties of ideal and practical Op-amp: input offset voltage, input resistance, output resistance, gain, bandwidth, CMRR, slew rate; basic Op-map applications: inverting amplifier, non-inverting amplifier, summing amplifier, differential amplifier, differentiator and integrator; Op-amp comparator; feedback: positive and negative feedback; criteria for stability and oscillations (Barkhausen criterion); RC phase shift oscillators; (Textbook 1: Chapter 10: 10.1, 10.4 to 10.7, Chapter 14: 14.5 to 14.7)	

UNIT – IV	09 Hours
Digital Electronics: Binary number system: conversion and representation; logic levels: high and low; Boolean algebra: operators and DeMorgan's law; Boolean Expression, logic gates with truth-table and representation: AND, OR, NOT, XOR, NAND, NOR; combination of gates and associated numerical; sequential logic circuits: SR latch using NAND/NOR gate, SR FLIP-FLOP, D Flip-Flop, J-K Flip- Flop. **Microprocessor Systems:** Overview of microprocessor and microcontroller architecture. (Textbook 2: Chapter 1: 1.1 to 1.3, Chapter 2: 2.1 to 2.5, Chapter 4: 4.1 to 4.3, Chapter 5.1 to 5.5, Chapter 6.1 to 6.4)	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	**Demonstrate** a solid understanding of the fundamental principles underlying electronic components, such as diodes, transistors, operational amplifiers, logic gates, and microcontrollers.	L2
2	**Apply** knowledge of electronic components to **analyze** circuits for various applications, such as rectification, amplification, filtering, and digital logic operations.	L4

3	**Apply** the acquired knowledge to construct small scale circuits consisting of semiconductor devices.	L4
4	**Analyze** the performance of operational amplifiers (Op-amps) in various circuit configurations, including amplifiers, comparators, and oscillators, to optimize their functionality and address design requirements.	L4
5	**Demonstrate** comprehension of microprocessor and microcontroller architecture, operation, and their applications.	L2
	Identify the need for modulation and demodulation in signal transmission.	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	1	2
CO1	3	2	1								2	3	
CO2	3	3	2	1							2	3	
CO3	3	3	2	2							2	3	2
CO4	3	3	2	2							2	3	2
CO5	3	3	3	1							3	3	3

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

TEXT BOOKS:

- R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", 11th Ed, Pearson Education, 2013.
- M. Moris. Mano and Michael D. Ciletti, "Digital Electronics", 4th Ed, Pearson Education, 2006.
- Michael Tooley, "Electronic Circuits: Fundamentals and Applications" BA Elsevier Ltd., Third Edition,2006

REFERENCE BOOKS:

- David A Bell, "Electronic Devices and Circuits", 5th Ed, Oxford university press, 2008.
- Millman & Halkias, "Electronics Devices and Circuits", 2nd Ed, McGraw Hill, 2010.

E-Resources:

- NPTEL- https://nptel.ac.in/courses/122/106/122106025
- Virtual Labs- http://vlabs.iitkgp.ac.in/be/
- https://nptel.ac.in/courses/117104072

Activity Based Learning (Suggested Activities in Class):

- Real world problem solving using group discussion and hands-on activities. E.g., Interfacing different types of sensors using Arduino.
- Simulation of different electronic circuits. E.g., Rectifiers and Amplifiers.

ENGINEERING SCIENCE COURSE – II for Mechanical cluster

ENGINEERING MECHANICS

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

SEMESTER – I/II

Course Code	:	25EN1119	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–J	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Illustrate** Couples and equivalent force couple system
2. **Understand the** principles of resolution and composition of forces
3. **Calculate** moment of coplanar concurrent and coplanar non-concurrent forces
4. **Draw** free body diagrams of objects subjected to coplanar concurrent and non-concurrent force systems
5. **Calculate** center of gravity/centroid for various planar figures
6. **Determine** area moment of inertia for various planar geometrical objects and standard symmetrical sections
7. **Explain** Limiting friction and Laws of Friction
8. **Solve numerical on** wedge friction, ladder friction
9. **Explain** assumptions made in analysis of Trusses
10. **Determine** axial forces in members of Planar determinate Truss
11. **Illustrate** rectilinear, plane curvilinear and projectile motions

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I Introduction to Engineering Mechanics	**08 Hours**

INTRODUCTION:

Introduction to Engineering Mechanics, Force Systems Basic concepts, Particle Equilibrium in 2-D; System of Forces, Co-planar Concurrent Forces, Resultant- Moment of Forces and its Application; Couples and Resultant of force System, Equilibrium of System of Forces,

UNIT – II Centroid, Centre and gravity and Moment of inertia	08 Hours
Introduction, Centroid of simple figures from first principle, centroid of standar sections Centreof Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections	
UNIT – III Friction	**07 Hours**
Introduction, Free body diagrams, Equations of Equilibrium. Types of friction, Limiting friction, Cone of Friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, related problems.	
UNIT – IV Dynamics	**08 Hours**
Introduction, Rectilinear motion; Plane curvilinear motion (rectangular path, and polar coordinates); Projectile motion, Basic terms, general principles in dynamics; Types of motion, motion and simple problems, Kinetics- Newton's laws of motion and related problems.	
UNIT – V Analysis of Trusses	**08 Hours**
Introduction, Classification of trusses, Equilibrium in two and three dimension; Method of Joints; To determine if a member is in tension or compression; Simple Trusses; Zero force members.	

Course Outcomes:

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

1. **Compute** Resultant and reactions by principles and resolution of forces in a plane.
2. **Analyse** the objects under the action of applied and frictional forces in a plane by equations of equilibrium.
3. **Determine** the Moment of Inertia of composite geometrical sections in a plane
4. **Analyse** determinate two-dimensional truss by the method of joints and method of section.
5. **Analyze** the motion of objects by equations of motion, equations of equilibrium, and Newton's laws of motion and **calculate** quantities in projectile motion by equations of motion.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Compute** Resultant and reactions by principles and resolution of forces in a plane.	L2
2	**Analyse** the objects under the action of applied and frictional forces in a plane byequations of equilibrium.	L3
3	**Determine** the Moment of Inertia of composite geometrical sections in a plane	L2
4	**Analyse** determinate two-dimensional truss by the method of joints and method of section.	L3
5	**Analyze** the motion of objects by equations of motion, equations of equilibrium, and Newton's laws of motion	L3

	and **calculate** quantities in projectile motion by equations of motion.	

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**											**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	1	3	3	1	1	2	0	0	1	1	0	1	3	2
CO2	2	3	3	2	1	2	0	0	1	1	0	2	2	0
CO3	3	3	2	2	1	2	0	0	0	1	0	3	2	0
CO4	4	3	3	3	1	2	1	0	1	1	1	3	3	0
CO5	5	3	3	2	1	2	0	0	0	1	0	2	2	0

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

TEXT BOOKS:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall publications.
2. A Nelson (2009), Engineering Mechanics: Statics and dynamics, Tata McGraw Hillpublications.

REFERENCE BOOKS:

1. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics,Vol II, – Dynamics, 9th Ed, Tata McGraw Hill publications.
2. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
3. H.J. Sawant, S.P Nitsure (2018), Elements of Civil Engineering and Engineering Mechanics, Technical Publications.

E-Resources:

1. https://archive.nptel.ac.in/courses/105/105/105105108/
2. https://onlinecourses.nptel.ac.in/noc22_ce46/preview
3. https://www.youtube.com/watch?v=LIZ-PQbGZkA

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving and puzzles using group discussion.
2. Demonstration of solution to a problem through experiential learning.
   Demonstrations using real objects, taking students on an educational tour.

INTRODUCTION TO SUSTAINABLE ENGINEERING
Semester I/II

Course Code	:	25EN1120	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	26
L–T–P–S	:	2–0–0–0			

Course Learning Objectives:

This course will enable students to:

1. Introduce the foundational concepts of sustainable engineering and its role in addressing environmental and resource challenges.
2. Develop the ability to analyze energy and material flows in engineering systems and propose efficient conservation strategies.
3. Apply green design and sustainable manufacturing principles for minimizing environmental impacts across product life cycles.
4. Integrate sustainable approaches in mobility, infrastructure, and construction while balancing performance, safety, and environmental considerations.
5. Utilize digital tools, lifecycle assessment, and responsible innovation frameworks in making ethical and sustainable engineering decisions.

Teaching-Learning Process (General Instructions)

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

- ***Lecture method*** means it includes not only traditional lecture method but different *types of teaching methods* that may be adopted to develop the course outcomes.
- ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and roleplaying.
- Show ***Video/animation*** films to explain the functioning of various concepts.
- Encourage ***Collaborative*** (Group Learning) Learning in the class.
- To make ***Critical thinking***, ask at least three Higher-order Thinking questions in the class.
- Adopt ***Problem-Based Learning***, which fosters students' Analytical skills, and develops thinking skills such as evaluating, generalizing, and analysing information rather than simply recalling it.
- Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the student's understanding.
- **Practical experimentation** of different additive manufacturing methods

UNIT – I	**06 Hours**

Foundations of Sustainable Engineering

Sustainability principles in engineering systems, environmental and resource challenges. Systems thinking in design and analysis, lifecycle perspective, and circular economy concepts. Product stewardship and sustainable development goals as guiding frameworks. Understanding the role of engineers in sustainable transitions across sectors.

UNIT – II	**05Hours**

Energy and Resource Efficiency

Energy flow in thermal, fluid, and structural systems, identifying loss points.

Energy conservation strategies and efficient design practices in physical systems. Material efficiency, sustainable sourcing, and reduction of embodied energy. Case studies on optimizing system performance for minimal resource use.
UNIT – III **05 Hours**
Green Design and Manufacturing Design for environment (DfE), reuse, and ease of disassembly in product lifecycle. Sustainable manufacturing through low-emission machining and fabrication methods. Additive and subtractive processes with minimal material waste. Selection of processes and materials based on environmental performance.
UNIT – IV **05 Hours**
Sustainable Mobility and Infrastructure Light weighting and material substitution in transportation system design. Structural optimization for energy savings and enhanced durability. Sustainable material choices in public infrastructure and construction. Balancing safety, performance, and environmental considerations in design. Net carbon Zero at inbuilt environment.
UNIT – V **05 Hours**
Digital Tools and Responsible Innovation Lifecycle Assessment (LCA) using digital tools for evaluating sustainability. Design optimization and predictive analytics for efficient system operation.AI-assisted support in material selection and maintenance planning. Engineering ethics, standards, and compliance with EPR, RoHS, and SDGs.
DEMONSTRATION EXERCISE/ASSIGNMENTS
1. **Demonstration of the Principle and Operation of a Turbo Machines** 2. **Demonstration of the Principle and Operation of a CNC Machine** – Discuss role in precision and low-waste manufacturing 3. **Demonstration of the 3D Printing Process** – Understand sustainable prototyping and material recyclability 4. **Demonstration of a Heat Transfer Application Device** (e.g., heat exchanger) and preparation of a report analyzing energy losses 5. **Demonstration of an Air Conditioning System** – Measure and analyze Coefficient of Performance (COP) and environmental impact 6. **Demonstration of Mechatronic System Elements** – Explore automation and energy-saving benefits 7. **Demonstration of a Robotic System** – Understand its role in smart and sustainable manufacturing 8. **Case study** on Net Zero Energy Building (NEZB) at Dayananda Sagar University

Course Outcome	Description
At the end of the course the student will be able to:	
1	Analyze engineering systems from a sustainability perspective and evaluate lifecycle and circular economy principles for improved system design.
2	Assess energy flows and material usage in complex engineering systems to propose efficient conservation and resource optimization solutions.
3	Design products and manufacturing processes that minimize emissions, waste, and environmental impact throughout the product lifecycle.

4	Evaluate sustainable mobility and infrastructure solutions by integrating material selection, structural optimization, and durability considerations.
5	Apply digital tools, lifecycle assessments, and AI-supported methods to optimize system performance while ensuring compliance with ethical standards and sustainability regulations.

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	1	2	0	0	0	1	0	1	2	2	2
CO2	3	2	2	1	2	0	0	0	1	0	1	2	2	2
CO3	3	2	3	1	2	0	0	0	1	0	1	3	3	2
CO4	2	2	3	2	2	2	1	2	2	2	2	2	2	2
CO5	3	2	3	2	3	1	0	1	2	2	2	3	2	2

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

TEXT BOOKS :

1. David T. Allen, David R. Shonnard, *Sustainable Engineering: Concepts, Design and Case Studies*, 2nd Edition, Pearson Education, 2012.
2. Bhavik R. Bakshi, *Sustainable Engineering: Principles and Practice*, Cambridge University Press, 2019.

REFERENCES :

1. David Dornfeld (Ed.), *Green Manufacturing: Fundamentals and Applications*, Springer, 2013.
2. Michael F. Ashby, *Materials and the Environment: Eco-Informed Material Choice*, 2nd Edition, Elsevier, 2012.

BIOLOGY FOR ENGINEERS

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

SEMESTER – I/II

Subject Code	:	25EN1121	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P–S	:	2–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Acquire an understanding on basic modern biological concepts with an emphasis on how bio-processes are analogous to engineering field, as a multidisciplinary field.
2. Understand basic engineering principles imminently run physiological processes particularly about engineering designs and solutions are arrived citing body functional examples.
3. Explain aspects that many bio-solutions could be foundational to design, develop better processes, products and useful to achieve quality of life.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

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

COURSE CONTENT:

UNIT 1	**6 Hrs**
Biomimetics: Biology for Engineers, Body Fluid: Blood- Mechanics of heart, Blood pressure, Life molecules: Water, Carbohydrates, Proteins, Lipids and Nucleic acids, Biomimetics: Bio-processes - engineering analogies **For CIA only**	
UNIT 2	**5 Hrs**
Bioenergy: Unit of life: Human and Plant cell, Metabolism: Enzymes as Bio-catalysts and physiological entities, Anabolism- Bioenergy from Sun-Photosynthesis, catabolism **For CIA only**	

UNIT 3	5 Hrs
Biomechanics -Human Body Movement Mechanics: Normal Human Movement: Force-Vector of Body; Movement Angles; Muscle contraction -Relaxation; Posture – Static & Dynamic; Ideal and abnormal posture, Practical: Stepping-Lifting-Sit-Stand. **For CIA only**	
UNIT 4	**5 Hrs**
Bioelectronics: Brain & Computer: Senso-neural networks, Biosensors and IoT as applied to biology, Bionic Eye: Mechanism of Vision, Electronic Nose: Bio-olfactory mechanisms (Science of smell), Impulses: Cardiac and Nerve, Biological Clock and Circadian rhythm **For CIA only**	
UNIT 5	**5 Hrs**
Biopharma: Metabolic syndromes, Cancer and its diagnostics, Lab on a chip, Drug development and Discovery **For CIA only**	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply and Utilize** essential knowledge of the biological mechanisms of living organisms from the perspective of engineers and find solutions to solve bio-engineering problems with appropriate tools.	L3
2	**Distinguish and make use of** optimal designs in engineering that are bio-mechanical in nature and build and use by observing and understanding bio-physiological processes involved in sensing, locomotion, and knowledge application of range of bio-chemicals.	L3
3	**Demonstrate** that bio-chemical, bio-sensory, bio-processes could be path-finders to optimise similarities for functional aspects of electronic, computer, mechanical, electrical machines.	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	1	2	3
CO1	2	1	0	0	0	2	0	0	2	0	0	3	0	2
CO2	2	1	0	0	0	2	0	0	2	0	0	3	0	2
CO3	2	1	0	0	0	2	0	0	2	0	0	3	0	2
CO4	2	1	0	0	0	2	0	0	2	0	0	3	0	2
CO5	3	1	0	0	0	2	0	0	2	0	0	3	0	2

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

Activity Based Learning (Suggested Activities in Class)

6. Real world problem solving and puzzles using group discussion.
7. Demonstration of solution to a problem through experiential learning.
8. Demonstrations using real objects, taking students on an educational tour.

TEXT BOOKs:

1. "Biology for Engineers" by Arthur T. Johnson: published by CRC Press in 2010.
2. *Biology for Engineers*. Author *Dr. M. Srinivasan & Dr. Santosh Kumar*;Khanna Publishers. ISBN: 978-93-92549-01-4

REFERENCE BOOKS:

1. Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson. "Biology: A global approach", , Global Edition, 10/E, 2014
2. David Nelson, Michael Cox. "Lehninger Principles of Biochemistry". W H Freeman & Company, Seventh Edition, 2017.
3. Janine M Benvus. "Biomimicry: Innovation inspired by Nature". William Morrow Paperbacks, 2002.
4. Lecture Notes, PPT slides by course instructor.

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS
[As per Choice Based Credit System (CBCS) scheme]
SEMESTER – I/II

Course Code : 25EN1122	**Credits: 01**
Hours / Week : 01 Hours	**Hours : 13 Hours**
L-T-P-J : 1-0-0-0	

Course Learning Objectives:

This Course will enable students to **:**

1. Acquaint the students with legacies of constitutional development in India and help those to understand the most diversified legal document of India and philosophy behind it.
2. Make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. Channelize students thinking towards basic understanding of the legal concepts and its implications for engineers.
4. Acquaint students with latest legislation and Laws with related regulatory framework.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods like power point presentations and group discussion may be adopted to develop the course outcomes.
2. **Interactive Teaching:** Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show **Video/animation** films to explain 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 students' understanding.

COURSE CONTENT

UNIT 1 : Introduction and Basic Information about Indian Constitution	**2 Hrs**

- Meaning of the constitution and constitutionalism;
- Historical background of the constituent assembly;
- Indian constitution and its salient features;
- The sources of Indian constitution; &
- The Preamble of constitution.

UNIT 2 : Fundamental rights & duties and D.P.S.P	3 Hrs
▪ Importance and features of fundamental rights; ▪ Types of fundamental rights; ▪ Directive principles of state policy; & ▪ Fundamental duties.	
UNIT 3 : Judiciary	**3 Hrs**
▪ The independence of the judiciary; ▪ Appointment of judges; ▪ Judicial review and judicial activism; & ▪ Public interest litigation.	
UNIT 4 : Amendment and emergency	**3 Hrs**
▪ Amendment of the constitutional power and procedure; ▪ The historical perspective of the constitutional amendments in India; ▪ Emergency provisions; ▪ National emergency; ▪ State emergency; & ▪ Financial emergency.	
UNIT 5 : Intellectual property rights	**2 Hrs**
▪ Overview of the Concept of Intellectual Property; ▪ Importance of Human Creativity in Presence Scenario; ▪ Patents; ▪ Trademark; & ▪ Copyrights.	

Course Outcome	Description
At the end of the course the student will be able to:	
1	Identify and explore the basic features and modalities about Indian constitution.
2	Differentiate and relate the functioning of Indian parliamentary system at the Centre and State level.
3	Differentiate different aspects of Indian Legal System and its related bodies.
4	Discover and apply different laws and regulations related to engineering practices.
5	Correlate role of engineers with different organizations and governance models

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11		1	2	3

CO1	1	0	0	0	0	0	0	0	0	0	0		0	0	0
CO2	1	0	0	0	0	0	0	0	0	0	0		0	0	0
CO3	1	0	0	0	0	0	0	0	0	0	0		0	0	0
CO4	1	0	0	0	0	0	0	0	0	0	0		0	0	0
CO5	1	0	0	0	0	0	0	0	0	0	0		0	0	0

TEXT BOOKS:

1. Introduction to the Constitution of India by D.D.Basu, 25th edition published by LexisNexis
2. Indian Constitutional law by M.P.J.AIN, 8th edition published by LexisNexis
3. The Indian Constitution: Cornerstone of a nation by Granville Austin, 2nd edition by Oxford University Press.

REFERENCE BOOKS:

1. V.N.Shukla's Constitution of India by Mahendra Pal Singh, 13nth edition published by Eastern Book Company.
2. Intellectual property rights law in India 3rd edition by T.Ramappa published by Asia law house.
3. Managing Intellectual property by, 3rd edition Vinod.V.Sople published by PHI learning.

E-RESOURCES:

- https://www.constitutionofindia.net/read/
- https://www.constitutionofindia.net/debate_paragraphs/
- https://dst.gov.in/sites/default/files/E-BOOK%20IPR.pdf
- https://ipindia.gov.in/resources.htm

Semester 2

SINGLE AND MULTIVARIATE CALCULUS (SMC)

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

SEMESTER – II

Subject Code	: 25EN1201	**Credits**	: 04
Hours / Week	: 03 Hours	**Total Hours**	: 52 Hours
L–T–P–J	: 3–0–0-0		

Course Learning Objectives:

This Course will enable students to:

1. **Apply** sophisticated techniques of differential calculus to solve problems involving functions of multiple variables.
2. **Apply** double and triple integrals in various coordinate systems (Cartesian, polar, cylindrical, and spherical) and effectively employ them to calculate areas, volumes.
3. **Acquire** a comprehensive understanding of fundamental concepts related to functions of multiple variables, including limits, continuity, and partial derivatives.
4. **Analyze** critical points of functions of two or more variables using partial derivatives and Lagrange multipliers, evaluate extreme values.
5. **Apply** vector calculus principles, such as line integrals, surface integrals, and the divergence theorem effectively to vector field.
6. **Analyze** the convergence and divergence of sequences and infinite series of real numbers by employing various convergence criteria and tests.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

- **Lecture method** means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
- **Interactive Teaching:** Adopt the **Active learning** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
- Show **Video/animation** films to explain functioning of various concepts.
- Encourage **Collaborative** (Group Learning) Learning in the class.
- To make **Critical thinking**, ask at least three Higher order Thinking questions in the class.
- Adopt **Problem Based Learning**, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every **concept can be applied to the real world** - and when that's possible, it helps improve the students' understanding.

UNIT – I	12 Hours
Differential Calculus Functions of two or more variables: Definition, Region in a plane, Level curves, Level surfaces, Limits, Continuity, Partial derivatives, Differentiability, Extreme values and saddle points, Lagrange multipliers. **Self-Learning Component:** Single variable calculus	
UNIT – II	**12 Hours**
Integral calculus	
Double integral and iterated integrals - Cartesian and polar coordinates, Triple integral, Change of variables, Multiple integrals in cylindrical and spherical coordinates.	
UNIT – III	**12 Hours**
Vector Calculus Line Integrals, Vector Fields, Work, Circulation and flux, Path independence, Potential functions, and Conservative fields, Green's theorem in the plane, Surface area and surface integrals, Surface area of solid of revolution, Parametrized surfaces, Stokes' theorem, The Divergence theorem.	
UNIT – IV	**O8 Hours**
Sequence and Series I: Sequences of real numbers and their convergence criteria, Infinite series, Sequence of partial sums, Tests for convergence/divergence - nth term test, Boundedness and monotonicity, Integral, Condensation, Comparison, Ratio and root tests.	
UNIT – V	**08 Hours**
Sequence And Series II: Alternating series, Absolute and conditional convergence, Rearrangement theorem, Power series, Taylor and Maclaurin series (one and two variables).	

Course Outcome	Description
At the end of the course the student will be able to:	
1	Apply the principles of differential calculus to solve problems involving functions of two or more variables.
2	Utilize double and triple integrals in Cartesian, polar, cylindrical, and spherical coordinates to compute areas, volumes, and evaluate mathematical expressions.
3	Extend a comprehensive understanding of the concepts related to functions of multiple variables and evaluate critical points, including extreme values and saddle points using partial derivatives and Lagrange multipliers.
4	Analyze vector calculus concepts, such as line integrals, surface integrals, and the

	divergence theorem, in the context of vector fields and their applications.
5	Apply convergence criteria and various tests, such as the nth term test, boundedness and monotonicity, integral, condensation, comparison, ratio, and root tests, to analyze and determine the convergence or divergence of sequences and infinite series of real numbers.

Table: Mapping Levels of COs to POs / PSOs

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	0	2	0	0	0	0	0	0			
CO2	3	2	1	0	2	0	0	0	0	0	0			
CO3	3	2	1	0	2	0	0	0	0	0	0			
CO4	3	2	1	0	2	0	0	0	0	0	0			
CO5	3	2	1	0	2	0	0	0	0	0	0			

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

TEXT BOOKS:

[1] Thomas' Calculus, George B. Thomas, D. Weir and J. Hass, 2014, 13th edition, Pearson.
[2] Advanced Engineering Mathematics, Erwin Kreyszig , 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.
[5] Basic Multi Variable Calculus, Marsden, Tromba and Weinstein, W.H. Freeman, 1993 Third Edition.

E-Resources:

1. https://www.youtube.com/playlist?list=PLtKWBwrvn4nA2h8TFxzWL2zy8O9th_fy
2. https://www.youtube.com/playlist?list=PLU6SqdYcYsfJqbZvQECrwnlQrp4f g6isX

Activity Based Learning (Suggested Activities in Class)

1. Activity which makes students to apply the concepts learned in the course to apply in real life engineering problems will be discussed in class.
2. Real world problem solving and puzzles using group discussion.
   Demonstration of solution to a problem through programming.

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

COMPUTER SCIENCE & ENGINEERING
(Artificial Intelligence and Data Science)

(3rd to 4th Semester)

With effect from 2025

B.Tech. PROGRAMME– 2025-29 BATCH

B Tech CoOrdinator

ChairPerson

Chairperson
Department of CSE (AI & Data Science)
School of Engineering
Dayananda Sagar University
Devarakaggalahalli, Harohalli, Kanakapura Road,
Bengaluru South Dt.-562 112, Karnataka, India

SCHOOL OF ENGINEERING

(A State Private University under the Karnataka Act No. 20 of 2013)
Approved by UGC & AICTE, New Delhi, Accredited by NAAC with A+ grade

Department of Computer Science and Engineering (Artificial Intelligence &Data Science)

III-SEMESTER											
S. N0	Course Type	Course Code	Course Title	Teaching Hours / Week				Examination			Credits
				Lecture	Tutorial	Practical	Project	CIE Marks	SEE Marks	Total Marks	
				L	T	P	J				
1	BSC	25AD2301	APPLIED STATISTICS & STOCHASTIC PROCESSES	3	0	0	0	60	40	100	**3**
2	IPCC	25AD2302	DIGITAL LOGIC DESIGN & COMPUTER ARCHITECTURE	3	0	2	0	60	40	100	**4**
3	IPCC	25AD2303	DATABASE MANAGEMENT SYSTEMS	3	0	2	0	60	40	100	**4**
4	PCC	25AD2304	IOT SENSORS AND ITS APPLICATIONS	3	0	0	0	60	40	100	**3**
5	IPCC	25AD2305	DATA STRUCTURES & ALGORITHMS	3	0	2	0	60	40	100	**4**
6	PCC	25AD2306	FOUNDATIONS OF AI & AUTHENTIC INTELLIGENCE	3	0	0	0	60	40	100	**3**
7	SEC	25AD23XX	SKILL ENHANCEMENT COURSE – I	1	0	2	0	100	-	100	**2**
8	TPC	25AD2307	COGNITIVE AND TECHNICAL SKILLS-III	-	-	-	-	-	-	-	**0**
TOTAL				**19**	**0**	**8**	**0**	**460**	**240**	**700**	**23**

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Skill Enhancement Course I	
Course Code	**Course Name**
25AD2308	MATLAB FOR DATA SCIENCE
25AD2309	LINUX PROGRAMMING AND SCRIPTING
25AD2310	BI USING TABLEAU / POWER BI
25AD2311	FULL STACK DEVELOPMENT
25AD2312	MOOC - NPTEL - ARTIFICIAL INTELLIGENCE FOR ECONOMICS

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IV-SEMESTER											
S. No	Course Type	Course Code	Course Title	Teaching Hours / Week				Examination			Credits
				Lecture	Tutorial	Practical	Project	CIE Marks	SEE Marks	Total Marks	
				L	T	P	J				
1	BSC	25AD2401	DIFFERENTIAL EQUATIONS & OPTIMIZATION	3	0	0	0	60	40	100	**3**
2	IPCC	25AD2402	DATA MINING & PREDICTIVE MODELLING	3	0	2	0	60	40	100	**4**
3	PCC	25AD2403	OPERATING SYSTEMS	3	0	0	0	60	40	100	**3**
4	PCC	25AD2404	DESIGN STUDIO I: AI- ENABLED SYSTEMS	1	0	0	2	60	40	100	**2**
5	IPCC	25AD2405	MACHINE LEARNING	3	0	2	0	60	40	100	**4**
6	PCC	25AD2406	INTRODUCTION TO DATA SCIENCE	2	0	0	0	60	40	100	**2**
7	HASC	25LSXXXX	LIBERAL STUDIES	2	0	0	0	100	--	100	**2**
8	SEC	25AD24XX	SKILL ENHANCEMENT COURSE - II	1	0	2	0	100	--	100	**2**
9	TPC	25AD2407	COGNITIVE AND TECHNICAL SKILLS- IV	-	-	-	-	-	-	-	**0**
TOTAL				**18**	**0**	**6**	**2**	**560**	**240**	**800**	**22**

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Skill Enhancement Course II	
Course Code	**Course Name**
25AD2408	R PROGRAMMING
25AD2409	DJANGO FRAMEWORK
25AD2410	PROGRAMMING IN JAVA
25AD2411	WEB TECHNOLOGIES
*CID	MOOC

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APPLIED STATISTICS & STOCHASTIC PROCESSES

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

SEMESTER - III

Course Code	: 25AD2301	**Credits:**	03
Hours / Week	: 03	**Total Hours:**	45
L–T–P–J	: 3–0–0–0	**CIE+SEE:**	60+40 Marks

Course Vision:

To develop strong foundations in probability, statistical inference, and stochastic process, enabling students to analyze uncertainty, make data-driven decisions, and explore advanced computational models including AI systems.

Course Objectives: This course will enable students to:

1. **Understand** the concepts of random variables and probability distributions for modelling uncertainty.
2. **Analyze** relationships between variables using correlation and regression techniques.
3. **Apply** statistical inference methods for decision-making under uncertainty.
4. **Use** parametric and non-parametric tests for hypothesis testing and data analysis.
5. **Discuss** the fundamentals of stochastic processes and their applications in modeling random systems, decision-making, and AI-driven applications.

Teaching-Learning Process (General Instructions)

Following are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes:

1. Lecture Method**:** Concepts, algorithms, and models are explained through structured lectures supported by R Programming demonstrations.
2. Interactive Teaching**:** Active learning is promoted through discussions, brainstorming, and group problem-solving activities.
3. Demonstration using R Programming and Python**:** AI techniques like classification and optimization are demonstrated to visualize results and understand implementation.
4. Multimedia Learning: Videos and simulations are used to explain complex concepts and real-world applications.
5. Collaborative Learning: Students work in groups to implement projects and analyze datasets using computational tools.
6. Higher Order Thinking Questions: Analytical questions are used to develop model design, evaluation, and decision-making skills.
7. Problem-Based Learning: Real-world problems are given to apply techniques using Python for practical solutions.

MODULE – I	**09 Hours**

Random Variables and Probability Distributions

Topics: Introduction to random variables, probability mass function (PMF), probability density function (PDF), distribution functions, joint probability distribution and joint density functions,

marginal and conditional distributions, mathematical expectation and its properties, covariance, moment generating function, characteristic function. **Applications:** Risk analysis and financial modelling, Reliability engineering, Data analysis and forecasting, Signal processing	
MODULE – II	**09 Hours**
Inference for Decision Making – I **Topics:** Introduction to hypothesis, hypothesis testing procedure, p-values and decision making, test of hypothesis for proportion (single and difference of proportions), testing hypothesis about mean (Z-test and t-test), two-sample tests, test for equality of variance (F-test), ANOVA (one-way analysis of variance). **Applications:** Quality assurance and control, Clinical trials and testing, Business decision-making, Industrial process evaluation	
MODULE – III	**09 Hours**
Inference for Decision Making – II **Topics:** Introduction to non-parametric tests, Chi-Square test for goodness of fit, Chi-Square test using probability distributions, Chi-Square test for independence of attributes, Run and rank test. **Applications:** Survey data analysis, Market research, Pattern recognition, Categorical data analysis.	
MODULE – IV	**09 Hours**
Bi-variate Data, Correlation and Regression Analysis **Topics:** Bi-variate random variables, correlation, types of correlation, measures of correlation, graphical methods (scatter diagram), Karl Pearson's correlation, rank correlation (for repeated and non-repeated ranks), linear regression model, regression lines, least squares method, fitted model. **Applications:** Market trend analysis, Economic forecasting, Quality control and process analysis, Data relationship analysis	
MODULE – V	**09 Hours**
Stochastic Processes **Topics:**Poisson Process, Introduction to Stochastic Processes (SPs), Markov chains, Discrete-time Markov Chains (DTMCs), Continuous-time Markov Chains (CTMCs), Monte-Carlo Simulation. **Applications:** Queueing systems and waiting line models, Reliability and maintenance systems, Population growth and epidemic modelling, Financial market analysis	

Course Outcomes (COs)	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Understand probability concepts and random variables to quantify uncertainty.	L3
2	Perform hypothesis testing and statistical inference for decision making.	L4
3	Apply non-parametric tests for categorical data analysis.	L4

4	Analyze data using correlation and regression techniques.	L3
5	Model and analyze stochastic processes such as Markov chains.	L5

Mapping Levels of COs to POs / PSOs

Table: Mapping Levels of Cos to Pos / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1									2	1	1
CO2	2	2	3	2	3				1			3	2	2
CO3	2	3	3	2	2				1			3	2	2
CO4	3	3	2	3	2							3	2	3
CO5	2	2	3	2	3				2	1		3	3	3

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

TEXT BOOKS:

1. Gupta, S. C., and V. K. Kapoor. Fundamentals of Applied Statistics. S. Chand, 2006.
2. Miller, Irwin, Marylees Miller, and John E. Freund. Miller and Freund's Probability and Statistics for Engineers. 8th ed., Pearson, 2018.
3. Mendenhall, William, Robert J. Beaver, and Barbara M. Beaver. Introduction to Probability and Statistics. Cengage Learning, 2020.
4. Ross, Sheldon M. Stochastic Processes. 2nd ed., John Wiley & Sons, 1995.
5. Operations Research: An Introduction Taha, Hamdy A. Operations Research: An Introduction. 10th ed., Pearson Education, 2017.

REFERENCE BOOKS:

1. R.E. Walpole, R.H. Mayers, S.L. Mayers and K.Ye, Probability and Statistics for engineers and scientists, 9th Edition, Pearson Education, 2018.
2. Douglas A. Wolfe, Grant Schneider, Intuitive Introductory Statistics, Springer, 2017.
3. Miller & Freund's, Probability and statistics for engineers, 8th edition, Pearson publication, 2018.
4. Richard I. Levin, David S. Rubin, Masood H. Siddiqui, Sanjay Rastogi, Statistics for Management, 8th Edition, Pearson Publications, 2018.

5. Mark L. Berenson, David M. Levine, Kathryn A. Szabat, Basic Business Statistics Concept and Application, Thirteenth Edition, Pearson Education Limited, 2015.
6. Bruce L. Bowerman, Richard T. O'Connell, Emily S. Murphree, Business Statistics in Practice, Seventh Edition, McGraw-Hill, 2014.
7. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Sixth Edition, John Wiley and Sons, 2014.
8. Norean R. Sharpe, Richard D. De Veaux, Paul F. Velleman, Business Statistics, Fourth Edition, Pearson Education. 2019.

E-RESOURCES:

RECOMMENDED TOOLS

- Python
- R Programming

LAB EXERCISES

S. No	Exercise Title	Aim / Objective	Tools	Hrs	CO
MODULE I: Exercises 1–3: Random Variables and Probability Distributions (03 Hours)					
1	Random Variable Visualization	Generate and visualize discrete and continuous random variables	R Programming	1 h	CO1
2	PMF, PDF & CDF	Compute PMF, PDF, and CDF for standard distributions	R Programming	1 h	CO1
3	Joint Distributions	Simulate joint probability distributions	R Programming	1 h	CO1
MODULE II: Exercises 4–6: Bi-variate Data, Correlation and Regression Analysis (03 Hours)					
4	Bivariate Data Visualization	Visualize bivariate data using scatter plots	R Programming	1 h	CO2
5	Correlation Analysis	Compute Karl Pearson's and Spearman's rank correlation	R Programming	1 h	CO2

S. No	Exercise Title	Aim / Objective	Tools	Hrs	CO
6	Linear Regression	Fit and evaluate regression model	R Programming	1 h	CO2
MODULE III: Exercises 7–9: Inference for Decision Making – I (03 Hours)					
7	Z-Test & t-Test	Perform Z-test and t-test (single & two-sample)	R Programming	1 h	CO3
8	Proportion Testing	Test for proportion and difference of proportions	R Programming	1 h	CO3
9	F-Test & ANOVA	Perform F-test and one-way ANOVA	R Programming	1 h	CO3
MODULE IV: Exercises 10–12: Inference for Decision Making – II (03 Hours)					
10	Chi-Square Tests	Perform goodness of fit and independence tests	R Programming	1 h	CO4
11	Bayesian Inference	Implement basic Bayesian inference techniques	R Programming	1 h	CO4
12	Data Visualization	Visualize probability distributions and statistical results	R Programming	1 h	CO4
MODULE V: Exercises 13–15: Stochastic Processes (03 Hours)					
13	Monte Carlo Simulation	Perform Monte Carlo simulations for probabilistic models	R Programming	1 h	CO5
14	Markov Chains	Construct transition matrices and simulate state transitions	R Programming	1 h	CO5

S. No	Exercise Title	Aim / Objective	Tools	Hrs	CO
15	Exponential Distribution	Study exponential distribution and waiting time analysis	R Programming	1 h	CO5

DIGITAL LOGIC DESIGN & COMPUTER ARCHITECTURE

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

SEMESTER – III

Course Code	: 25AD2302	**Credits**	: 04
Hours/Week	: 05 Hours	**Total Hours**	: 45(Th) + 15 (L)
L–T–P-J	: 3–0–2-0		

Prerequisites: Basic Mathematics, Programming Fundamentals.

Course Learning Objectives: This Course will enable students to:

1.Understand the elements of digital logic functions to digital system abstractions sing Verilog.

2. Illustrate the simplification of Boolean expressions using Karnaugh.

3. Use combinational logic circuits for arithmetic operations and logical operations.

4. Interpret and model sequential elements, flip-flops, counters, and shift registers

5. Understand the concepts of processor architecture and instruction set architecture.

6. Understand the implementation of a multi-cycle processor architecture along with optimizations applicable to cache memory.

Teaching-Learning Process (General Instructions)

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

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/Animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE – I INTRODUCTION	**08 Hours**

Number System- Binary, Hexa, Decimal, Octal and its conversion, Addition and subtraction using 1's and 2's complement, Canonical Notation - SOP & POS forms, Minimization of SOP and POS forms. ARITHMETIC CIRCUITS AND VERILOG MODELLING Adders: Half adder, full adder, Ripple carry adder, parallel adder /subtractor, fast adders-CLA, comparator- 2 bit. Simplification using K-Maps. Introduction to GPU Programming model, CPU vs GPU algorithm, GPU architecture, Basics of CUDA program.	
MODULE – II Combinational Circuit Building	**09 Hours**
Combinational Circuit Building: Multiplexers 4:1, 8:1, decoders 3:8, 2:4, demultiplexers 1:4, encoders 8:3, 4:2, code converters- B to G and G to B- Simplification using K-Maps. Verilog for combinational circuits: Behavioural modelling- if else, case-casex, casez, structural modelling.	
MODULE – III Sequential circuits-2	**12 Hours**
Basic Latch, Gated latches, Flip Flops SR, D, JK, T, Race round condition, master-slave flip-flops JK, 0's and 1's Catching Problem, Conversion of flip-flops SR-JK, JK-T, shift registers- SISO, SIPO, PISO, PIPO, Universal Shift Register, Setup time, Hold time, Propagation delay. Binary counters–asynchronous and synchronous, mod-n counter, Verilog blocking and non-blocking. Introduction to Electronic Design Automation: FPGA Design Flow, ASIC Design flow.	
MODULE – IV INTRODCUTION TO COMPUTER ARCHITECTURE	**08 Hours**
Defining Computer architecture, Trends in Technology, Power, and energy in Integrated Circuits. Measuring, Reporting, and Summarizing Performance. Quantitative Principles of Computer Design. Classifying Instruction Set Architectures. Memory Addressing. Type and Size of Operands. Operations in the Instruction. Instructions for Control Flow.	
MODULE – V PIPELINING AND MEMORY HIERARCHY	**08 Hours**
Introduction. The Major Hurdle of Pipelining—Pipeline Hazards. How Is Pipelining Implemented? What Makes Pipelining Hard to Implement? Introduction to memory hierarchy. Cache Performance. Six Basic Cache Optimizations. Virtual Memory. Protection and Examples of Virtual Memory.	

COURSE OUTCOME:

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

CO	Outcome	Blooms Taxonomy Level
CO1	Interpretation of Boolean Expressions of digital design in simplified form.	L2
CO2	Build the various elements of digital logic system with Verilog.	L3
CO3	Construct Combinational and Sequential logic circuits and analyse the hardware model of a digital system at different levels of abstraction in Verilog	L6
CO4	Understand the basic principles of the quantitative design of computers and Instruction set architecture.	L2
CO5	Analyse the implementation of pipelined processors and cache optimization	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	1	2	3
CO1	3	2	1									2	1	1
CO2	2	2	3	2	3				1			3	2	2
CO3	2	3	3	2	2				1			3	2	2
CO4	3	3	2	3	2							3	2	3
CO5	2	2	3	2	3				2	1		3	3	3

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

Laboratory Component

Part A: Implementation using CUDA NVCC Compiler.

1	Introduction to the CUDA C, a simple CUDA C program to implement basic gates.
2	Design and realize Half and Full Adder using CUDA C.
3	Design and implement the following Combinational designs – I, a. Multiplexer: 4:1, 8:1 MUX. b. De Multiplexer: 1:4, 1:8 DEMUX using CUDA C program for parallel processing.
4	Design and implement the following Combinational designs – II, c. Encoder with and without Priority: 8:3 and 4:2. d. Decoder: 3:8 and 2:4 using CUDA C program for parallel processing.

Part B: Implementation using Xilinx

1	Introduction to Verilog, Syntax of Verilog coding, Modelling styles in Verilog, Verilog Operators, Test bench for simulation.
2	Design and realize Half and Full Adder.
3	Design and implement the following Combinational designs – I, a. Multiplexer: 4:1, 8:1 MUX. b. De Multiplexer: 1:4, 1:8 DEMUX
4	Design and implement the following Combinational designs – II, c. Encoder with and without Priority: 8:3 and 4:2. d. Decoder: 3:8 and 2:4
5	Design a 4 bit ALU.
6	Implement D, T and JK Flip Flop.
7	Design of Mod – n Up/Down Counter with Synchronous reset.
8	Design of Mod – n Up/Down Counter with Asynchronous.

TEXT BOOKS:

1. M. Morris Mano Michael D. Ciletti , "Digital Design with an Introduction to the Verilog HDL", 6th Edition, Pearson Education, 2014.
2. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog design", McGraw Hill, 2014.
3. Douglas J Smith, "HDL Chip Design", Doone publications 1996.
4. John L. Hennessy and David A. Patterson. Computer Architecture A Quantitative Approach. Sixth edition, Morgan Kauffmann publisher.

REFERENCE BOOKS:

1. Nazein M. Botros, "HDL programming (VHDL and Verilog)", Dreamtech Press, 2006.
2. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2014.
3. Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2015.
4. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, 2016.

E-Resources:

1. NPTEL Digital Circuits
2. NPTEL Computer Organization
3. Coursera – Digital Systems
4. Udemy – Digital Electronics

****

DATABASE MANAGEMENT SYSTEMS

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

SEMESTER – III

Course Code: 25AD2303	**Credits**: 04
Hours /Week: 05 Hours	**Total Hours**: 45 (Th)+ 15(L)
L–T–P–J: 3-0-2-0	

Course Learning Objectives: This Course will enable students to:

1. **Acquire** the concept of databases and the Relational Model, Entity-Relationship Model, and design databases for real-world scenarios.
2. **Develop** queries to extract and manipulate data from databases using Structured Query Language (SQL).
3. **Draw and interpret** ER Diagrams including entity sets, relationship sets, complex attributes, mapping cardinalities, and weak entities; optimize database design using Normalization concepts.
4. **Understand** the importance of Transaction Management, Concurrency Control mechanisms, and Recovery Techniques.
5. **To equip students with the technical skills to build** scalable data infrastructures by mastering the transition from traditional SQL feature engineering to modern AI-driven workflows, including vector search and natural language-to-SQL integration.

Teaching-Learning Process (General Instructions) These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Module 1: RELATIONAL DATABASES & ER DIAGRAMS	**09 Hours**

Purpose of Database System – Views of Data – Data Models – Database System Architecture – Database

System Applications – Introduction to Relational Databases – Structure of Relational Databases – Database Schema – Keys – Schema Diagrams – Entity-Relationship Model – E-R Diagrams – Types of Attributes (Simple, Composite, Multivalued, Derived) – Entity Sets and Relationship Sets – Mapping Cardinalities (One-to-One, One-to-Many, Many-to-Many) – Participation Constraints – Weak Entity Sets– Extended ER Features – ER-to-Relational Schema Mapping – Features of Good Relational Designs.

Engineering Applications: Enterprise data management, healthcare record systems, banking and financial databases.

Text Book 1: Chapter 1, 2,6

Module 2: RELATIONAL QUERY LANGUAGE	**09 Hours**

Overview of the SQL Query Language – SQL Data Definition – Basic Structure of SQL Queries – Additional Basic Operations – Aggregate Functions – Nested Subqueries – Join Expressions – Views – Transactions – SQL Data Types and Schemas – Authorization – Accessing SQL from a Programming Language – Functions and Procedures – Triggers.

Engineering Applications: Data extraction in business intelligence, dynamic report generation, web application backends.

Text Book 1: Chapter 3, 4, 5

Module 3: DATABASE DESIGN & NOSQL	**09 Hours**

Part A-Normalization: Decomposition Using Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms – Dependency Preservation – Boyce-Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

Part- B-NoSQL & MongoDB: Introduction to NoSQL & MongoDB Architecture – NoSQL vs. RDBMS, CAP Theorem, ACID vs. BASE – MongoDB Data Model: Databases, Collections, Documents – Core CRUD Operations: insertOne, insertMany, find with Projections, Comparison/Logical Operators, updateOne, updateMany, deleteOne, deleteMany – Aggregation Pipeline Basics.

Engineering Applications: Hospital management systems, e-commerce databases, academic information systems.

Text Book 1: Chapter 7 (Normalization); Text Book 3: Chapters 1, 2, 3, 4 (MongoDB & NoSQL)

Module 4: Transaction Management	**09 Hours**

Transaction Concepts – ACID Properties – A Simple Transaction Model – Transaction Atomicity and Durability – Transaction Isolation – Schedules – Serializability – Transactions as SQL Statements – Concurrency Control – Lock Based Protocols – Deadlock Handling – Recovery System – Failure Classification – Recovery Algorithm – Buffer Management – ARIES.

Engineering Applications: Banking systems, airline reservation, stock trading platforms requiring ACID guarantees.

Text Book 1: Chapter 17, 18, 19

Module 5: SQL Meets AI – Integrating to Future	**09 Hours**

Preparing Data for Machine Learning – Data Cleaning & Normalization – Feature Engineering with SQL– Vector Search & Embeddings – Scalable Pipelines – AI-Assisted SQL & Intelligent Querying – Natural Language to SQL Translation.

Engineering Applications: AI-powered recommendation engines, semantic search systems, large-scale ML data pipelines.

Text Book 2: Chapter 24

Course Outcome	Description At the end of the Course the Students will be able to	Bloom's Taxonomy Level
1	Understand the basic concepts of database management system and Relational Model and Create E-R diagrams and design relational schema.	L2
2	Utilize SQL concepts to build and manipulate relational databases for a given schema.	L3
3	Design document-based database by applying NoSQL principles and apply normalization techniques in designing the relational database.	L3
4	Understand the Transaction Management, concurrency control and recovery management techniques.	L2
5	Design a scalable data pipeline that leverage SQL feature engineering and vector embeddings to build AI-driven systems capable of natural language querying.	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	1	2	3
CO1	3	2	1									2	1	1
CO2	2	2	3	2	3				1		1	3	2	2
CO3	2	3	3	2	2				1			3	2	2
CO4	3	3	2	3	2						1	3	2	2
CO5	2	2	3	2	3				2	1		3	3	2

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

Textbooks:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan – Database System Concepts, Seventh Edition, McGraw-Hill, 2020.
2. Daiki Moriyama - SQL for the AI Era: The Complete Handbook for Intelligent Data Systems, Machine Learning Readiness, and Real-World Automation, Richa Publishing Minds, 2025.

3. Shannon Bradshaw, Eoin Brazil, and Kristina Chodorow, MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media.

Reference Books:

1. Ramez Elmasri, Shamkant B. Navathe – Fundamentals of Database Systems, Seventh Edition, Pearson Education, 2017.
2. Raghu Ramakrishnan and Johannes Gehrke – Database Management Systems, Third Edition, McGraw-Hill, 2003.
3. C.J. Date, A. Kannan, S. Swamynatham – An Introduction to Database Systems, Eighth Edition, Pearson Education, 2012.

E Resources:

1. IBM Documentation – What is a Database Management System (DBMS)? https://www.ibm.com/docs/en/zos-basic-skills?topic=zos-what-is-database-management-system
2. Oracle – What Is a Database? https://www.oracle.com/in/database/what-is-database/
3. SWAYAM Course – Database Management Systems (CEC Course Preview) https://onlinecourses.swayam2.ac.in/cec19_cs05/preview
4. NPTEL Course – Database Management Systems (Online Certification Course) https://onlinecourses.nptel.ac.in/noc19_cs46/preview
5. arXiv Research Paper – A Study on Database Management Systems (DBMS) https://arxiv.org/pdf/2203.07376
6. Pinecone Docs – Vector Database: Overview and Getting Started Guide https://docs.pinecone.io/guides/get-started/overview

Laboratory Experiments:

1. Database Table Creation and Manipulation – Consider the schema for UNIVERSITY Database: STUDENT(USN, SName, Address, Phone, Gender), SEMSEC(SSID, Sem, Sec), CLASS(USN, SSID).
2. Consider the schema for UNIVERSITY Database: STUDENT(USN, SName, Address, Phone, Gender), SEMSEC(SSID, Sem, Sec), CLASS(USN, SSID), SUBJECT(Subcode, Title, Sem, Credits), IAMARKS(USN, Subcode, SSID, Test1, Test2, Test3, FinalIA).
3. Write SQL queries to:
   1. Identify 5 Fast learners considering performance of both Test 1 & Test2 combined, Modify the query to retrieve 5 slow learners.
   2. Calculate the FinalIA (average of best of two test marks) and update the corresponding table for all students.
   3. Categorize students based on the following criterion If finalia=17 to 20 then cat='Outstanding' If finalia=12 to 16 then cat='Average' If finalia<12 then cat='weak' Give these details only for 8th semester A,B, and C section students.
4. Write SQL queries to:
   1. Count the number of students whose final IA marks is above SUBJECT average FOR DBMS.
   2. Find the total count of Credits for the given student 'ava lewis'.
   3. Classify all FEMALE and MALE students who have opted for 'Digital Logi; using UNION..

5. Write SQL queries to:
   1. Retrieve Students and Their Semester Details using NATURAL JOIN.
   2. Retrieve Student Marks with Subject Details using Equijoin.
   3. Retrieve All Students and Their Marks (Including Students Without Marks) using Left outer Join.
   4. Retrieve All Subjects and Their Students (Including Subjects Without Students) using Right Outer Join.
   5. Retrieve All Subjects and Their Students (Including Subjects Without Students) using FULL Outer Join.
6. Calculate the Grade based on finalIA marks and update Grade column of the corresponding table for all students using user defined function and stored procedure and Transaction Control Language (TCL) commands.
7. Write a SQL transaction to insert a new student into the STUDENT table and enroll the student in a specific class in the CLASS table. If any error occurs during the enrollment, roll back the transaction. Write a SQL trigger that logs every update made to the name of a student in the STUDENT table. The log should capture USN, SName, and the date/time when the update occurred.
8. Create a view to display basic student information including USN, SName, and Phone from the STUDENT table.
9. Create a view to show students along with their enrolled classes, including USN, SName, SSID (class ID), and Sem (semester). This will involve a join between the STUDENT, CLASS, and SEMSEC tables.
   Create a view to show the total number of students in each semester, grouping by Sem from the SEMSEC table. This will involve the CLASS table to count the number of students per semester.
   Create a view to show only the students who have scored above 15 in Test1 in the IAMARKS table. Include the USN, SName, and Test1 score.
10. Write and execute program to perform operations on MongoDb Database.
11. A student performance dataset contains missing values, inconsistent department names, and unscaled marks. Clean the data by handling missing values and standardizing text fields. Normalize the marks column using Min-Max normalization.

Open-Ended Experiments:

1. GUI-Based Database Application – Develop a simple GUI-based database application incorporating table creation, constraints, queries, joins, functions, procedures, transactions, and triggers.
1. Case Study: Real-Life Database Application – Design and implement a database solution for a real-world problem domain like:

- Student Placement Management System
- Online Food Ordering System
- E-Commerce Product and Sales Management System

IOT SENSORS AND ITS APPLICATIONS

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

SEMESTER – III

Course Code :25AD2304		Credits :	03
Hours / Week	: 3 Hours	Total Hours :	45 (Hours)
L–T–P–S	: 3–0–0–0		

Course Learning Objectives: This course will enable students to:

1. Master the fundamental architectures and protocols that govern the modern IoT landscape.
2. Analyse the integration of SDN and NFV in managing large-scale IoT networks.
3. Evaluate and select appropriate sensors, actuators, and communication modules (LoRa, Zigbee, RFID) for specific engineering constraints.
4. Develop end-to-end IoT solutions using Arduino and Raspberry Pi with integrated cloud analytics.
5. Address critical security and privacy challenges in distributed device environments.

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.

Module 1: Fundamentals of IoT	9 Hours

Introduction, Definition, and Characteristics of IoT; Physical Design: IoT Protocols; Logical Design: IoT Communication Models, IoT Communication APIs; Enabling Technologies: WSN, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems; IoT Levels and Templates; Domain-specific IoTs; IoT Architectural View. Engineering Applications: Smart Home Monitoring, Environmental Sensing. AI Integration: Use AI-assisted concept explainers for protocol visualization.Authentic Intelligence Reflection: Evaluate the effectiveness of automated sensing vs. human observation.

Module 2: M2M and IoT Design Methodology	9 Hours

IoT and M2M: Differences between IoT and M2M; Software Defined Networks (SDN); Network Function Virtualization (NFV); IoT Systems Management: Needs, NETCONF, YANG; IoT Design Methodology.Engineering Applications: Automated Network Management, Virtualized Infrastructure.AI Integration: AI-based network optimization demonstrations.Authentic Intelligence Reflection: Identify the balance between human network administrators and AI-driven SDN support.

Module 3: Elements of IoT	**9 Hours**
Sensors and Actuators; Sensor Classification, Sensor Interfacing Techniques, Communication Modules: Zigbee, LoRa, RFID, Wi-Fi; Power Sources and Energy Harvesting. Engineering Applications: Industrial Asset Tracking, Remote Agricultural Sensing.AI Integration: AI-assisted selection of sensor modules based on environment. Authentic Intelligence Reflection: Explore the ethical concerns of ubiquitous sensing in private spaces.	
Module 4: Building IoT with Cloud and Data Analytics	**9 Hours**
IoT Platforms: Arduino, Raspberry Pi; Physical Devices and Interfaces; Programming and APIs; Cloud Computing in IoT; Cloud Connectivity; Big Data Analytics; Data Visualization.Engineering Applications: Real-time Dashboarding, Predictive Maintenance.AI Integration: AI-based data trend prediction and dashboard generation. Authentic Intelligence Reflection: Human evaluation of AI-generated data insights and visualization.	
Module 5: Challenges in IoT and Case Studies	**9 Hours**
Security Concerns and Challenges; Real-time Applications: Home Automation (Automatic lighting, Intrusion detection), Smart Cities (Smart parking), Environment (Weather monitoring), Agriculture (Smart irrigation).Engineering Applications: Secure Smart Infrastructure, Agricultural Automation.AI Integration: AI-based threat modelling for IoT security auditing.Authentic Intelligence Reflection: Performance evaluation of AI-driven intrusion detection systems.	

Course Outcomes (CO)

Course Outcome	Description	Bloom's Taxonomy Level
CO1	Describe the physical/logical designs and architectural views of IoT systems.	L2
CO2	Implement design methodologies involving SDN and NFV for network efficiency.	L3
CO3	Integrate advanced communication modules like LoRa and Zigbee into IoT hardware.	L3
CO4	Build cloud-connected IoT platforms with integrated Big Data Analytics and visualization.	L4
CO5	Evaluate security vulnerabilities and deploy ethical, real-time IoT applications.	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	1	2	3

CO1	3	2	2	1	2	0	0	0	1	0	1	2	1	0
CO2	3	3	3	2	3	0	0	1	1	1	1	2	3	0
CO3	2	2	3	2	3	0	0	1	1	0	1	3	3	0
CO4	2	3	3	3	3	1	0	1	2	1	2	2	2	2
CO5	2	3	2	2	3	3	3	1	2	1	2	2	1	2

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

Textbooks:

1. Arshdeep Bahga, Vijay Madisetti, **"Internet of Things-A hands-on approach"**, Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, **"The Internet of Things: Key applications and Protocols"**, Wiley Publications 2nd edition, 2013.

Reference Books:

1. Sudip Misra, Anandarup Mukherjee, and Arijit Roy, "Introduction to IoT: Systems and Applications", 2nd Edition, Cambridge University Press, 2023.
2. Raj Kamal, **"Internet of Things – Architecture and Design Principles"**, Mc Graw Hill Education Pvt. Ltd., 2017.
3. **"Internet of Things and Data Analytics"**, Hwaiyu Geng, P.E, Wiley Publications, 2017.
4. Manoel Carlos Ramon, **"Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers"**, Apress, 2014.

DATA STRUCTURES AND ALGORITHMS

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

SEMESTER – III

Course Code: 25AD2305	**Credits** : 04
Hours / Week:03 Hours	**Total Hours**: 45 [Th] +15 (L)
L–T–P–J: 3–0–2–0	

Course Learning Objectives: This Course will enable students to:.

1. **To Understand** the fundamental concepts of algorithms, their characteristics and performance evaluation using asymptotic notations.
2. **To impart** knowledge on mathematical techniques to analyze both recursive and non-recursive algorithms including solving recurrence relations.
3. **To familiarize** basic data structures such as arrays, linked list, stacks, queues and trees using C programming concepts.
4. **To impart** basic algorithm design techniques such as brute force, divide and conquer, greedy methods, dynamic programming and back tracking to solve computational problems.
5. **To understand** and compare different algorithms based on efficiency, scalability and suitability for real-world applications.

MODULE – I: Foundations of Algorithms	**08 Hours**
Algorithm: Definition and characteristics - Performance analysis and efficiency - Asymptotic notations: Big-O, Theta, Omega - Mathematical analysis of algorithms: Non-recursive and recursive algorithms - Recurrence relations: Substitution method, recursion tree method, Master theorem.	
MODULE – II: Basic Data Structures	**10 Hours**
Introduction to Arrays, Pointers and dynamic memory allocation – Divide and Conquer - merge sort and quick sort - Linked lists: Singly and doubly linked lists; operations including insertion, deletion, and traversal, Circular linked list. **Engineering Applications:** Music Playlist creation, Textbook Page Number Finder.	
MODULE – III: Stacks, Queues, and Trees	**08 Hours**
Stacks: Linked list implementation - Queues: Linear queue; linked list implementation - Expression evaluation using stacks - Trees: Binary trees, representation, and traversal techniques - Binary Search Trees (BST): Operations - Balanced trees: AVL trees. **Engineering Applications:** Ticket Counter Implementation, Student Details - Effective Storing and Searching.	

MODULE – IV: Algorithm Design Techniques	**09 Hours**
Brute force techniques: String matching - Graph representations: adjacency list, matrix - Graph traversal algorithms: Depth First Search (DFS), Breadth First Search (BFS), Dijkstra's algorithm, Hashing: Open and closed hashing techniques. **Engineering Applications:** Delivery Route Optimization, GPS Navigation.	
MODULE – V: Advanced Algorithms	**10 Hours**
Greedy algorithms: Fractional knapsack problem - Minimum Spanning Trees: Prim's and Kruskal's algorithms - Dynamic programming: Concept and methodology; 0/1 knapsack problem and Floyd-Warshall algorithm - Backtracking: Concept and methodology; Sum of Subsets problem, P, NP, NP Hard, NP Complete. **Engineering Applications:** Sales Profit Maximization, Delivery Route Planning, N queens in Chess Board.	

Laboratory Component (1 Credit)

The lab emphasizes hands-on implementation of data structures and algorithms using C programming language with applicable co-pilot integration, along with visualization and AI-assisted debugging techniques.

List of Experiments

1. Sorting algorithms (merge sort, quick sort)
2. Linked list operations (singly and doubly linked lists)
3. Stack and queue implementation using linked lists
4. Binary tree and binary search tree (BST) implementation
5. Tree traversal techniques (inorder, preorder, postorder)
6. Graph traversal algorithms (DFS and BFS)
7. Implementation of hashing techniques

Course Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course the student will be able to:		
1	**Understand** the efficiency analysis of algorithms using asymptotic notations and solve recurrence relations for both recursive and non-recursive algorithms.	L2
2	**Implement** and manipulate basic data structures such as linked lists using C concepts like pointers and dynamic memory allocation. **Design and analyse** algorithms divide and conquer technique.	L3
3	Apply stack, queue, and tree data structures to solve problems involving expression evaluation, traversal, and hierarchical data representation including BST and AVL trees	L3

	for efficient data organization.	
4	Design and analyse algorithms using brute force, graph traversal, and hashing techniques.	L3
5	Apply advanced algorithmic techniques such as greedy methods, dynamic programming, and backtracking to solve optimization problems.	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	1	2
CO1	3	2	2	1	2	-	-	-	-	-	-	2	3
CO2	2	2	3	-	3	-	-	-	-	-	-	2	3
CO3	2	2	3	-	3	-	-	-	-	-	-	2	3
CO4	2	2	3	-	3	-	-	-	-	-	-	2	3
CO5	2	2	3	-	3	-	-	-	-	-	-	2	3

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

TEXT BOOKS:

1. Thomas H. Cormen, Charles E.Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI, 2014.

2. Mark Allen Weiss, "Data Structures and Algorithm Analysis", 4th Edition, Pearson, 2013.

E-Resources:

1. MIT OpenCourseWare - Introduction to Algorithms https://ocw.mit.edu/courses/6-006-introduction-to- algorithms-spring-2020/

2. Stanford Algorithms Lectures - Algorithms: Design and Analysis, Part 1https://online.stanford.edu/courses/soe-ycsalgorithms1-algorithms-design-and-analysis-part-1.

FOUNDATIONS OF AI & AUTHENTIC INTELLIGENCE

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

SEMESTER – III

Course Code	:	25AD2307	**Credits**	:	3
Hours / Week	:	03 Hours	**Total Hours**	:	45 Hrs
L–T–P-J	:	3–0–0-0			

Course Learning Objectives: This course will enable students to:

1. Understand and develop a strong foundation in artificial intelligence, including its history, core principles, types (narrow vs. general AI), and real-world applications.
2. Explore how intelligent agents operate, including search algorithms, state-space representation, and decision-making strategies.
3. Learn to represent knowledge using logical and probabilistic models and apply reasoning techniques to solve complex problems.
4. Understand introductory machine learning concepts and evaluate the importance of fairness, transparency, accountability, and authenticity in AI systems.
5. Examine the distinction between artificial and authentic intelligence, focusing on human cognition, trust in AI, and responsible deployment in society.

Teaching-Learning Process (General Instructions)

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

2) ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
3) ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
4) Show ***Video/animation*** films to explain functioning of various concepts.
5) Encourage ***Collaborative*** (Group Learning) Learning in the class.
6) To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
7) Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
8) Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
9) Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE – I Introduction and Searching decisions	**09 Hours**

Introduction, Definition, Future of Artificial Intelligence, Characteristics, Typical Intelligent agents, Problem solving approach, Problem Solving methods, Search strategies, Uniformed and informed, Heuristics, Local search, Algorithm and optimization problems, Searching with partial observations Constraint satisfactory problems ,Constraint propagation ,Back tracking search ,Game playing Optimal decision. Applications: Heuristics are intelligent estimation techniques that improve

search efficiency by prioritizing promising solution paths, Responsible deployment of AI chatbots, systematic techniques.	
MODULE – II AI Reasoning	**09 Hours**
Alpha beta pruning, Stochastic games, First order predicate logic, Prolog programming, Unification, Forward Chaining, Backward chaining, Resolution, Knowledge Representation, Ontological Engineering, Categories, Objects, Events, Mental Events, Mental Objects, Reasoning Systems, Reasoning with default information, Typical AI Problems. Applications: Heuristics are intelligent estimation techniques that improve search efficiency by prioritizing promising solution paths, Responsible deployment of AI chatbots, systematic techniques.	
MODULE – III Intelligent Agents	**09 Hours**
Architecture for intelligent agents, Agent communication, Negotiation, Bargaining, Argumentation, Agents, Trust, Reputation, Multi agent systems, AI applications, Language Models, Information Retrieval, Information extraction, Natural language processing, Machine translation, Speech recognition, Robot Hardware, Perception. Applications: Heuristics are intelligent estimation techniques that improve search efficiency by prioritizing promising solution paths, Responsible deployment of AI chatbots, systematic techniques.	
MODULE – IV Foundations of Authentic Intelligence	**09 Hours**
Concept and principles of Authentic Intelligence, Augmented Intelligence vs Artificial Intelligence, Human-centered AI design principles, Value alignment between AI systems and human values, Human cognition and intelligence augmentation, Human–AI collaboration models. Applications: Ethical design of intelligent assistants, Responsible deployment of AI chatbots	
MODULE – V Authentic Intelligence in Emerging Intelligent Systems	**09 Hours**
AI for human creativity and innovation, AI-driven knowledge discovery and learning systems, Intelligent systems for adaptive learning and personalization, Generative AI systems and creative intelligence, Authentic Intelligence and human–AI partnership. Applications: Generative AI for design, art, and content creation, Intelligent tutoring systems and personalized education	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Evaluate** the characteristics and advantages of different intelligent agents.	L2
2	**Identify** the different search strategies in AI.	L3
3	**Apply** to solve AI problems.	L3
4	**Creating** software agents in different ways of designing software agents	L3
5	**Develop** the applications of AI & solve the problems	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**	**1**	**2**	**3**
CO1	3	2	1	-	2	-	-	2	1	-	-	2	1	1
CO2	3	3	1	1	2	-	-	-	-	-	-	2	2	2
CO3	3	3	-	1	3	-	-	-	-	-	-	2	1	2
CO4	3	2	3	1	3	-	-	1	2	1	-	2	2	2
CO5	3	3	3	2	3	2	1	2	2	2	1	3	2	2
3: Substantial (High)						**2: Moderate (Medium)**						**1: Poor (Low)**		

TEXT BOOKS:

1. S Co-Intelligence: Living and Working with AI, E. Mollick, 2024, Penguin Publishing Group.
2. Augmented intelligence: the business power of human–machine collaboration, J. Hurwitz, H. Morris, C. Sidner, and D. Kirsch, 2019, Auerbach Publications.
3. The Cambridge handbook of responsible artificial intelligence: interdisciplinary perspectives, S. Voeneky, P. Kellmeyer, O. Mueller, and W. Burgard, eds., 2022, Cambridge University Press.
4. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach||, Prentice Hall, Third Edition, 2009.

REFERENCE BOOKS:

1. Bratko, —Prolog: Programming for Artificial Intelligence||, Fourth edition, Addison- Wesley Educational Publishers Inc., 2011
2. M. Tim Jones, —Artificial Intelligence: A Systems Approach (Computer Science) ||, Jones and Bartlett Publishers, Inc.; First Edition, 2008.
3. William F. Clocksin and Christopher S. Mellish, Programming in Prolog: Using the ISO Standard||, Fifth Edition, Springer, 2003.

E-Resources:

- ChatGPT / Gemini for ideation
- Jupyter Notebook / Google Colab / AnacondaGoogle Vertex AI
- NetworkX or draw.io
- AutoML platforms
- OpenAI Gym
- UCI Machine Learning Repository
- https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+S-RX-02+V2

MATLAB FOR DATA SCIENCE

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

Course Code	:	25AD2308	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	30 Hours
L–T–P–J	:	1–0–2–0			

Course Learning Objectives: This Course will enable students to:

1. Understand the fundamentals of symbolic computation and create symbolic variables, expressions, and equations using MATLAB
2. Apply algebraic manipulation, simplification, and equation-solving techniques using the Symbolic Math Toolbox
3. Construct symbolic functions and generate 2D and 3D visualizations of mathematical expressions
4. Perform symbolic calculus operations including differentiation, integration, and solving ordinary differential equations
5. Implement numerical root-finding methods and solve systems of nonlinear equations using MATLAB built-in functions

Teaching-Learning Process (General Instructions)
These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1) ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2) ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3) Show ***Video/animation*** films to explain 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) Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7) Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8) Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Module– I	**06 Hours**

INTRODUCTION TO SYMBOLIC COMPUTATION AND MATLAB BASICS Symbolic Math Toolbox – Overview and Setup. Symbolic Variables: Declaration using sym and syms. Symbolic Constants and Expressions. Arithmetic Operations on Symbolic Objects. Substitution using subs. Assumptions on Variables: assume, assume Also, assumptions. Modules of Measurement in Symbolic Computations.

MODULE – II	**06 Hours**

SYMBOLIC EXPRESSIONS, EQUATIONS, AND ALGEBRAIC MANIPULATIONS Forming Symbolic Equations using == operator. Solving Symbolic Equations: solve and vpasolve. Expanding and Factoring: expand, factor, collect. Simplification: simplify, simplifyFraction, rewrite. Polynomial Operations: coefficients, roots, evaluation. Partial

Fraction Decomposition: partfrac.	
MODULE – III	**06 Hours**
SYMBOLIC FUNCTIONS AND VISUALIZATION Defining Symbolic Functions using symfun. Function Composition, Inversion, and Evaluation. 2D Visualization: fplot, ezplot – Curves and Parametric Plots. Axis Labels, Titles, and Legends. 3D Visualization: fsurf, fmesh, fcontour. Parametric 3D Curves and Surfaces.	
MODULE – IV	**06 Hours**
SYMBOLIC CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS Symbolic Differentiation: diff – Univariate and Partial Derivatives. Higher-Order Derivatives. Symbolic Integration: int – Definite and Indefinite Integrals. Multivariable Calculus: Double and Triple Integrals. Taylor and Maclaurin Polynomials: taylor; Basic Statistical Analysis using MATLAB (Mean, Median, Standard Deviation, Correlation); Solving ODEs: dsolve – Initial and Boundary Value Problems.	
MODULE – V	**06 Hours**
NONLINEAR EQUATION SOLVING AND NUMERICAL ROOT FINDING Roots of Functions: Definition, Existence, and Multiplicity. Graphical Visualization of Roots. Bisection Method – Algorithm and MATLAB Implementation. MATLAB fzero Function: Syntax and Applications. Anonymous Functions. Locating Multiple Roots. Systems of Nonlinear Equations: fsolve Function – Jacobian Options and Convergence. Multivariable Nonlinear Systems.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Recall symbolic variable declarations, expressions, and assumption functions in MATLAB, and demonstrate basic substitution and Module operations.	L1
2	Solve symbolic algebraic equations and apply simplification, expansion, factoring, and partial fraction techniques using MATLAB Symbolic Math Toolbox.	L3
3	Construct symbolic functions and generate 2D and 3D visualizations of mathematical expressions and parametric curves using MATLAB plotting functions.	L3
4	Apply symbolic differentiation, integration, Taylor series, and solve ordinary differential equations including initial and boundary value problems using dsolve.	L4
5	Implement numerical root-finding algorithms (Bisection, fzero, fsolve) and solve systems of nonlinear equations using MATLAB, evaluating convergence and accuracy.	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**	**1**	**2**	3
CO1	3	1										2		
CO2	3	2	1									3		1
CO3	2	2	2	1								3	1	
CO4	3	3	2	2	1							3		
CO5	3	3	3	2	2	1						3	2	2

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

TEXT BOOKS:

- Gilat, A., MATLAB: An Introduction with Applications, 6th Edition, Wiley, 2016.
- Attaway, S., MATLAB: A Practical Introduction to Programming and Problem Solving, 5th Edition, Butterworth-Heinemann, 2019.

E-Resources:

- MathWorks Symbolic Math Toolbox Documentation: https://www.mathworks.com/help/symbolic/
- MathWorks Optimization Toolbox (fsolve, fzero): https://www.mathworks.com/help/optim/
- MATLAB Onramp (Free Course): https://matlabacademy.mathworks.com
- NPTEL – MATLAB Programming for Numerical Computation: https://nptel.ac.in

LINUX PROGRAMMING & SCRIPTING

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

SEMESTER – III

Course Code	:	25AD2309	**Credits**	:	02
Hours /Week	:	02 Hours	**Total Hours**	:	30 Hours
L–T–P–J	:	1–0–2–0			

Course Learning Objectives:

1. **Study** the fundamental principles and syntax of various scripting languages, including **PERL, TCL/TK, Python, and BASH**.
2. **Create** and execute programs effectively within the **Linux environment** while mastering the Linux file system and kernel commands.
3. **Analyze** and explore the practical application of scripting languages specifically within the context of **IC design flows**.
4. **Develop** the technical ability to write scripts for the **automation** of complex processes in **VLSI tool design**.
5. **Understand** essential **Linux networking** tools and services, such as FTP, DNS, and DHCP, to manage data and connectivity in a professional environment

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE – I: LINUX BASICS	**06 Hours**

Introduction to Linux and the Linux File System; General usage of Linux kernel and basic commands;

Management of Linux users and groups; Permissions for files, directories, and users; Searching files and directories; Shell Scripting using Bash (Variables, Conditional Statements, Loops, Functions, and Automation Scripts); Zipping and unzipping concepts.	
MODULE – II: LINUX NETWORKING	**06 Hours**
Introduction to Networking in Linux; Network basics and essential tools; File Transfer Protocol (FTP) in Linux; Network File System (NFS); Domain Naming Services (DNS); Dynamic Host Configuration Protocol (DHCP) and Network Information Services (NIS).	
MODULE – III: PERL SCRIPTING	**06 Hours**
ntroduction to Perl Scripting; Working with simple values, lists, and hashes; Control structures (loops and decisions); Regular expressions; Files and data management in Perl; References and subroutines; Running and debugging Perl; Modules and Object-Oriented Perl.	
MODULE – IV: TCL SCRIPTING	**06 Hours**
Tcl Fundamentals; String and Pattern Matching; Tcl Data Structures and Control Flow Commands; Procedures and Scope; Working with UNIX; Reflection and Debugging; Script Libraries; Tk Fundamentals and examples; Geometry Managers (Pack); Binding commands to X events; Tk Widgets (Buttons, Menus, Entry, Listbox).	
MODULE – V: PYTHON SCRIPTING	**06 Hours**
Introduction to Python and using the Python Interpreter; Control Flow Tools and Data Structures; Modules, Input, and Output; Errors and Exceptions; Classes and Object-Oriented programming; Brief tour of the Python Standard Library.	

COURSE OUTCOMES

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Utilize the Linux environment, kernel commands, and file permissions for system administration.	L2
2	Configure and manage Linux networking services such as DNS, DHCP, and FTP.	L3
3	Develop Perl scripts to automate data processing and handle complex data structures.	L3
4	Create Tcl/Tk scripts and GUI widgets for tool automation in IC design	L3

	flow.	
5	Build Python-based automation scripts using standard libraries and object-oriented principles.	L3

CO-PO MAPPING

	Table: Mapping Levels of COs to POs / PSOs													
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	3
CO1	3	2	1	1	3	1	1	1	1	–	2	2	2	1
CO2	3	3	3	2	3	2	1	1	1	1	2	2	3	1
CO3	2	3	3	2	3	1	–	1	1	1	2	3	3	1
CO4	3	2	3	2	3	1	–	1	2	1	2	2	3	1
CO5	3	3	3	3	3	1	1	1	2	2	3	3	3	2

3 – High Correlation 2 – Moderate Correlation 1 – Low Correlation

TEXT BOOKS:

1. Guido van Rossum and Fred L. Drake, Jr., **Python Tutorial**, Release 2.6.4.
2. Brent Welch, **Practical Programming in Tcl and Tk**, Updated for Tcl 7.4 and Tk 4.0.
3. David Till, **Teach Yourself Perl 5 in 21 days**, Sams Publishing.
4. **Red Hat Enterprise Linux 4: System Administration Guide**, Red Hat, Inc.

E-RESOURCES:

- NPTEL Video Course: http://nptel.ac.in
- Python Official Documentation: https://docs.python.org
- Perl Documentation: https://perldoc.perl.org

BI USING TABLEAU/ POWER BI

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

SEMESTER – III

Course Code	:	25AD2310	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	30
L–T–P-J	:	1–0–2-0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the fundamentals of data visualization and the role of BI tools in modern data analytics
2. Connect to multiple data sources and transform raw data using Power Query and Tableau Prep
3. Build interactive dashboards and reports using Power BI Desktop and Tableau
4. Apply calculated fields, measures, DAX expressions, and Tableau LOD expressions to derive insights
1. Publish, share, and collaborate on dashboards using Power BI Service and Tableau Server/Public

Teaching-Learning Process (General Instructions)

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

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE – I	**06 Hours**

INTRODUCTION TO DATA ANALYTICS & BI TOOLS

Overview of Business Intelligence and data analytics; role of visualization in decision-making; introduction to Power BI and Tableau ecosystems; comparing Power BI and Tableau — strengths and use cases; installing Power BI Desktop and Tableau Public/Desktop; navigating the interface — canvas, fields pane, visualizations pane; connecting to data sources (Excel, CSV, databases); data import vs. live connection; introduction to Power Query Editor and Tableau Data Source tab.

MODULE – II	**06 Hours**

DATA PREPARATION & TRANSFORMATION

Power Query Editor — data cleaning, renaming, merging, appending queries; data types and transformations; Tableau Prep — connecting, cleaning, and shaping data flows; handling null values and duplicates; data blending vs. data joining in Tableau; relationships and data modelling in Power BI; star schema vs. flat table approaches; loading transformed data into the report canvas.

MODULE – III	**06 Hours**

VISUALIZATIONS & DASHBOARD DESIGN

Core chart types in Power BI and Tableau — bar, line, pie, scatter, map, treemap, waterfall; slicers and filters in Power BI; quick filters, parameters, and sets in Tableau; drill-down and drill-through interactions; tooltips and cross-highlighting; building interactive dashboards — layout, containers, actions; responsive and mobile-optimised design; best practices for effective data storytelling; colour theory and accessibility in dashboards.

(Text Book 1: Chapter 5, Chapter 6; Text Book 2: Chapter 4, Chapter 5)

MODULE – IV	**06 Hours**

CALCULATIONS, DAX & LOD EXPRESSIONS

Introduction to DAX (Data Analysis Expressions) — calculated columns vs. measures; common DAX functions: SUM, AVERAGE, COUNT, CALCULATE, FILTER, RELATED, IF; time intelligence functions (TOTALYTD, SAMEPERIODLASTYEAR); Tableau calculated fields — basic aggregations, string and date functions; Level of Detail (LOD) expressions — FIXED, INCLUDE, EXCLUDE; table calculations in Tableau; KPI visuals and cards in Power BI.

MODULE – V	**06 Hours**

PUBLISHING, SHARING & MINI PROJECT

Publishing reports to Power BI Service — workspaces, apps, row-level security; scheduling data refresh; sharing and collaboration in Power BI; publishing to Tableau Server and Tableau Public; Tableau Stories for narrative presentations; embedding dashboards in web applications; introduction to Power BI APIs; Mini Project — students design and publish an end-to-end interactive dashboard using a real-world dataset in both Power BI and Tableau, presenting insights and design decisions.

Course Outcome	**Description**	**Bloom's Taxonomy Level**
At the end of the course the student will be able to:		
1	Describe the Power BI and Tableau ecosystems, connect to data sources, and navigate the tools' interfaces confidently.	L2
2	Prepare and transform raw data using Power Query Editor and Tableau Prep for analysis-ready datasets.	L3
3	Build interactive dashboards and reports using a variety of chart types, filters, and cross-visual interactions.	L3

4	Apply DAX measures and Tableau LOD/table calculations to derive meaningful business insights.	L3
5	Publish, share, and present an end-to-end dashboard solution using Power BI Service and Tableau Server/Public.	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	1	2	3
CO1	1	1	2									3		
CO2	2	2	2									3		
CO3	3	2	3									3		
CO4	2	2	2	1	1							3		
CO5	2	2	3	2	2	1						3	1	

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

TEXT BOOKS:

1. Alberto Ferrari and Marco Russo, The Definitive Guide to DAX: Business Intelligence for Microsoft Power BI, SQL Server Analysis Services, and Excel, Microsoft Press, 2nd Edition, 2019.
2. Marleen Meier, Learning Tableau 2022: Create Effective Data Visualizations, Build Interactive Visual Analytics, and Transform Your Organization, Packt Publishing, 5th Edition, 2022.
3. Avi Singh and Luke Wallwork, Power BI from Rookie to Rock Star, Leanpub, 3rd Edition, 2023.

E-Resources:

1. Power BI Official Documentation: https://learn.microsoft.com/en-us/power-bi/
2. Microsoft Learn — Power BI: https://learn.microsoft.com/en-us/training/powerplatform/power-bi
3. Tableau Official Learning Resources: https://www.tableau.com/learn/training
4. Tableau Public Gallery: https://public.tableau.com/en-us/gallery
5. SQLBI — DAX and Power BI Resources: https://www.sqlbi.com
6. Guy in a Cube (Power BI YouTube): https://www.youtube.com/c/GuyinaCube

FULL STACK DEVELOPMENT

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

SEMESTER – III

Course Code	:	25AD2311	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	30
L–T–P-J	:	1–0–2-0			

Course Learning Objectives: This Course will enable students to:

1. Understand the full web stack architecture, including client-server communication, HTTP/HTTPS, REST principles, and modern JavaScript runtimes
2. Build responsive, accessible, and interactive front-end applications using HTML5, CSS3, JavaScript ES6+, and React
3. Design and implement RESTful and GraphQL APIs using Node.js and Express, integrated with SQL and NoSQL databases
4. Apply authentication, authorization, and API security best practices to build production-grade, secure web applications
5. Deploy full stack applications using Docker containers, CI/CD pipelines, and cloud hosting platforms following DevOps principles

Teaching-Learning Process (General Instructions)

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

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE – I	**06 Hours**

FRONT-END FOUNDATIONS (HTML, CSS & JAVASCRIPT)

Web architecture overview; HTML5 semantic structure; forms and validation; accessibility basics; CSS3 layout (Flexbox, Grid), responsive design; JavaScript ES6+ fundamentals; asynchronous JavaScript (Promises, async/await, Fetch API); DOM manipulation; Web Storage API; Git and GitHub basics.

MODULE – II	**06 Hours**

REACT & FRONT-END DEVELOPMENT

React basics (JSX, components, props, state); Hooks (useState, useEffect, useContext); component

patterns; React Router; state management (Context API, Redux basics); TypeScript basics with React.	
MODULE – III	**06 Hours**
BACK-END DEVELOPMENT (NODE.JS, EXPRESS & DATABASES) Node.js fundamentals; Express.js framework; REST API design; CRUD operations; Database Connectivity and CRUD Integration between React, Express, and Database Systems; PostgreSQL basics; SQL and schema design; MongoDB basics with Mongoose.	
MODULE – IV	**06 Hours**
AUTHENTICATION, SECURITY & REAL-TIME SYSTEMS Authentication (JWT, bcrypt); authorization (RBAC, OAuth basics); API security (CORS, rate limiting, validation); file uploads; WebSockets and Socket.io; GraphQL basics.	
MODULE – V	**06 Hours**
TESTING, DEVOPS & DEPLOYMENT Software testing basics; React and API testing; Docker basics; CI/CD with GitHub Actions; cloud deployment; performance optimization; Next.js basics; PWA concepts; web accessibility fundamentals.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Apply HTML5, CSS3, JavaScript ES6+ and Git to build responsive web pages.	L2
2	Develop React-based single-page applications using components, hooks, and routing.	L3
3	Build REST APIs using Node.js and Express with SQL and NoSQL databases.	L3
4	Implement authentication, authorization, and basic security in web applications.	L3
5	Deploy full stack applications using Docker, CI/CD, and cloud platforms.	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	1	2	3
CO1	1	1	2									3		
CO2	2	2	2									3		
CO3	3	2	3									3		

CO4	2	2	2	1	1							3		
CO5	2	2	3	2	2	1						3	1	

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

TEXT BOOKS:

1. Jon Duckett, HTML and CSS: Design and Build Websites, John Wiley & Sons, 2011; JavaScript and JQuery: Interactive Front-End Web Development, John Wiley & Sons, 2014.
2. Ethan Brown, Web Development with Node and Express: Leveraging the JavaScript Stack, 2nd Edition, O'Reilly Media, 2019.
3. Robin Wieruch, The Road to React: The One with Hooks, Self-published (updated annually), 2023.

E-Resources:

1. The Odin Project — Full Stack JavaScript Track: https://www.theodinproject.com
2. Full Stack Open (University of Helsinki): https://fullstackopen.com
3. MDN Web Docs — Comprehensive web platform reference: https://developer.mozilla.org
4. React Official Documentation: https://react.dev
5. Node.js Official Documentation: https://nodejs.org/en/docs

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DIFFERENTIAL EQUATIONS & OPTIMIZATION

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

SEMESTER – IV

Course Code	:	25AD2401	**Credits**	: 3
Hours/ Week	:	03 Hours	**Total Hours**	:45(T)
L–T–P-J	:	3–0–0-0		

Course Learning Objectives: This Course will enable students to:

1. **Apply** their knowledge of Laplace transforms and inverse Laplace transforms to proficiently solve linear ordinary differential equations with constant coefficients, facilitating the analysis and modelling of complex systems.
2. **Analyze** periodic functions using Fourier series, assessing the convergence properties and precision of the series expansion, thereby enhancing their ability to understand and manipulate periodic phenomena.
3. **Utilize** complex exponential form, Fourier transforms of basic functions, and Fourier sine and cosine transforms to solve problems involving Fourier integrals, developing proficiency in applying these techniques to various mathematical scenarios.
4. **Employ** numerical methods, including Euler's Method, Runge-Kutta 4th order, Adams- Bashforth, and Adams-Moulton Methods, to solve differential equations and effectively analyze dynamic systems, enabling them to model real-world phenomena and make accurate predictions**.**
5. **Apply** finite difference methods, including the Crank-Nicolson method and appropriate techniques for hyperbolic PDEs, to effectively solve different types of partial differential equations (PDEs) such as elliptic, parabolic, and hyperbolic equations, enhancing their problem-solving skills in the context of differential equations and their applications.

Teaching-Learning Process (General Instructions)

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

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
1. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE – I: Laplace Transform and Inverse Laplace Transform	**09Hours**

Laplace Transforms of Elementary functions (without proof),
Laplace Transforms of $e^{at}f(t)$, $t^n f(t)$ and $\frac{f(t)}{t}$, Periodic functions, Module step function and impulse functions
Inverse Laplace Transforms- By the method of Partial Fractions, Logarithmic and Trigonometric functions,

Convolution Theorem, Inverse Laplace transform using Convolution Theorem Solution to Differential Equations by Laplace Transform.	
MODULE – II: Fourier Series	**09 Hours**
Periodic Functions, Trigonometric Series, Fourier series Standard function, Functions of any Period 2L, Even and Odd functions, Half-range Expansions. Practical Harmonic analysis (calculate average power and RMS values of periodic waveforms)	
MODULE – III: Fourier Transform	**09 Hours**
Calculation of Fourier integrals using complex exponential form, Fourier transform of basic functions Fourier sine and cosine transforms.	
MODULE – IV: Numerical Methods for Solving Ordinary Differential Equations	**09 Hours**
Euler's Method-Basic principles of Euler's method for solving first-order ODEs, Runge-Kutta 4th order, Multistep Methods-Explanation of multistep methods (Adams-Bashforth, Adams–Moulton Methods), Second-Order ODE. Mass–Spring System (Euler Method, Runge–Kutta Methods)	
MODULE – V: Numerical Methods for Partial Differential Equations	**09 Hours**
Classification of PDEs (elliptic, parabolic, hyperbolic), Difference Methods (Laplace and Poisson Equations), Derivation of finite difference approximations, Crank–Nicolson Method, Method for Hyperbolic PDEs	

Course Outcome	Description	Bloom's Taxonomy Level
CO1	Apply Laplace Transform and Inverse Laplace Transform techniques to solve ordinary differential equations involving elementary, periodic, step, and impulse functions using partial fractions and convolution methods.	L3
CO2	Analyze periodic functions using Fourier Series, including trigonometric series, half-range expansions, and harmonic analysis for determining RMS and average power values.	L4
CO3	Evaluate Fourier integrals and determine Fourier, sine, and cosine transforms of standard functions for engineering and scientific applications.	L5
CO4	Implement numerical methods such as Euler's method, Runge–Kutta methods, Adams–Bashforth, and Adams–Moulton methods to solve first-order and second-order ordinary differential equations including mass–spring systems.	L5
CO5	Classify partial differential equations and apply finite difference techniques, including Crank–Nicolson and hyperbolic PDE methods, to obtain numerical solutions of engineering 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	1	2	3
C01	3		2										2	
C02	3		3		1								2	
C03	3	3	1										2	
C04	3	3	1										2	
C05	3	3	1										2	

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

TEXT BOOKS:

1. 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.

E-Resources:

1. https://nptel.ac.in/courses/111106139
2. https://nptel.ac.in/courses/111101164

DATA MINING AND PREDICTIVE MODELLING

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

SEMESTER – IV

Course Code	:	25AD2402	**Credits**	:	04
Hours / Week	:	05 Hours	**Total Hours**	:	45(Th) + 15(L)
L–T–P-J	:	3–0–2-0			

Course Learning Objectives: This Course will enable students to:

2. Understand data mining and knowledge discovery processes.
3. Analyse and pre-process real-world datasets.
4. Build predictive models using statistical and machine learning techniques.
5. Evaluate model performance and uncertainty.
6. Use AI-assisted tools responsibly in data-driven systems.

Teaching-Learning Process (General Instructions) These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE – I	**08 Hours**

Data Mining Fundamentals and Pre-processing: Introduction to data mining and knowledge discovery; evolution of data mining techniques; KDD process and its stages; data types including numerical, categorical, binary and time-series data; dataset characteristics such as dimensionality, sparsity and distribution; data quality issues including missing values, noise and outliers; noise analysis and data cleaning techniques; data pre-processing methods including aggregation and sampling; dimensionality reduction techniques; feature selection approaches; data transformation methods such as normalization and standardization; discretization techniques for continuous data.

MODULE – II	**08 Hours**

Similarity Measures and Association Rule Mining: Concept of similarity and dissimilarity in data analysis; distance measures including Euclidean and Manhattan distance; set-based similarity measures including Jaccard index and Dice coefficient; rule-based reasoning and decision-making systems; association rule mining concepts including support, confidence and lift; Apriori algorithm for frequent itemset mining; pattern mining techniques including frequent and sequential pattern mining; model selection techniques; evaluation metrics; error analysis including bias-variance trade-off, overfitting and underfitting.

MODULE – III	**11 Hours**

EXPLORATORY DATA ANALYSIS AND PREDICTIVE MODELLING: EDA concepts and importance; data

summarization and visualization (histograms, scatter plots, box plots); correlation and covariance analysis; clustering techniques (K-means, hierarchical); outlier detection methods; regression analysis (simple and multiple linear regression); model assumptions and diagnostics; ANOVA; parametric and non-parametric models; classification basics; frequent pattern mining concepts.

MODULE – IV	10 Hours

Advanced Predictive Modelling: Discriminant analysis for classification problems and decision boundaries; time-series analysis concepts including trend, seasonality and stationarity; ARIMA models for forecasting; autocorrelation function (ACF) and partial autocorrelation (PACF); autoregressive (AR) and moving average (MA) models; factor analysis for dimensionality reduction and latent variable identification; matrix factorization techniques for data representation; recommendation systems including collaborative filtering and content-based filtering approaches.

MODULE – V	08 Hours

Data Mining Applications and Advanced Topics: Text mining concepts including text preprocessing, tokenization, TF-IDF and sentiment analysis; spatial and temporal data mining for location-based and time-dependent patterns; privacy and security issues in data analytics including data protection and secure processing; ethical considerations such as bias, fairness, transparency and responsible use of AI systems.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Explain data mining concepts and pre-processing techniques.	L2
2	Apply similarity measures and pattern mining techniques.	L3
3	Develop predictive models using statistical methods.	L3
4	Evaluate model performance and data-driven decisions.	L5
5	Critically assess AI-generated outputs in data analysis.	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	1	2	3
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	
CO1	1	1										2	3	
CO2	2	2	1									2	3	
CO3	3	2	2	1								3	3	
CO4	2	2	2	2							1	3	3	
CO5	2	2	1	2							1	2	3	

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

Note: To achieve a thorough comprehension and in-depth knowledge of theoretical principles for topics on regression,

classification and neural network, students are encouraged to refer the textbook authored by Christopher M Bishop.
(Text book 1 in Reference books)

Primary Textbooks

1. Bruce Ratner – Statistical and Machine Learning Data Mining
2. Dursun Delen – *Predictive Analytics*
3. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, Jian Pei

Reference Textbooks

1. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, Vipin Kumar
2. An Introduction to Statistical Learning by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani
3. Python for Data Analysis by Wes McKinney
4. Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow by Aurélien Géron
5. Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeffrey Ullman

DATA MINING AND PREDICTIVE MODELLING LABORATORY

Total Contact Hours: 15

Following are experiments to be carried out using Python:

1. Implement data pre-processing techniques such as handling missing values, normalization, and encoding
   for a given dataset.
2. Perform feature selection and ranking on a dataset and analyse the impact on model performance.
3. Develop an association rule mining system using the Apriori algorithm and evaluate support and confidence.
4. Compute similarity measures (Euclidean, Jaccard, Dice) for a given dataset and compare results.
5. Perform clustering analysis on a dataset and identify meaningful patterns and outliers.
6. Build a regression-based predictive model and evaluate its performance using appropriate metrics.
7. Implement discriminant analysis for classification and analyze decision boundaries.
8. Apply factor analysis on a dataset and interpret latent factors.
9. Develop a recommendation system using collaborative filtering techniques.
10. Analyze a real-world dataset and build a complete predictive modelling pipeline
    (EDA → pre-processing → model → evaluation).

OPERATING SYSTEMS

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

SEMESTER – IV

Course Code	:25AD2403	**Credits**	:	04
Hours / Week	: 05 Hours	**Total Hours**	:	45(Th)+15(L)
L–T–P–S	: 3–0–2–0			

Course Learning Objectives: This course will enable students to:

1. Understand the basic concepts, structure, and functions of operating systems.
2. Learn how an operating system manages processes, threads, and CPU scheduling for efficient execution.
3. Study process synchronization techniques and solve concurrency-related problems.
4. Examine and handle deadlock situations and ensure system stability.
5. Understand memory management techniques and virtual memory.
6. Explore file systems, I/O systems, device management, along with protection and security mechanisms, and apply these concepts through practical problem-solving.

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.

MODULE – I Introduction to OS and System Structure	**8 Hours**

Basic organization of computing system, grand tour of major components of operating system and overview of various types of computing environment. Operating System Services, User and OS interface, System Calls and their types, Operating System Structure.

Engineering Applications: Embedded systems in automobiles, Industrial automation systems, Distributed systems (Cloud computing), Mobile computing, Touch interfaces, Smartphone System

Case Studies: Computing Environments, Operating System Services, Operating System Structure

MODULE – II Process Management, Threads and Process Scheduling	**8 Hours**

Process Concept, Operations on Processes, Inter-process Communication. Multicore Programming, Multithreading Models and other Threading issues. Basic Concepts of scheduling, Scheduling Criteria, Scheduling Algorithms, Multi-Processor Scheduling, Real Time Scheduling

Engineering Applications: Chat and messaging systems, buffer management (Netflix), Gaming engines,

Web browsers, Multimedia applications, Banking systems, Cloud computing platforms, Air traffic control systems Case Studies: Operations on Processes, IPC, Multicore Programming, CPU Scheduling Concepts and Real-Time Scheduling	
MODULE – III Process Synchronization and Deadlocks	**10 Hours**
Background, Critical Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problem of Synchronization, Monitors. **Dead Locks:** System Model, Deadlock Characterization, Methods of Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock **Engineering Applications:** Banking systems, Reservation systems, Inventory management systems, Real-time embedded controllers, Producer–Consumer problem, Dining Philosophers Problem, AWS Case studies: Classic Synchronization Problems: Readers and Writer problem etc, Methods of Handling Deadlocks	
MODULE – IV Memory Management and Virtual Memory	**10 Hours**
Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Structure of Page Table. **Virtual Memory:** Background, Demand Paging, Copy-on- Write, Page Replacement, Allocation of Frames, Thrashing, Memory Mapped Files, Allocating Kernel Memory **Engineering Applications:** Real-time systems, embedded controllers, Modern operating systems, Data analytics systems, Mobile apps, Container systems and Streaming systems Case Studies: Page Replacement	
MODULE – V File System, Implementation of File System, Mass storage structures and Protection and Security	**9 Hours**
File system: File concept; Access methods; Directory structure; File system mounting; File sharing. Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management. Mass storage structures: Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection and Security, Program Threats, System and Network Threats **Engineering Applications: Collaborative platforms (Google docs),** Cloud Storage Platform, Storage networks Case Studies: Access Methods, Directory Structure, File System Structure and Allocation Methods	

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

CO'S	Outcome	Bloom's taxonomy Level
CO1	Illustrate the basic concepts, structure, and functions of operating systems.	L2
CO2	Apply process management, threads, CPU scheduling, and process synchronization techniques to solve concurrency problems.	L3
CO3	Identify, analyze, and resolve deadlock situations using appropriate methods.	L4

CO4	Evaluate and apply memory management techniques such as paging, segmentation, and virtual memory.	L3
CO5	Analyze file systems, I/O systems, disk management, protection, and security mechanisms.	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	1	2	3
CO1	2	2	1	1	2	-	-	-	-	-	2	2	2	2
CO2	2	2	1	2	2	-	-	-	-	-	2	2	2	2
CO3	2	2	2	1	3	1	-	-	-	-	2	3	3	2
CO4	2	2	2	1	2	1	1	-	-	-	2	2	3	3
CO5	1	2	2	2	2	2	3	-	-	-	3	2	2	3
3: Substantial (High)						2: Moderate (Medium)						1: Poor (Low)		

TEXT BOOKS:

1. Silberschatz, A, Galvin, P.B., Gagne G., "Operating System Concepts" 10th edition, Wiley Publishers, 2018.

REFERENCES:

1. Stallings, W., Operating Systems: Internals and Design Principles, Pearson, 9th Edition, 2026
2. Maurice Bach, "Design of Unix Operating System", PHI, 2013

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs80/preview
2. https://onlinecourses.nptel.ac.in/noc24_cs108/preview
3. https://www.coursera.org/learn/codio-intro-to-operating-systems-2-memory-management
4. Modern Operating Systems by Andrew S. Tanenbaum - Known for its comprehensive coverage of modern operating systems principles and design.
5. Operating System Fundamentals - Course (nptel.ac.in)
6. Introduction to Operating Systems - Course (nptel.ac.in)
7. Intro to Operating Systems 1: Virtualization | Coursera
8. Intro to Operating Systems 3: Concurrency | Coursera
9. Intro to Operating Systems 2: Memory Management | Coursera

LABORATORY EXPERIMENTS

The laboratory component emphasizes hands-on implementation that can be used for OS lab programs only when implementing parallel or multicore concepts using NVIDIA GPUs and CUDA concepts for enabling students to translate theoretical concepts into practical solutions.

OS Lab Programs that CAN work with NVIDIA (GPU-based)

Experiment 1: Parallel Process Simulation (Multicore Programming)

Students can understand that the program is divided into independent tasks, and each task is executed in parallel using multiple cores or threads. Instead of running one process at a time (sequential execution), the system runs many processes concurrently, improving performance and efficiency.

Experiment 2: Parallel Scheduling Simulation

Students can implement Parallel Scheduling Simulation. It is a concept used to demonstrate how a system assigns and executes multiple tasks simultaneously across multiple CPU cores. A scheduler distributes processes or threads among available cores so that several tasks run in parallel instead of sequentially. This improves performance, reduces execution time, and increases CPU utilization.

Experiment 3: Producer–Consumer (Using GPU Threads)

It is a parallel version of the classic synchronization problem where multiple threads act as producers (generate data) and consumers (use data) on a shared resource (buffer). Students can implement in a GPU environment, many threads run simultaneously, so producers and consumers execute in parallel. Proper coordination is required to ensure:

Experiment 4: Memory Management Simulation (Parallel Access)

Students can understand how multiple processes or threads access and modify memory simultaneously in a parallel computing environment (multi-core CPU or GPU).In this simulation, different threads operate on shared or separate memory locations at the same time, showing how memory is allocated, accessed, and updated concurrently. It also highlights the need for synchronization to avoid problems like race conditions when multiple threads access the same data.

Experiment 5: Banker's Algorithm for Deadlock avoidance (Parallel Simulation)

Banker’s Algorithm is a deadlock avoidance technique where the system checks whether granting a resource request will keep it in a safe state before actually allocating the resources. Students can do parallel environments (multi-core or GPU), multiple processes (or threads) request resources simultaneously.

MACHINE LEARNING

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

SEMESTER - IV

Course Code : 25AD2405	**Credits :**04
Hours / Week: 05	**Total Hours:**45[Th] + 15[L]
L–T–P–J :3–0–2–0	**CIE+SEE** 60+40 Marks

Course Vision:

To develop the ability to design, analyze, and implement machine learning solutions for engineering problems by integrating data-driven modeling, computational tools, and responsible AI practices.

Course Objectives:

This course will enable students:

1. To summarize the basic concepts, Feature Engineering and different types of Machine Learning.
2. To make Use of the Supervised Machine Learning techniques for solving appropriate real-world applications.
3. To make Use of the Unsupervised Machine Learning techniques, Dimensionality Reduction techniques for solving appropriate real-world applications.
4. To utilize the Probabilistic Graphical Models and Ensemble Learning Methods for handling complex real time problems.
5. To evaluate the performance and reliability of machine learning models.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes:

1. **Lecture method** along with traditional lecture method, different type of teaching methods may be adopted to develop the course outcomes.
2. **Interactive Teaching:** incorporating brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Showing **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
5. To make **Critical thinking**, asking Higher order Thinking questions in the class in the form of Quiz and writing programs with complex solutions.
6. Showing the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them

MODULE – I	**09 Hours**

Foundations of Machine Learning

Topics: Well-posed learning problems, designing a Learning system, Introduction to Machine learning and types Of Learning: Supervised, Unsupervised, And Reinforcement Learning, Data Pre-processing: Missing Value Imputation, Handling balanced and Imbalanced Data, and Feature Engineering.

Applications: Classification and regression problems in real-world scenarios, predictive analytics in healthcare and finance, feature engineering for improving model performance

MODULE – II	**09 Hours**

Supervised Machine Learning Algorithms

Topics: Introduction to Supervised Learning: Binary and Multi-Class Classification, Regression - Linear Regression and Nonlinear Regression, Logistic Regression, Naive Bayes Classification, Decision Trees (ID3, CART) and Random Forest, K-Nearest Neighborhood, Support Vector Machine (Linear and Non-linear

Kernels). **Applications:** house price prediction systems, medical diagnosis systems, fault detection in machines, financial risk prediction.	
MODULE – III	**09 Hours**
Unsupervised Machine Learning Algorithms **Topics:** 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, Dimensionality Reduction - Linear Discriminant Analysis and Principal Component Analysis. **Applications:** Customer Segmentation in Business Analytics, Anomaly Detection in Network Traffic, Pattern Discovery in Industrial Data	
MODULE – IV	**09 Hours**
Probabilistic Graphical Models and Ensemble Learning **Topics:** Probabilistic Graphical Models - Bayesian Networks, Markov Random Fields, and Ensemble Learning - Bagging Algorithms, Understanding Out-Of-Bag Score, Boosting: AdaBoost, Gradient Boosting Machines (GBM), XGBoost, CatBoost. **Applications:** uncertainty modeling using Bayesian Networks, image analysis with Markov Random Fields, prediction tasks using ensemble methods, fraud detection and recommendation systems with boosting algorithms.	
MODULE – V	**09 Hours**
Machine Learning Model Validation, Optimization, and Regularization **Topics:** Hyperparameter Tuning: Grid Search CV, Random Search CV, Machine Learning Model Validation - Confusion Matrix, Accuracy, Precision, Recall, F1 Score, Cost Function, Cross-Validation, Error Metrics (MSE, RMSE, MAE). Machine Learning Optimization Algorithms: Gradient Descent Techniques, Bayesian Optimization, Overfitting, Underfitting, Optimal Fit, Bias, Variance, Regularization - L1 Regularization, L2 Regularization, Elastic Net Regularization. **Applications:** model tuning for improved prediction accuracy, performance evaluation in classification tasks, optimization of machine learning models in healthcare, finance, and engineering applications.	

Course Outcome

Course Outcomes (COs)	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Describe the basic concepts and different types of Machine Learning techniques and to design Well Posed Learning System.	L2
2	Apply the learned concepts of the Supervised learning algorithms for regression and classification problems.	L3
3	Apply Unsupervised Machine Learning Algorithms such as Hard and Soft clustering and Dimensionality Reduction techniques for solving appropriate real-world applications.	L3
4	Make Use of the learned concepts of the Probabilistic Graphical Models and Ensemble Learning Methods for handling complex real time problems.	L3

5	Evaluate the performance of Machine Learning algorithms using appropriate metrics such as accuracy, precision, recall, FI Score and Make Use of the different Optimization and Regularization Techniques for improving the model performance.	L5

Mapping Levels of COs to POs / PSOs

Table: Mapping Levels of Cos to Pos / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	1	-	-	-	-	-	-	-	1	2	2	2
CO2	2	2	1	-	-	-	-	-	-	-	1	2	2	2
CO3	3	2	1	1	1	2	1	-	2	1	1	2	2	2
CO4	3	2	1	1	1	2	1	-	2	1	1	2	2	2
CO5	3	2	1	1	1	2	1	-	2	1	1	2	2	2
3: Substantial (High)						2: Moderate (Medium)						1: Poor (Low)		

TEXT BOOKS:

1. Machine Learning – Tom M. Mitchell, McGraw-Hill, 1st Edition, 1997.
2. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow – Aurélien Géron, O'Reilly Media, 3rd Edition, 2022.

REFERENCE BOOKS:

1. Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer, 1st Edition, 2006.
2. Introduction to Machine Learning with Python – Andreas C. Müller & Sarah Guido, O'Reilly Media, 1st Edition, 2017.

E-RESOURCES:

1. Accelerating End-to-End Data Science Workflows
https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+S-DS-01+V2

2. Best Practices in Feature Engineering for Tabular Data With GPU Acceleration
https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+S-DS-06+V1

3. **Accelerating Clustering Algorithms to Achieve the Highest Performance**
https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+S-DS-04+V1

4. **Exploring Adversarial Machine Learning**
https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+S-DS-03+V1

5. **Accelerate Data Science Workflows with Zero Code Changes**
https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+S-DS-03+V1

LAB EXERCISES

S.No	Exercise Title	Aim / Objective	Tools	Hrs	CO
MODULE I · Exercises 1–3 : Foundations of Machine Learning (06 Hours)					
1	Data Analysis and Visualization	Perform Exploratory Data Analysis and Visualize Features using the suitable Dataset (e.g: Iris Dataset)	Google Colab/ Jupyter	2 h	CO1
2	Handling Missing Values, Scaling Features	Preprocess Data by Handling Missing Values, Encoding Categorical Variables, and Scaling Features on Standard Dataset.	Google Colab/ Jupyter	2 h	CO1
3	Split Dataset, cross validation	Split Dataset into Training and Testing Sets and Apply Cross-Validation.	Google Colab/ Jupyter	2 h	CO1
MODULE II · Exercises 4–9 : Supervised Machine Learning Algorithms (12 Hours)					
4	Linear Regression	Implement Linear Regression to Predict House Prices using the Housing Price Dataset.	Google Colab/ Jupyter	2 h	CO2
5	Logistic Regression	Build a Logistic Regression Model to Perform Classification	Google Colab/ Jupyter	2 h	CO2
6	K-Nearest Neighbors (KNN)	Apply the K-Nearest Neighbors (KNN) Algorithm to perform classification on suitable dataet (e.g Classify Flower Species using the Iris Dataset)	Google Colab/ Jupyter	2 h	CO2
7	Decision Tree Model	Train and Visualize a Decision Tree Model to perform Classification (e.g. Wine Quality using the Wine Quality Dataset)	Google Colab/ Jupyter	2 h	CO2
8	**Random Forest Model**	Develop a Random Forest Model to perform Prediction. (e.g: Heart Disease using the Heart Disease Dataset)	Google Colab/ Jupyter	2 h	CO2

9	**Linear and Non-linear Support Vector Machine**	Implementation of Linear and Non-linear Support Vector Machine for Classification	Google Colab/ Jupyter	2 h	CO2
MODULE III ·Exercises 10–11 :Unsupervised Machine Learning Algorithms (04 Hours)					
10	K-Means Clustering	Apply K-Means Clustering to Perform Customer Segmentation. (e.g using the Mall Customer Segmentation Dataset)	Google Colab/ Jupyter	2 h	CO3
11	Principal Component Analysis	Apply Principal Component Analysis (PCA) to Reduce Feature Dimensions. (e.g: using the Wine Dataset)	Google Colab/ Jupyter	2 h	CO3
MODULE IV · Exercises 12 : Probabilistic Graphical Models and Ensemble Learning (02 Hours)					
12	Bagging, Boosting	Implement and compare ensemble techniques: Bagging (Random Forest) Boosting (AdaBoost / Gradient Boosting)	Google Colab/ Jupyter	2 h	CO4
MODULE V · Exercises 13–15 : Machine Learning Model Validation, Optimization, and Regularization (06 Hours)					
13	Model evaluation	Evaluate Classification Models by Computing Accuracy, Precision, Recall, F1-Score, and Confusion Matrix using dataset (e.g Breast Cancer Dataset)	Google Colab/ Jupyter	2 h	CO5
14	Hyperparameter Tuning	Perform Hyperparameter Tuning using Grid Search with Cross-Validation on suitable dataset (e.g: The Digits Dataset)	Google Colab/ Jupyter	2 h	CO5
15	Machine Learning Model to Solve a Real-World Engineering	Design and Implement a Machine Learning Model to Solve a Real-World Engineering Problem using an Open Engineering Dataset (e.g., Energy Consumption, Traffic Flow, or Predictive Maintenance Dataset)	Google Colab/ Jupyter	2 h	CO5

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INTRODUCTION TO DATA SCIENCE

[As per the Choice Based Credit System (CBCS) scheme]
SEMESTER - IV

Course Code : 25AD2406	**Credits:**02
Hours / Week:02	**Total Hours:**30
L–T–P–J: 2–0–0–0	**CIE+SEE:**60+40 Marks

Course Vision:
To provide foundational knowledge of data science concepts, statistical analysis, data preprocessing, and visualization techniques for solving real-world problems across multiple engineering domains.

Course Objectives:

1. This course will enable students:
2. Understand fundamental data science concepts and workflows
3. Apply statistical techniques and visualization for data analysis
4. Perform data cleaning and preprocessing
5. Use feature selection and dimensionality reduction methods
6. Gain exposure to scalable data analytics techniques

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods where teacher can use to accelerate the attainment of the various course outcomes:

1. **Lecture method** along with traditional lecture method, different type of teaching methods may be adopted to develop the course outcomes.
2. **Interactive Teaching:** incorporating brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Showing **Video/animation** films to explain functioning of various concepts.
4. Encourage **Collaborative** (Group Learning) Learning in the class.
6. To make **Critical thinking**, asking Higher order Thinking questions in the class in the form of Quiz and writing programs with complex solutions.
7. Showing the **different ways to solve** the same problem and encourage the students to come up with their own creative ways to solve them

Module 1: Basic Concepts and Python Packages	**06 Hours**

Topics: Predictive Modelling, Introduction: Data Preparation, Importance of Data Preparation, Data Cleaning, Feature Selection, Data Transformation, Python Packages: NumPy, Matplotlib, Pandas, SciPy, Scikit-learn, DataFrames, Loading Machine Learning data

Module 2: Descriptive Statistics and Data Visualization	**06 Hours**

Sampling, Data Analysis Process, Mean, Median, Standard Deviation, Skewness, Kurtosis, Data Visualization Techniques: Box Plot, Scatter Plot, Histogram, Bar Chart, Pie Chart, Heat Map, Correlation Analysis, Pivot Tables, ANOVA, Data Preprocessing, Rescaling, Standardization, Normalization, Binarization, Univariate and Bivariate Analysis, Recursive Feature Elimination, Principal Component Analysis

Module 3: Data Cleaning and Feature Selection	**06 Hours**
Handling Missing Data, Outlier Detection and Removal, Statistical Imputation, KNN Imputation, Iterative Imputation, Feature Selection Techniques, Methods for Categorical and Numerical Data, Feature Selection for Outputs, Recursive Feature Elimination, Importance of Feature Selection	
Module 4: Data Transformation and Dimensionality Reduction	**06 Hours**
Scaling Techniques, Min-Max Scaling, Standard Scaling, Handling Outliers, Encoding Categorical Data, Transforming Data Distributions, Feature Engineering, PCA, LDA, SVD Techniques	
Module 5: Accelerated Data Analytics	**06 Hours**
CPU vs GPU in Data Processing, Need for Fast Data Analytics, Introduction to RAPIDS, GPU-Accelerated Data Workflows, Handling Large Datasets Efficiently, Basic Concept of Accelerated DataFrame Operations, Overview of Machine Learning Acceleration, Identifying Processing Bottlenecks, Real-World Applications of Accelerated Data Analytics	

Course Outcomes (COs)

CO	Description
CO1	Explain basic data science concepts and data preprocessing techniques
CO2	Apply statistical methods and visualization techniques for data analysis
CO3	Perform data cleaning and feature selection for efficient data preparation
CO4	Apply data transformation and dimensionality reduction techniques
CO5	Understand scalable data analytics concepts using modern tools

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	1	2	-	-	-	-	-	1	2	2	-
CO2	3	3	2	2	3	-	-	1	-	-	1	2	2	-
CO3	2	3	2	2	3	-	-	1	2	1	1	2	2	-
CO4	2	2	3	3	3	1	-	1	2	1	1	2	2	-
CO5	2	3	2	1	3	1	1	1	2	1	1	2	2	-

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

TEXT BOOKS:

1. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big Data Analytics”, 1st Edition, Wiley, 2015.

2. Mohammed J. Zaki, Wagner Meira Jr., “Data Mining and Machine Learning: Fundamental Concepts and Algorithms”, 2nd Edition, Cambridge University Press, 2020.

References

1. Joel Grus – *Data Science from Scratch*
2. Wes McKinney – *Python for Data Analysis*

3. Jake VanderPlas – *Python Data Science Handbook*
4. Online documentation (Pandas, Scikit-learn, Matplotlib)
5. DLI Link: https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+T-DS-03+V1#:~:text=The%20course%20prerequisites%20include:%20*%20Basic%20understanding,the%20NVIDIA%20Deep%20Learning%20Institute%20at%20www.nvidia.com/dli
6. https://learn.nvidia.com/courses/course-detail?course_id=course-v1:DLI+C-DS-04+V1#:~:text=Build%20and%20compare%20classification%20models,learning%20and%20clustering%20on%20embeddings.

R-PROGRAMMING

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

SEMESTER – IV

Course Code	:	25AD2408	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	30(L) Hours
L–T–P-J	:	1–0–2-0			

Course Learning Objectives: This Course will enable students to:

1. To introduce the fundamentals of data science and data preprocessing techniques.
2. To develop the ability to perform statistical analysis and visualization of data.
3. To enable learners to apply feature engineering and dimensionality reduction techniques.
4. To equip students with scalable data analytics concepts using modern tools.
5. To train students to solve real-world engineering problems using data-driven approaches.

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. The lecture method includes traditional and interactive teaching methods to achieve course outcomes.
2. Interactive Teaching: Adopt active learning methods such as brainstorming, discussions, group activities, focused listening, and collaborative learning.
3. Use videos and animations to explain data science concepts and analytical techniques.
4. Encourage students to participate in collaborative and problem-solving activities.
5. Ask Higher Order Thinking questions to develop analytical and critical thinking skills.
6. Adopt Problem-Based Learning methods to improve interpretation and analytical abilities.
7. Demonstrate multiple approaches to solve the same analytical problem.
8. Discuss practical applications of data science concepts in engineering and industry

MODULE – I	**06 Hours**

INTRODUCTION TO DATA SCIENCE AND EXPLORATORY ANALYSIS: Introduction to Data Science and Data Analytics, Data Collection and Data Preparation, Introduction to Python/R Programming for Data Science, Exploratory Statistical Data Analysis, Frequency and Frequency Distribution, Cumulative Distribution Functions.

MODULE – II	**06 Hours**

DATA VISUALIZATION AND STATISTICAL MEASURES: Continuation of Exploratory Data Analysis, Graphical Procedures using Visualization Tools, Measures of Central Tendency, Measures of Variation, Moments and Statistical Interpretation, Data Visualization using Graphs and Charts, Data Manipulation using dplyr and Data Visualization using ggplot2.

MODULE – III	**06 Hours**

DATA ASSOCIATION AND FEATURE ANALYSIS: Skewness and Kurtosis, Scaling and Normalization of Data, Graphical Analysis for Association of Variables, Correlation and Covariance, Introduction to

Feature Selection, Visual Representation of Relationships in Data.	
MODULE – IV	**06 Hours**
DATA TRANSFORMATION AND DIMENSIONALITY REDUCTION: Data Transformation Techniques, Feature Engineering Concepts, Principal Component Analysis (PCA), Dimensionality Reduction Methods, Clustering Concepts and Applications, Analytical Procedures for Continuous Variables.	
MODULE – V	**06 Hours**
SCALABLE DATA ANALYTICS AND MODERN TOOLS: Introduction to Big Data Analytics, Scalable Data Processing Concepts, Cloud-based Data Analytics, Introduction to Hadoop and Spark, Real-time Data Analytics Concepts, Engineering Applications and Case Studies.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Explain basic data science concepts and data preprocessing techniques.	L2
2	Apply statistical methods and visualization techniques for data analysis.	L3
3	Perform data cleaning and feature selection for efficient data preparation.	L3
4	Apply data transformation and dimensionality reduction techniques.	L4
5	Understand scalable data analytics concepts using modern tools.	L2

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	1	2				1		1	2	1	
CO2	3	2	2	2	3			1	1		1	3	2	
CO3	2	3	2	3	3			1	1		1	3	2	1
CO4	2	3	3	3	3	1		1	1		2	2	3	2
CO5	2	2	2	2	3	1	1	1	1	1	3	2	3	2

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

TEXT BOOKS:

1. Joel Grus, *Data Science from Scratch*, O'Reilly Media, 2nd Edition, 2019.

REFERENCE BOOKS:

1. Jake VanderPlas, *Python Data Science Handbook*, O'Reilly Media, 2016.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, *An Introduction to Statistical Learning*, Springer, 2nd Edition, 2021.
3. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly Media, 3rd Edition, 2022.
4. Foster Provost and Tom Fawcett, *Data Science for Business*, O'Reilly Media, 2013.

E-Resources:

1. NPTEL Course – Data Science for Engineers.
2. Coursera – Applied Data Science with Python.
3. Kaggle Learning Resources and Datasets.

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DJANGO FRAMEWORK

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

SEMESTER – IV

Course Code	:	25AD2409	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	30
L–T–P-J	:	1–0–2-0			

Course Learning Objectives: This Course will enable students to:

1. Understand the architecture of Django as a high-level Python web framework and the client-server model
2. Build functional web pages using Django views, URL routing, and the Django Template Language with Bootstrap integration
3. Design and implement RESTful and GraphQL APIs using Node.js and Express, integrated with SQL and NoSQL databases
4. Implement form-based applications with user authentication, sessions, and input validation
5. Deploy a working Django web application and demonstrate awareness of REST API fundamentals

Teaching-Learning Process (General Instructions)

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

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain 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. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

MODULE – I	**06 Hours**

INTRODUCTION TO WEB DEVELOPMENT & DJANGO: Web architecture overview; client-server model; HTTP/HTTPS and request-response cycle; static vs. dynamic websites; introduction to web frameworks; Django overview and philosophy; Python refresher — virtual environments, pip, OOP basics; installing Django; project directory structure: settings.py, urls.py, wsgi.py; running the development server.

(Text Book 1: Chapter 1, Chapter 2; Text Book 2: Chapter 1)

MODULE – II	**06 Hours**

APPS, URL ROUTING, VIEWS & TEMPLATES: Creating and registering Django apps; MVT architecture; URL routing — urlpatterns, path(), include(); function based views: HttpRequest, HttpResponse; Django Template Language (DTL) — template inheritance, block, extends, include; template filters; static files;

integrating Bootstrap 5.	
MODULE – III	**06 Hours**
MODELS, DJANGO ORM & ADMIN INTERFACE: Defining Django models and field types (CharField, IntegerField, DateField, ForeignKey, ManyToManyField); migrations — makemigrations and migrate; ORM QuerySet API — .all(), .filter(), .get(), .create(), .update(), .delete(); CRUD via views; Admin Interface — list_display, search_fields, list_filter; superuser; manage.py shell.	
MODULE – IV	**06 Hours**
FORMS, AUTHENTICATION & SESSION MANAGEMENT: Authentication (JWT, bcrypt); authorization (RBAC, OAuth basics); API security (CORS, rate limiting, validation); Django Forms and Model Forms; file uploads; WebSockets and Socket.io; GraphQL basics.	
MODULE – V	**06 Hours**
REST API BASICS, DEPLOYMENT & MINI PROJECT: Introduction to REST architecture — HTTP methods, status codes; Django REST Framework (DRF) — Serializers, APIView; building a JSON API endpoint; testing with Postman; deployment — DEBUG=False, ALLOWED_HOSTS, collectstatic; deploying on PythonAnywhere / Render; Gunicorn and Whitenoise; Mini Project — students build and deploy a Django application incorporating models, views, templates, forms, authentication, and a REST endpoint .	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Explain the Django MVT architecture, project structure, and configure a working development environment.	L2
2	Develop functional web pages using Django views, URL routing, and the Django Template Language with Bootstrap.	L3
3	Design database models and perform CRUD operations using Django ORM and the Admin Interface.	L3
4	Implement Django Forms, user authentication, and session management in web applications.	L3
5	Build and deploy a Django web application with a basic REST API endpoint.	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	1	2	3
CO1	1	1	2									3		1
CO2	2	2	2									3		2
CO3	3	2	3									3		3
CO4	2	2	2	1	1							3		2
CO5	2	2	3	2	2	1						3	1	2

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

TEXT BOOKS:

1. William S. Vincent, Django for Beginners: Build Websites with Python and Django, WelcomeToCode, 4th Edition, 2022.
2. Antonio Melé, Django 4 By Example: Build Powerful and Reliable Python Web Applications from Scratch, Packt Publishing, 4th Edition, 2022.
3. Adam Charnock, Django REST Framework Basics, Agiliq, 2023.

E-Resources:

1. Django Official Documentation: https://docs.djangoproject.com
2. Django REST Framework: https://www.django-rest-framework.org
3. Django Girls Tutorial: https://tutorial.djangogirls.org
4. Real Python — Django Tutorials: https://realpython.com/tutorials/django
5. Full Stack Python (Django): https://www.fullstackpython.com/django.html
6. MDN Web Docs: https://developer.mozilla.org

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PROGRAMMING IN JAVA

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

SEMESTER – IV

Course Code	:	25AD2410	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	30
L–T–P-J	:	1–0–2-0			

Course Learning Objectives: This Course will enable students to:

1. To introduce the fundamentals of Java programming language and object-oriented concepts.
2. To develop problem-solving skills using Java programming constructs.
3. To enable learners to implement classes, inheritance, polymorphism, and exception handling.
4. To equip students with file handling and GUI programming concepts in Java.
5. To train students to develop simple real-world applications using 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 includes traditional and interactive teaching methods to achieve course outcomes.
2. Interactive Teaching: Adopt active learning methods such as brainstorming, coding discussions, debugging activities, and collaborative learning.
3. Use videos and animations to explain Java programming concepts and object-oriented principles.
4. Encourage students to participate in collaborative programming activities.
5. Ask Higher Order Thinking questions to develop logical and analytical thinking skills.
6. Adopt Problem Based Learning methods to improve programming and debugging abilities.
7. Demonstrate multiple approaches to solve the same programming problem.
8. Discuss practical applications of Java programming in software development.

MODULE – I	**06 Hours**

INTRODUCTION TO JAVA AND BASIC PROGRAMMING:

Introduction to Java, Features of Java, Java Virtual Machine, Structure of Java Program, Variables and Data Types, Operators, Control Statements, Arrays, Command Line Arguments.

MODULE – II	**06 Hours**

OBJECT ORIENTED PROGRAMMING CONCEPTS:

Classes and Objects, Constructors, Method Overloading, Inheritance, Method Overriding, Polymorphism, Abstract Classes, Interfaces, Packages.

MODULE – III	**06 Hours**

EXCEPTION HANDLING AND MULTITHREADING:

Exception Handling Concepts, Types of Exceptions, Try-Catch-Finally Block, Throw and Throws Keywords, Multithreading Concepts, Thread Lifecycle, Synchronization.	
MODULE – IV	**06 Hours**
FILE HANDLING AND COLLECTION FRAMEWORK: File Handling in Java, Input and Output Streams, File Reader and Writer, Collection Framework, List, Set, Map Interfaces, ArrayList and HashMap, Lambda Expressions.	
MODULE – V	**06 Hours**
GUI PROGRAMMING AND APPLICATION DEVELOPMENT: Introduction to AWT and Swing, Event Handling, GUI Components, Applets Basics, JDBC Introduction, Simple Java Application Development.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Explain the fundamentals of Java programming and object-oriented concepts.	L2
2	Apply Java programming constructs to solve computational problems.	L3
3	Implement object-oriented concepts such as inheritance, polymorphism, and exception handling in Java applications.	L3
4	Develop Java programs using file handling, multithreading, and collection framework concepts	L4
5	Design simple GUI-based and database-connected Java applications for real-world problems.	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	1	2	3
CO1	3	2	1	1	2				1		1	2	1	
CO2	3	2	2	2	3			1	1		1	3	2	
CO3	2	3	2	3	3			1	1		1	3	2	1
CO4	2	3	3	3	3	1		1	1		2	2	3	2
CO5	2	2	2	2	3	1	1	1	1	1	3	2	3	2

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

TEXT BOOKS:

1. Herbert Schildt, *Java: The Complete Reference*, McGraw Hill, 11th Edition, 2019.

REFERENCE BOOKS:

1. E. Balagurusamy, *Programming with Java*, McGraw Hill Education, 6th Edition, 2019.
2. Cay S. Horstmann, *Core Java Volume I – Fundamentals*, Pearson Education, 11th Edition, 2018.
3. Kathy Sierra and Bert Bates, *Head First Java*, O'Reilly Media, 3rd Edition, 2022.
4. Deitel and Deitel, *Java How to Program*, Pearson Education, 11th Edition, 2018.

E-Resources:

1. NPTEL Course – Programming in Java.
2. Oracle Java Documentation and Tutorials.
3. W3Schools Java Programming Tutorials.

WEB TECHNOLOGY (HTML, CSS, JAVASCRIPT)

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

SEMESTER – IV

Course Code	:	25AD2411	**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	30
L–T–P-J	:	1–0–2-0			

Course Learning Objectives: This Course will enable students to:

1. Understand the structure and design of web pages using HTML.
2. Apply CSS techniques for styling and layout design.
3. Develop interactive web pages using JavaScript.
4. Integrate HTML, CSS, and JavaScript to build complete front-end applications.
6. Analyze and improve usability and responsiveness of web interfaces.

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 includes traditional and interactive teaching methods to achieve course outcomes.
2. Interactive Teaching: Adopt active learning methods such as brainstorming, coding discussions, debugging activities, and collaborative learning.
3. Use videos and animations to explain Java programming concepts and object-oriented principles.
4. Encourage students to participate in collaborative programming activities.
5. Ask Higher Order Thinking questions to develop logical and analytical thinking skills.
6. Adopt Problem Based Learning methods to improve programming and debugging abilities.
7. Demonstrate multiple approaches to solve the same programming problem.
8. Discuss practical applications of Java programming in software development.

MODULE – I	**06 Hours**

HTML Fundamentals

Introduction to Web Development, Structure of HTML Document, Basic Tags (head, body, title), Text Formatting Tags, Lists, Links, Images.

MODULE – II	**06 Hours**

ADVANCED HTML

Tables, Forms (input types, form elements), Frames (basic concepts), Semantic HTML (header, footer, section, article), Multimedia elements (audio, video).

MODULE – III	**06 Hours**

CSS FUNDAMENTALS

Introduction to CSS, Inline, Internal, External CSS, Selectors (class, id, element), Colors, Fonts, Text Styling.

MODULE – IV	**06 Hours**

ADVANCED CSS	
Box Model, Margins, Padding, Borders, Display Properties, Positioning, Flexbox/Grid (basics), Responsive Design basics. UI layout optimization using Flexbox/Grid, Responsive design testing across devices, UI/UX evaluation techniques.	
MODULE – V	**06 Hours**
JavaScript Introduction to JavaScript, Variables, Data Types, Operators, Control Statements, Functions, Arrays, Objects, Events, Basic DOM Manipulation, Code generation and debugging techniques, Integration with external APIs (chatbots, recommendation systems), Asynchronous programming (Promises, async/await).	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Explain the structure and elements of HTML	L2
2	Design web pages using HTML tags and layouts	L3
3	Apply CSS for styling and responsive design	L4
4	Develop interactive web pages using JavaScript	L5
5	Integrate HTML, CSS, and JavaScript for complete web applications	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	1	2	3
CO1	-	1	1	2	-	-	-	1	-	1	2	1	-	-
CO2	3	2	2	2	3	-	-	1	1	-	1	3	2	-
CO3	3	3	2	2	3	-	-	1	1	-	1	3	2	1
CO4	3	3	3	3	3	1	-	1	1	-	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	3	2	3	3

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

TEXT BOOKS:

1. Jon Duckett – HTML & CSS: Design and Build Websites
2. Jon Duckett – JavaScript & jQuery

E-Resources:

1. Introduction to Internet Technology (NPTEL Course)
2. W3Schools
3. MDN Web Docs
4. FreeCodeCamp