MITS Kochi
Muthoot Institute of Technology and Science
(Autonomous)

B. TECH

COMPUTER SCIENCE & ENGINEERING (ARTIFICIAL INTELLIGENCE)

CURRICULUM & SYLLABUS

2025 REGULATION

B.Tech

COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE)

2025 REGULATION

CURRICULUM & SYLLABUS

CONTENTS

SEMESTER 2

CURRICULUM

SLOT	COURSE CATEGORY	COURSE CODE	COURSE NAME	L	T	J	P	S	C
A	BST	B250904/MA200A	Mathematics for Information Science-2	3	1	0	0	2	3
B	BSE	B250904/PH910B	Physics for Information Science	3	0	0	2	3	4
C	EST	B250802/CN200C	Foundations of Artificial Intelligence and Data Science	3	1	0	0	2	3
D	EST	B250802/CN210D	Programming in C++	2	0	0	2	4	4
E	PCT	B250904/CN200E	Discrete Mathematics	3	1	0	0	4	4
F	ESB	B250908/CN220F	Entrepreneurship and IPR	2	0	1	0	3	3
K	HMT	B250908/CN900K	Life Skills and Professional Communication	1	0	0	1	0	1
U	ESL	B250904/CN230U	IT Workshop	0	0	0	2	0	1
G	Skill Enhancement Course: NASSCOM or equivalent								1
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work, C- Credit)									

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-2**	**Version**	**25/0**	**Credits**	3
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
B250904/MA200A	**Mathematics for Information Science - 2**	**BST**
Pre-requisite		
The basic knowledge of matrices & vectors.		

COURSE OBJECTIVES	
1	To develop a fundamental understanding of linear systems of equations, matrix methods such as Gaussian elimination, rank, eigenvalues, eigenvectors, and diagonalization, and to apply them in solving algebraic problems.
2	To acquire knowledge of vector spaces, subspaces, and spanning sets, and to apply basis, dimension, and transition matrices in understanding coordinate representations.
3	To introduce inner product spaces and their properties, and to apply orthogonality, Gram–Schmidt process, and least squares methods to solve approximation and projection problems.
4	To apply the theory of linear transformations to compute kernel, range, rank, and nullity, and to represent transformations using matrices in analytical and engineering context

COMPETENCY STATEMENT (CC)	
CC 1	Demonstrate the ability to apply matrix methods to solve linear systems, compute eigenvalues and eigenvectors, and use diagonalization to simplify matrix computations.
CC 2	Demonstrate the ability to apply concepts of vector spaces and inner product spaces to construct bases and orthonormal sets, solve least squares problems, and use matrices, rank, and nullity to represent linear transformations.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	**Solve** linear systems of equations by applying the properties of matrices and vectors.	CC 1	A	-	Rs
CO 2	**Explain** the concept of vector space, basis and transition matrix.	CC 2	U	-	Rs
CO 3	**Apply** the concept of inner product spaces in the orthonormalization process.	CC 2	A	-	Rs
CO 4	**Use** the theory of matrix algebra to find the rank and nullity of linear transformations.	CC 2	A	-	Rs

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

CO	Program Outcomes & Program Specific Outcomes Correlation Matrix													
	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	2									1			
2	2	2									1			
3	2	2									1			
4	2	2									1			

Correlation [3 – High, 2 -Medium, 1 – Low]

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1	0	0	2	3	90	40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Linear Algebra	Linear systems of equations, Solution by Gauss elimination, Row echelon form and rank of a matrix, Fundamental theorem for linear systems - homogeneous and non-homogeneous (without proof), Eigenvalues and Eigenvectors of matrices, Diagonalization of matrices. [Relevant topics from Text 1- sections 7.3, 7.4, 7.5, 8.1, 8.4]	10
2	Vector Spaces	Vector Spaces, Examples of vector space $-R^n$, $M_{m\times n}$ and P_2 only, Subspaces, Examples as subspaces of R^n, $M_{m\times n}$, Linear combinations of vectors in a vector space, Spanning sets, Linear dependence and independence, Basis for a vector space, The dimension of vector space, Coordinate representation in R^n, Change of basis in R^n: Transition Matrix (without proof). [Relevant topics from Text 2 - sections 4.2, 4.3, 4.4, 4.5, 4.7]	12
3	Inner Product Spaces	Vector length and unit vector, Dot product and angle between two vectors, The Cauchy- Schwarz Inequality, Inner product, Examples as R^n and $M_{2\times 2}$, Properties of inner products, Definitions of length, distance and angle, Orthogonal projections in inner product spaces, Orthogonal and orthonormal sets, Orthogonal and orthonormal basis, Gram-Schmidt orthonormalization process (without proof), The least squares problem, Orthogonal Subspaces, Solving the least square problems. [Relevant topics from Text 2 - sections 5.1, 5.2, 5.3, 5.4]	10
4	Linear Transformations	Linear Transformations, Properties of linear transformations, Linear Transformation given by a matrix, Rotation in R^2, Projection in R^3, Kernel of a Linear Transformation and its basis, Range of a Linear Transformation and its basis, Rank and Nullity of a Linear Transformation, Sum of Rank and Nullity (without proof), Matrices for Linear Transformations. [Relevant topics from Text 2 - sections 6.1, 6.2, 6.3]	10

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Symmetric matrix, Skew-symmetric matrix, Orthogonal Matrix, Properties of eigenvalues of Symmetric matrix, Skew-symmetric matrix, Orthogonal Matrix (1 hour) Practice problems on solving systems of linear equations using Gauss elimination (1 hour), finding eigenvalues and eigenvectors (2 hours), diagonalization (2 hours), quadratic forms and their canonical forms (2 hours) Team Work - Solve mathematically and write a Python program that computes the eigenvalues and corresponding eigenvectors of matrices and visualize the eigenvectors as arrows originating from the origin (1 hour).	9
2	Addition and scalar multiplication of polynomials, matrices and vectors in R^n (1 hour), Practice problems on example of vector spaces, subspaces (2 hours), Practice problems on Linear dependence and independence of vectors (2 hours), Practice problems on basis vector space and dimension of a vector space (2 hours), Team Work - Given two bases B and B' of R^2 and a vector v expressed in basis B. Solve mathematically and write a Python program that compute the transition matrix $P_{B\to B'}$, Also convert the coordinates of v from basis B to basis B′ and visualize both bases and the vector before and after the transformation (2 hours).	9

3	Vector length and unit vector, Dot product and angle between two vectors (1 hour), Practice problems on orthogonal projections in inner product spaces (2 hours), Practice problems on Gram-Schmidt orthonormalization process (2 hours), Practice problems on the least squares problem (2 hours). Team Work - Solve mathematically and write a Python program that takes linearly independent vectors as input, apply the Gram-Schmidt process to convert them into an orthonormal set. Also plot the original and orthonormal vectors in 3D (2 hours).	9
4	Practice problems on Linear Transformation given by a matrix (2 hours), Practice problems on Rotation in R^2, Projection in R^3(2 hours), Practice problems on Kernel of a Linear Transformation and its basis (1 hour), Practice problems on rank and nullity of a linear transformation (1 hour), Practice problems on matrices for linear transformations (1 hour), Team Work - Solve mathematically and write a Python program to explore and visualize linear transformations in two-dimensional space. Given a transformation matrix A, your program defines a triangle using a given set of points and apply the transformation A to all points of the shape. Also Plot the original shape and the transformed shape on the same axes for comparison (2 hours).	9

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons 10th edition, 2016
2	Elementary Linear Algebra	Ron Larson	Cengage Learning 8th edition, 2017

Reference			
Sl. No.	Title of Book	Author	Publication
1	Mathematics for Machine Learning	Marc Peter Deisenroth, A. Aldo Faisal & Cheng Soon Ong	Cambridge University Press 1st edition, 2020
2	Linear algebra and learning from data	Gilbert Strang Wellesley	Cambridge Press 1st edition, 2019
3	Elementary Linear Algebra	Stephen Andrilli & David Hecker	Academic Press Inc. 4th edition, 2010
4	Elementary Linear Algebra	Howard Anton, Chris Rorres	Wiley 11th edition, 2019

Web Resource	
1	nptel.ac.in/courses/111101115
2	nptel.ac.in/courses/111104137
3	nptel.ac.in/courses/111102012

DETAILED SYLLABUS (*Self – learning if any to be marked*)

Module	Topic	Mode of Delivery	CO	Learning Domain			Hrs
				C	P	A	
1	Matrix operations and properties	S	CO1	U			
	Linear systems of equations	L	CO1	U			1
	Solution by Gauss elimination,	L	CO1	A			1
	Tutorial Problems	T	CO1	U		Rs	1

	Row echelon form and rank of a matrix	L	CO1	A			1
	Fundamental theorem for linear systems - homogeneous and non-homogeneous (without proof)	L	CO1	A			2
	Eigenvalues and Eigenvectors of matrices	L	CO1	U			2
	Tutorial Problems	T	CO1	U		Rs	1
	Symmetric matrix, Skew-symmetric matrix, Orthogonal Matrix	S	CO1	U			
	Properties of eigenvalues of Symmetric matrix, Skew-symmetric matrix, Orthogonal Matrix	S	CO1	U			
	Diagonalization of matrices	L	CO1	A			2
	Tutorial Problems	T	CO1	U		Rs	1
2	Vector Spaces	L	CO2	U			1
	Examples of vector space – R^n, $M_{m\times n}$ and P_2 only	L	CO2	U			1
	Subspaces, Examples as subspaces of R^n, $M_{m\times n}$	L	CO2	U			1
	Tutorial Problems	T	CO2	U		Rs	1
	Linear combinations of vectors in a vector space	L	CO2	U			1
	Spanning sets	L	CO2	U			1
	Linear dependence and independence	L	CO2	U			1
	Tutorial Problems	T	CO2	U		Rs	1
	Basis for a vector space	L	CO2	U			2
	The dimension of vector space	L	CO2	U			1
	Coordinate representation in R^n	L	CO2	U			1
	Change of basis in R^n : Transition Matrix (without proof)	L	CO2	U			2
	Tutorial Problems	T	CO2	U		Rs	1
3	Vector length and unit vector Dot product and angle between two vectors	S	CO3	U			
	The Cauchy- Schwarz Inequality	L	CO3	U			1
	Inner product, Examples as R^n and $M_{2\times 2}$	L	CO3	U			1
	Properties of inner products	L	CO3	U			1
	Tutorial Problems	T	CO3	U		Rs	1
	Definitions of length, distance and angle	L	CO3	U			1
	Orthogonal projections in inner product spaces	L	CO3	A			1
	Orthogonal and orthonormal sets	L	CO3	U			1
	Orthogonal and orthonormal basis	L	CO3	A			1
	Gram-Schmidt orthonormalization process (without proof)	L	CO3	A			1
	Tutorial Problems	T	CO3	U		Rs	1
	The least squares problem	L	CO3	A			1
	Orthogonal Subspaces	L	CO3	U			1
	Tutorial Problems	T	CO3	U		Rs	1
	Linear Transformations	L	CO4	U			1

4	Properties of linear transformations	L	CO4	U			1
	Linear Transformation given by a matrix	L	CO4	U			1
	Tutorial Problems	T	CO4	U		Rs	1
	Rotation in R^2, Projection in R^3	L	CO4	A			1
	Kernel of a Linear Transformation and its basis	L	CO4	U			1
	Range of a Linear Transformation and its basis	L	CO4	U			1
	Tutorial Problems	T	CO4	U		Rs	1
	Rank and Nullity of a Linear Transformation	L	CO4	U			1
	Sum of Rank and Nullity (without proof)	L	CO4	U			1
	Matrices for Linear Transformations	L	CO4	U			2
	Tutorial Problems	T	CO4	U		Rs	1

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Linear Algebra	✓	✓	✓				15
2	Vector Spaces	✓	✓					15
3	Inner Product Spaces	✓	✓	✓				15
4	Linear Transformations	✓	✓	✓				15

ASSESSMENT PATTERN

Assessment	Marks
Continuous Internal Assessment	**40**
1. Internal Examination	20
2. Learning Activity	15
3. Regularity	5
4. Course Project	0
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, DECEMBER 2025 (2025 SCHEME)			
Course Code:	B250904/MA200A		
Course Name:	MATHEMATICS FOR INFORMATION SCIENCE-2		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Common to CS, CY, AI, AD.			

PART A

(Answer all questions. Each question carries 3 marks)

No.	***Question***	***CO***	***Marks***
1	Choose the number q so that (if possible) the ranks of $A = \begin{bmatrix} 6 & 4 & 2 \\ -3 & -2 & -1 \\ 9 & 6 & q \end{bmatrix}$ are: (a) 1, (b) 2, (c) 3.	CO1	(3)
2	If $A = \begin{bmatrix} 0 & 1 \\ * & * \end{bmatrix}$ has eigen values 4 and 7, find the second row of A.	CO1	(3)
3	Union of two subspaces of a vector space V is not necessarily a subspace of V. Substantiate.	CO2	(3)
4	Check whether the set of vectors $\{(1,2,3),(0,1,2),(-2,0,1)\}$ are linearly independent or not.	CO2	(3)
5	For polynomials $p = a_0 + a_1x + a_2x^2$ and $q = b_0 + b_1x + b_2x^2$ in P^2 the inner product is defined by $< p, q >= a_0b_0 + a_1b_1 + a_2b_2$. Let $p(x) = 1 - 2x^2$, $r(x) = x + 2x^2$ and q$(x) = 4 - 2x + x^2$,then: (a) Find the angle between q and r. (b) Verify Cauchy Schwarz inequality for p and q.	CO3	(3)
6	Find the vector v in the direction of u = (1, 2, 2) with length 3.	CO3	(3)
7	Determine whether $T: R^2 \to R^3$ given by $T(x, y) = (x^2, xy, y^2)$ is a linear transformation or not.	CO4	(3)
8	Let $T: R^2 \to R^2$be a linear transformation defined by $T(x, y) = (x - y, x + 3y)$. Find the standard matrix for T.	CO4	(3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

No.		***Question***	***CO***	***Marks***
MODULE I				
9	a)	There are three servers processing tasks in a distributed computing environment. Each server handles a different number of tasks, and you want to balance the workload based on current processing capacities. Let x, y and z be the number of tasks processed by servers 1, 2, and 3 respectively, such that $x + y + z = 6, x + 2y + 3z = 10, x + 2y + \alpha z = \beta$. Determine the values of α and β so that 1. the workload distribution is unique, 2. the workload distribution is not possible, 3. there are multiple possible workload distributions.	CO1	(5)
	b)	Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 11 & -4 & -7 \\ 7 & -2 & -5 \\ 10 & -4 & -6 \end{bmatrix}$.	CO1	(4)
OR				
10	a)	Diagonalize the matrix $\begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 1 \end{bmatrix}$.	CO1	(5)
	b)	In a computer simulation, the total processing time Tdepends linearly on three tasks: input loading (x), computation (y), and data transfer (z). For three different test runs, the observations are $x + y + z = 1, x + 2y + 4z = 2, x + 4y +$	CO1	(4)

		$10z = 4$. Use the Gauss elimination method to determine the time contribution of each task.		
MODULE II				
11	a)	Determine whether the given subsets of $R^3$are vector subspaces; 1. the plane of vectors (x, y, z) that satisfy $y - x + z = 0$. 2. the plane of vectors whose third component is -1.	CO2	(5)
	b)	Let W be the subspace of all symmetric $2x2$ matrices over R. Find a basis and dimension of W.	CO2	(4)
OR				
12	a)	Given B = {(1, 3), (−2, −2)} and B′ = {(−12, 0), (−4, 4)} are two bases of $R^2$and $[x]_{B'} = [-1\ 3\ ]$. 1. Find the transition matrix from B′ to B. 2. Find the coordinate matrix $[x]_B$, given the coordinate matrix $[x]_{B'}$.	CO2	(5)
	b)	Check whether the set $W = \{(x, y): x \geq 0, y \text{ is a real number}\}$ along with the standard operations is a vector space or not?	CO2	(4)
MODULE III				
13	a)	Apply the Gram-Schmidt orthonormalization process to transform the basis $B = \{(1,0,-1), (1,0,3), (0,1,2)\}$ for R^3into an orthonormal basis.	CO3	(6)
	b)	Find $(u + v).(2u - v)$ when $u.u = 4, u.v = -5$ and $v.v = 10$.	CO3	(3)
OR				
14	a)	A hardware retailer wants to know the demand for a rechargeable power drill as a function of price. The ordered pairs (25, 82), (30, 75), (35, 67) and (40, 55) represent the price x (in dollars) and the corresponding monthly sales y. (a) Find the least squares regression line for the data. (b) Estimate the demand when the price is $32.95.	CO3	(6)
	b)	Find the orthogonal projection of u = (−3, −1) onto v = (6, 3) in R^2.	CO3	(3)
MODULE IV				
15	a)	Find the Kernel of the linear transformation $T: R^2 \to R^2$ defined by $T(X) = AX$ where $A = \begin{bmatrix} 1 & -1 & -2 \\ -1 & 2 & 3 \end{bmatrix}$.	CO4	(5)
	b)	Let $T: R^3 \to R^3$ be a linear transformation such that $T(1,1,1) = (2,0,-1)$, $T(0,-1,2) = (-3,2,-1)$ *and* $T(1,0,1) = (1,1,0)$. Find $T(-2,1,0)$.	CO4	(4)
OR				
16	a)	Let $T: R^3 \to R^2$ be a linear transformation defined by T (x, y, z) = (3x − 2z, 2y − z). Find the matrix for T relative to the bases B = {(1, 0, 1), (1, −1, 0), (0, 1, 1)} and C = {(1, 1), (1, 0)}.	CO4	(5)
	b)	Find the rank and nullity of the linear transformation $T: R^3 \to R^3$ defined by the matrix A = $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$.	CO4	(4)

****

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-2-3**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
B250904/ PH910B	**Physics for information science**	**BSE**
Pre-requisite		
Basics of electricity, basics of dual nature of matter and radiation, basics of semiconductor materials and devices		

COURSE OBJECTIVES	
1	To develop a strong foundation in fundamentals of physics employed in information science disciplines.
2	To equip students with practical skills required in setting and characterizing semiconductor and optical devices.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate ability to apply microscopic theories of electrical conductivity to solve basic problems in electrical conductivity of metals and superconductors.
CC2	Demonstrate ability to apply the principles of semiconductors and quantum mechanics to solve basic problems in semiconductor circuits and atomic structure.

COURSE OUTCOME (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	Apply free electron theory and BCS theory to find electrical conductivity in metals and superconductors.	CC1	A		
CO 2	Apply the Schrodinger equation to a one-dimensional quantum mechanical system for finding energy levels in such systems	CC2	A		
CO 3	Apply the theory of semiconductors in a p-n junction under forward and reverse biased conditions	CC2	A	M	Rs
CO 4	Apply the theory of semiconductors to characterize semiconductor devices and circuits	CC2	A	M	Rs

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create.*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation.* ***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

CO	Program Outcomes & Program Specific Outcomes Correlation Matrix													
	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	2			1		2	2	2		2			
2	2	2			1		2	2	2		2			
3	2	2			1		2	2	2		2			
4	2	2			1		2	2	2		2			

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme						
							Theory			Practical			Total
L	T	J	P	S	C		CIA	ESE	Total	CIA	ESE	Total	
3	0	0	2	3	4	120	25	60	85	15	0	15	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Electrical conductivity	Electrical conductivity of metals, Band theory, Superconductivity	9
2	Quantum mechanics	Uncertainity principle, Schrodinger equation, Particle in one-dimensional potential well	9
3	Semiconductor physics	Intrinsic carrier concentration, Extrinsic semiconductor, Diode equation	9
4	Semiconductor devices	Half wave rectifier, full wave rectifier, Semiconductor laser, photo diode, solar cell, Light emitting diode	9

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Resistivity and conductivity (Self-Learning 1) - Atomic structure and band theory (Self-Learning 2) - Isotopic effect and critical field (Self-Learning 3)	6
2	de Broglie waves (Self-Learning 4) - Uncertainity principle (Self-Learning 5) - Quantum computers (Self-Learning 6)	6
3	Intrinsic semiconductors (Self-Learning 7) - Extrinsic semiconductors (Self-Learning 8) - LED (Self-Learning 9) - Zener diode as voltage regulator (Self-Learning 10) - Tunnel diode (Self-Learning 11)	10
4	Semiconductor laser (Self-Learning 12)- Photo diode (Self-Learning 13) - Solar cell (Self-Learning 14) - Half wave rectifier (Self-Learning 15) - Full wave rectifier (Self-Learning 16)	10
5	Prelab assignment 1-10	20
6	Practice problems 1-6	12

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	A Textbook of Engineering Physics	MN Avadhanulu, P G Kshirsagar, TVS Arun Murthy	S. Chand, 11th Edition, 2018
2	Engineering Physics	H K Malik, A.K. Singh,	McGraw2nd Edition, 2017 Hill Education,

Reference			
Sl. No.	Title of Book	Author	Publication
1	Advanced Engineering Physics	Premlet B	Phasor Books 10th Edition, 2017
2	A Text Book of Engineering Physics	I. Dominic and. A. Nahari	Owl Books Revised Edition, 2016
3	Semiconductor Devices	Kanaan Kano	PHI Learning, 2008
4	Semiconductor Physics and Devices	Donald A Neamen, Dhrubes Biswas	McGraw Hill Education, 4th Edition, 2017

Web Resource	
1	https://nptel.ac.in/courses/113104012
2	https://archive.nptel.ac.in/courses/115/103/115103108/

3	https://nptel.ac.in/courses/115106066
4	https://nptel.ac.in/courses/108108122

DETAILED SYLLABUS *(Self-learning if any to be marked)*								
Module	**Title**	**Topic**	**Mode of Delivery**	**CO**	**Learning Domain Level**			**Hrs**
					C	**P**	**A**	
1	Electrical conductivity	Classical free electron theory, Electrical conductivity in metals	L	CO1	A	M	Rs	1
		Expression for electrical conductivity in metals	L	CO1	A	M	Rs	1
		Fermi energy	L	CO1	A	M	Rs	1
		Practice problems 1	S	CO1	A			
		Prelab assignment 1	S	CO1	A			
		Self-Learning 1	S	CO1	A			
		Fermi Dirac distribution, Variation of Fermi function with temperature, Fermi energy	L	CO1	A	M	Rs	1
		Energy bands, Classification of materials into conductors, semiconductors and insulators	L	CO1	A	M	Rs	1
		Superconductivity, Transition temperature, Critical field, Meissner effect	L	CO1	A	M	Rs	1
		Prelab assignment 2	S	CO1	A			
		Self-Learning 2	S	CO1	A			
		Type I and Type II superconductors	L	CO1	A	M	Rs	1
		BCS theory	L	CO1	A	M	Rs	1
		Applications of superconductors	L	CO1	A	M	Rs	1
		Practice problems 2	S	CO1	A			
2	Quantum Mechanics	Prelab assignment 3	S	CO2	A			
		Self-Learning 3	S	CO2	A			
		Uncertainity principle, conjugate observables	L	CO2	A	M	Rs	1
		Application of uncertainity principle – Absence of electron inside nucleus, Natural line broadening	L	CO2	A	M	Rs	1
		Wave function, properties, physical interpretation	L	CO2	A	M	Rs	1
		Practice problems 3	S	CO2	A			
		Prelab assignment 4	S	CO2	A			
		Self-Learning 4	S	CO2	A			

		Formulation of time dependent Schrodinger equation	L	CO2	A	M	Rs	1
		Time independent Schrodinger equation	L	CO2	A	M	Rs	1
		Time independent Schrodinger equation	L	CO2	A	M	Rs	1
		Prelab assignment 5	S	CO2	A			
		Self-Learning 5	S	CO2	A			
		Particle in a one-dimensional potential well	L	CO2	A	M	Rs	1
		Derivation of eigen values and normalized wave function	L	CO2	A	M	Rs	1
		Quantum mechanical tunnelling	L	CO2	A	M	Rs	1
3	Semiconductor Physics	Prelab assignment 6	S	CO3	A			
		Self-Learning 6	S	CO3	A			
		Intrinsic semiconductor	L	CO3	A	M	Rs	1
		derivation of density of electrons in conduction band	L	CO3	A	M	Rs	1
		Density of holes in valence band	L	CO3	A	M	Rs	1
		Practice problems 4	S	CO3	A			
		Prelab assignment 7	S	CO3	A			
		Self-Learning 7	S	CO3	A			
		Intrinsic carrier concentration, variation of intrinsic carrier concentration with temperature, Extrinsic semiconductor	L	CO3	A	M	Rs	1
		Formation of p-n junction, Fermi level in semiconductors, intrinsic and extrinsic	L	CO3	A	M	Rs	1
		Energy band diagram of p-n junction, charge flow across p-n junction	L	CO3	A	M	Rs	1
		Practice problems 5	S	CO3	A			
		Prelab assignment 8	S	CO3	A			
		Self-Learning 8, Self-Learning 9	S	CO3	A			
		Forward and reverse biased p-n junction	L	CO3	A	M	Rs	1
		I-V characteristics of p-n junction	L	CO3	A	M	Rs	1
		Diode equation	L	CO3	A	M	Rs	1
		Self-Learning 10, Self-Learning 11	S	CO3	A			
4	Semiconductor Devices	Prelab assignment 9	S	CO4	A			
		Self-Learning 12	S	CO4	A			
		Half wave rectifiers	L	CO4	A	M	Rs	1
		Full wave rectifier	L	CO4	A	M	Rs	1

		Zener diode- VI characteristics, Tunnel diode, VI characteristics	L	CO4	A	M	Rs	1
		Practice problems 6	S	CO4	A			
		Prelab assignment 10	S	CO4	A			
		Self-Learning 13	S	CO4	A			
		Semiconductor laser, applications	L	CO4	A	M	Rs	1
		Photo detectors -Junction photo diode	L	CO4	A	M	Rs	1
		PIN photodiodes	L	CO4	A	M	Rs	1
		Self-Learning 14	S	CO4	A			
		Solar cell – construction and working	L	CO4	A	M	Rs	1
		VI characteristics - Efficiency, Stringing of solar cells to solar panel	L	CO4	A	M	Rs	1
		Light Emitting Diode, Applications	L	CO4	A	M	Rs	1
		Self-Learning 15, Self-Learning 16	S	CO4	A			

PRACTICAL SYLLABUS

Module	Topic	Objective	CO	Learning Domain Level			Hrs
				C	P	A	
1	Diffraction grating	To determine the wavelength of laser using grating	CO4	A	M	Rs	2
2	Diode characteristics	To determine the characteristics of a diode	CO3	A	M	Rs	2
3	Cathode Ray Oscilloscope	To determine voltage and frequency of an electronic signal from function generator	CO3	A	M	Rs	2
4	LED characteristics	To determine the characteristics of an LED	CO4	A	M	Rs	2
4	Solar cell	To determine the characteristics of a solar cell	CO4	A	M	Rs	2
4	Numerical aperture	To determine numerical aperture of an optical fiber	CO4	A	M	Rs	2
4	Zener diode characteristics	To determine the characteristics of a zener diode	CO4	A	M	Rs	2
4	Half wave rectifier	To determine input and output waveforms through a half wave rectifier	CO4	A	M	Rs	2
4	Full wave rectifier	To determine input and output waveforms	CO4	A	M	Rs	2

		through a half wave rectifier					
4	Photo diode characteristics	To determine the characteristics of a photo diode	CO4	A	M	Rs	2

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)								
Module	Module Title	Distribution of Marks (Revised Bloom's Level)						Total Marks
		R	U	A	An	E	C	
1	Electrical conductivity	√	√	√				15
2	Quantum Mechanics	√	√	√				15
3	Semiconductor Physics	√	√	√				15
4	Semiconductor Devices	√	√	√				15

ASSESSMENT PATTERN		
Assessment		**Marks**
Continuous Internal Assessment		40
1	Internal Examination	20
2	Continuous Lab Evaluation	15
3	Learning Activity	--
4	Regularity	5
5	Course Project	--
End Semester Examination - Lab		--
End Semester Examination _ Theory		60
Total		**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**B250904/PH910B**		
Course Name:	**PHYSICS FOR INFORMATION SCIENCE**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Common to Computer Science branches			
Use of Calculators are permitted.			

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	Free electron theory is used only for metals. What are its drawbacks?	CO1	(3)
2	Meissner effect is the hallmark of superconductivity. Explain it with the help of a diagram.	CO1	(3)
3	Physical meaning of wave function was given by Max Born. What was his interpretation of wave function?	CO2	(3)
4	Alpha particles with energy less than nuclear potential barrier can cross it. How will you explain it?	CO2	(3)
5	Intrinsic semiconductor is not suitable for device fabrication. Give reason.	CO3	(3)
6	Width of the depletion region varies with biasing in a pn junction. Explain it with the help of a diagram.	CO3	(3)
7	Photo diode is a light sensitive device. Explain its working.	CO4	(3)
8	Distinguish between PIN and junction photo diodes.	CO4	(3)

PART B				
(Answer any one full question from each module, each question carries 9 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
9	a)	Starting with postulates of free electron theory, derive an expression for electrical conductivity of metals with free electrons.	CO1	(6)
	b)	Estimate the collision time of conduction electrons in a metal if its resistivity is 1.54 x 10^{-8} Ωm and has 5.8 x 10^{28} conduction electrons/m^3.	CO1	(3)
OR				
10	a)	Type II superconductors are commonly used for practical applications. Give an account of type I and type II superconductor with examples. Give four applications of superconductors.	CO1	(6)
	b)	Lead in the superconducting state has critical temperature of 7.26 K and a critical field of 8 x 10^5 A/m at 0 K. Determine the critical field at 5 K.	CO1	(3)
MODULE II				
11	a)	Write the Schrodinger's equation for a particle in a one-dimensional potential well and obtain the expression for normalized wave function and energy eigen values.	CO2	(6)
	b)	Calculate the separation between the two lowest energy levels of an electron in a one dimensional box of width 4 Å in Joules.	CO2	(3)
OR				
12	a)	Using separation of variable method, solve time-dependent Schrodinger equation and obtain the time-independent Schrodinger equation.	CO2	(6)
	b)	Calculate the uncertainty in velocity of an electron which is confined in a 10 Å box.	CO2	(3)
MODULE III				
13	a)	Derive an expression for electron density in conduction band and hole density in valence band, thereby give an expression for intrinsic carrier concentration.	CO3	(6)
	b)	If the effective mass of an electron is equal to twice the effective mass of hole, determine the position of the Fermi level in an intrinsic semiconductor from the centre of forbidden gap at room temperature.	CO3	(3)
OR				
14	a)	Derive diode equation for a pn junction and draw its VI characteristics graph	CO3	(6)

	b)	Current flowing in a p-n junction is 0.2 μA at room temperature when a large reverse bias voltage is applied. Calculate the current when a forward bias of 0.1 V is applied.	CO3	(3)
MODULE IV				
15	a)	Give an expression for wavelength of light emitted by an LED. Explain the working of an LED with the help of a circuit diagram. What is your inference about white light produced from an LED?	CO4	(6)
	b)	Calculate the wavelength of light emitted from an LED with a band gap of 2 eV.	CO4	(3)
OR				
16	a)	Give an account of construction and working of a solar cell. Draw the VI characteristics graph, and give expression for fill factor and efficiency. Distinguish between series stringing and parallel stringing of solar cells.	CO4	(6)
	b)	A solar cell (10 cm x 10 cm) produces a voltage of 0.5 V and a current up to 2.5A. If the intensity of solar radiation is 800 W/m^2, calculate the efficiency of solar cell.	CO4	(3)

****

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-1-0-0-2**	**Version**	**25/0**	**Credits**	3
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
B250802/CN200C	**Foundations of Artificial Intelligence and Data Science**	**EST**
Pre-requisite		
NIL		

COURSE OBJECTIVES	
	To understand AI and Data Science fundamentals, including problem-solving, knowledge representation, and data pre-processing, analysis, and visualization techniques.

COMPETENCY STATEMENT (CC)	
CC1	Acquire the ability to design and implement AI based systems.
CC2	Gain the ability to analyze and solve real-world problems using statistical techniques and data analysis methods.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	**Apply** the fundamental concepts of AI and problem solving methods.	CC1	Apply	Manipulation	Responding
CO 2	**Apply** knowledge representation schemes with inferencing techniques.	CC1	Apply	Precision	Responding
CO 3	**Interpret** the fundamental concepts of data science, types of data, statistical techniques, and ethical considerations.	CC2	Understand	Precision	Valuing
CO 4	**Apply** various data pre-processing and exploratory data analysis techniques to prepare, clean, transform, and visualize datasets for effective data analysis.	CC2	Apply	Precision	Valuing

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

CO	Program Outcomes (PO) & Program Specific Outcomes (PSO) Correlation Matrix													
	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	1		1						2	1	1	
CO2	2	2	2		2						2	1	1	
CO3	2	2	1		1						2	1	2	
CO4	2	2	2		2						2	1	2	
Correlation [3 – High, 2 -Medium, 1 – Low]														

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
3	1	0	0	30	3		40	60	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Introduction to Artificial intelligence	Intelligent Systems , Problem Solving by Searching	13
2	Knowledge Representations & Reasoning	Knowledge Representations schemes, Reasoning techniques, First Order Logic	11
3	Introduction to Data Science	Types of Data, Descriptive statistics	13
4	Data pre-processing & EDA	Data quality, Data integration , data reduction techniques.	13

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Steps in data science process, ethical and privacy implications,	10
2	Descriptive Statistics: Mean, Median, Mode, Variance.	10
3	Sampling Techniques	10

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Artificial Intelligence	Elaine Rich, Kevin Knight, S.B.Nair	MedTech Science Press 2/e, 2010
2	Data mining concepts and Techniques.	Jiawei Han, micheline Kamber, Jian Pei	Morgan Kaufmann Publishers. 3/e 2011
3	Fundamentals of Data Science	Sanjeev J. Wagh, Manisha S. Bhende, et al	CRC Press, 2/e, 2021

Reference			
Sl. No.	Title of Book	Author	Publication
1	Artificial Intelligence – A Modern Approach	Stuart Russel, Peter Norvig	Pearson Education , 4/e, 2020
2	Principles of Artificial Intelligence	Nils J Nilsson	Illustrated Reprint Edition, Springer Heidelberg
3	Data Science from Scratch: First Principles with Python	Joel Grus	O'Reilly Media, 2/e, 2019
4	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython	Wes McKinney	O'Reilly Media, 3/e, 2022

Web Resource	
1	https://onlinecourses.nptel.ac.in/noc21_ge20/preview
2	https://onlinecourses.swayam2.ac.in/cec21_cs08/preview
3	https://nptel.ac.in/courses/106106179
4	https://onlinecourses.swayam2.ac.in/imb23_mg64/preview

DETAILED SYLLABUS *(Self-learning if any to be marked)*							
Module	Topic	Mode of Delivery	CO	Learning Domain			Hrs
				C	P	A	
1.1	Introduction to Artificial intelligence	L	CO1	U	I	Res	1
1.2	AI definition - Foundations of AI	L	CO1	U	I	Res	1
1.3	History and applications of AI	L	CO1	U	I	Res	1
1.4	Intelligent Systems, Agents and Environments.	L	CO1	U	I	Res	1

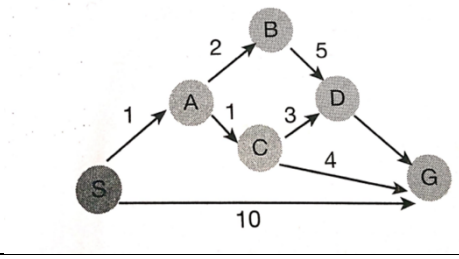
1.5	Problem Solving methods - Searching for Solutions	L	CO1	U	M	Res	1
1.6	Uninformed Search methods - Breadth First Search	L	CO1	A	M	Res	1
1.7	Uniform Cost Search	L	CO1	A	M	Res	1
1.8	Depth First Search	L	CO1	A	M	Res	1
1.9	Informed search methods-Heuristic function	L	CO1	A	M	Res	1
1.10	Greedy Search	L	CO1	A	M	Res	1
1.11	A* Search	L	CO1	A	M	Res	2
1.12	AO* Search.	L	CO1	A	M	Res	1
2.1	Knowledge Representation & Reasoning First order logic	L	CO2	U	P	Res	1
2.2	Syntax and Semantics of First-Order Logic	L	CO2	A	P	Res	2
2.3	Knowledge Engineering in First order logic	L	CO2	A	P	Res	1
2.4	Inference in first order logic	L	CO2	A	P	Res	1
2.5	Propositional vs. first order inference	L	CO2	A	P	Res	1
2.6	Unification & Lifting	L	CO2	A	P	Res	1
2.7	Forward chaining	L	CO2	A	P	Res	1
2.8	Backward chaining	L	CO2	A	P	Res	2
2.9	Resolution	L	CO2	A	P	Res	2
3.1	Introduction to Data Science definition, importance .	L	CO3	U	P	V	1
3.2	Types of data – structured, semi-structured, unstructured	L	CO3	U	P	V	1
3.3	Real world applications of data science	L	CO3	U	P	V	1
3.4	Data Science and Data Analytics	L	CO3	U	P	V	1
3.5	Steps in the Data Science Process			U	P	V	
3.6	Platforms, frameworks, languages	L	CO3	U	P	V	1
3.7	Databases and libraries	L	CO3	U	P	V	1
3.8	Inferential Statistics –Regression Analysis	L	CO3	U	P	V	2
3.9	Probability Distributions Chi Square test and t-test	L	CO3	U	P	V	2
3.10	Fitting a model – Hypothesis Testing	L	CO3	U	P	V	2
4.1	Data Pre-processing and EDA: Data Quality,Major Tasks in Data Pre-processing	L	CO4	U	p	Res	1
4.2	Data Cleaning, Missing Value Noisy Data , Data Cleaning as a Process	L	CO4	U	P	Res	1
4.3	Data Integration, Entity Identification Problem, Redundancy and Correlation Analysis , Tuple Duplication, Data Value Conflict Detection and Resolution	L	CO4	U	P	V	2
4.4	Data Reduction-Techniques overview	L	CO4	A	S	V	1
4.5	Principal Components Analysis	L	CO4	A	P	V	1
4.6	Attribute Subset selection	L	CO4	A	P	V	1
4.7	Histograms	L	CO4	U	P	V	1
4.8	Data Cube aggregation	L	CO4	U	P	V	1
4.9	Overview of Data Transformation Strategies (Smoothing, Normalization)	L	CO4	U	P	V	2
4.10	Introduction to Data Discretization (Decision Tree, and Correlation Analyses)	L	CO4	A	P	V	2

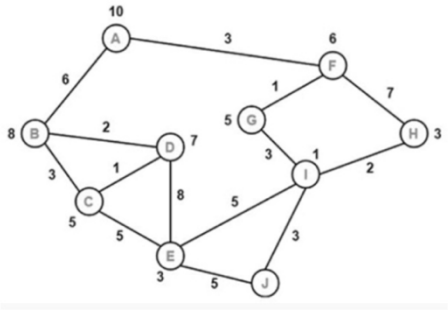
TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

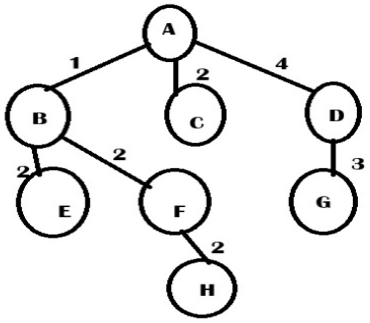
Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Introduction to Artificial intelligence		✓	✓				15
2	Knowledge & Reasoning		✓	✓				15
3	Introduction to Data Science		✓					15
4	Data preprocessing		✓	✓				15

ASSESSMENT PATTERN		
Assessment		**Marks**
Continuous Internal Assessment		40
1	Internal Examination	25
2	Learning Activity	10
3	Regularity	5
4	Course Project	0
End Semester Examination		60
Total		**100**

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**B250902/CN200C**		
Course Name:	**FOUNDATION OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
(Common to AI and AD			

PART A			
(Answer all questions. Each question carries 3 marks)			
No.	***Question***	***CO***	***Marks***
1	A navigation system uses the **A*** algorithm to find the **shortest route** from City **A** to City **G** using the map shown below. 	CO 1	(3)
2	Define a rational agent and illustrate its working using the Vacuum Cleaner problem scenario.	CO 1	(3)
3	A hospital keeps records of doctors, patients, and treatments. Every doctor treats at least one patient, and some patients are treated by multiple doctors. Represent this information using First Order Logic (FOL) and explain the meaning of your statements.	CO 2	(3)
4	Convert the following statements into propositional logic • If it is raining, then the ground will be wet. • Hari is hardworking and intelligent	CO 2	(3)
5	Explain the role of accurate data on patient history and treatment outcomes in identifying the causes of patient readmissions and improving healthcare strategies.	CO 3	(3)
6	Compare and contrast the scope and application of descriptive and inferential statistics	CO 3	(3)
7	Given the sorted dataset of student scores: {12,18,20,25,28,32,35,37,40,45,48,52} Partition the data into three equal-frequency bins and perform **s**moothing by bin means and smoothing by bin boundaries.	CO 4	(3)
8	A retail store records sales by product, city, and time. Explain the use of data cube aggregation to summarize and analyze sales across these dimensions.	CO 4	(3)

PART B				
(Answer any one full question from each module, each question carries 9 marks)				
No.		***Question***	***CO***	***Marks***
MODULE I				
9	a)	Identify the fastest route from Zone A to Zone J using both actual travel times and estimated remaining times from each zone.  Route Finding Problem	CO 1	(5)

	b)	A cleaning robot operates in a building, keeping track of which rooms are dirty. It cannot always sense the dirt directly but remembers past cleaning actions. Demonstrate why this robot is a model-based agent and how its internal model helps it decide the next room to clean.	CO 1	(4)
OR				
10	a)	Perform the following searches from node A to find the goal node H. For each, list the order in which the nodes are visited and the path to H, if found: i. Breadth-First Search (BFS) , ii. Depth-First Search (DFS) iii. Which of the above strategies guarantees finding the least-cost path to H? Justify your answer briefly  	CO 1	(5)
	b)	A smart home system is designed to control lighting, temperature, and security based on user preferences and environmental changes. It must handle incomplete information while ensuring comfort and safety. 1. Sketch and explain model-based and utility-based agent structures. 2. Identify and justify which agent type best suits this system.	CO 1	(4)
MODULE II				
11	a)	A smart home system has the following rules: • If it is dark outside, then turn on the lights. • If someone is home and the lights are on, then turn on the heater. Apply forward chaining to determine the actions the smart home system will take if it is dark outside and someone is home.	CO 2	(5)
	b)	Generate First Order Predicate Logic for i) Every man respects his parent ii) Not all students like both Mathematics and Science iii) Only one student failed in Mathematics	CO 2	(4)
OR				
12	a)	A company has these rules: • If an employee has completed training and has 2 years of experience, they are eligible for promotion. • Alice has completed training and has 2 years of experience. Apply backward chaining, and show how the system determines whether Alice is eligible for promotion.	CO 2	(5)
	b)	Convert the following sentences into FOL. • Brothers are siblings. • One's mother is one's female parent. • Onion and Potato are vegetables.	CO 2	(4)
MODULE III				
13	a)	A manufacturing firm wants to reduce unnecessary expenses and avoid repeating data collection efforts. Summarize the data science process that helps the company reduce costs and improve data handling efficiency?	CO 3	(5)
	b)	As a data scientist in a retail company, explain which recent data science technologies or methods you would suggest to enhance customer experience and describe how they can be beneficial.	CO 3	(4)
OR				

<table>
<tr><td rowspan="2">14</td><td>a)</td><td>A college wants to test whether the type of course (Online / Offline) is independent of students' pass results. The data from 120 students is given below. Perform a Chi-square test at 5% significance (critical value = 3.841).
<table>
<tr><th>Course Type</th><th>Pass</th><th>Fail</th><th>Total</th></tr>
<tr><td>Online</td><td>50</td><td>30</td><td>80</td></tr>
<tr><td>Offline</td><td>30</td><td>10</td><td>40</td></tr>
<tr><td>Total</td><td>80</td><td>40</td><td>120</td></tr>
</table></td><td>CO 3</td><td>(5)</td></tr>
<tr><td>b)</td><td>You are working as a data analyst at a healthcare technology company. Your team receives three different types of data:
• A spreadsheet containing patient information such as name, age, and diagnosis.
• Doctor's notes in the form of free-text clinical summaries.
• Medical records in XML format that combine structured fields and unstructured notes.
Classify each of the above data types as structured, unstructured, or semi-structured. Explain why it is important to correctly identify the type of data before processing and analysis.</td><td>CO 3</td><td>(4)</td></tr>
<tr><td colspan="5">MODULE IV</td></tr>
<tr><td rowspan="2">15</td><td>a)</td><td>You are analyzing a health dataset with many features (e.g., blood pressure, cholesterol, BMI). To simplify analysis, you choose to apply PCA. Outline the key steps of PCA and briefly explain with an example how each step helps reduce dimensionality while preserving important data patterns.</td><td>CO 4</td><td>(5)</td></tr>
<tr><td>b)</td><td>Given a dataset with three correlated variables (X1, X2, X3), perform Principal Component Analysis (PCA) to find the principal components, compute the explained variance for each, and represent the data using the first two principal components.
<table>
<tr><th>Obs</th><th>X1</th><th>X2</th><th>X3</th></tr>
<tr><td>1</td><td>2.5</td><td>2.4</td><td>0.5</td></tr>
<tr><td>2</td><td>0.5</td><td>0.7</td><td>0.2</td></tr>
<tr><td>3</td><td>2.2</td><td>2.9</td><td>0.9</td></tr>
<tr><td>4</td><td>1.9</td><td>2.2</td><td>0.4</td></tr>
<tr><td>5</td><td>3.1</td><td>3.0</td><td>1.1</td></tr>
</table></td><td>CO 4</td><td>(4)</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td rowspan="2">16</td><td>a)</td><td>A company wants to build a Decision Tree classifier to predict customer purchase behavior based on the attribute Age. The dataset contains continuous age values ranging from 18 to 70 years. To make the model more interpretable, the analyst needs to discretize the Age attribute into categories such as Youth, Middle-aged, and Senior. Use a Decision Tree method to determine the optimal age intervals (cut points) and show how the tree decides the splits based on information gain or entropy.</td><td>CO 4</td><td>(5)</td></tr>
<tr><td>b)</td><td>A data scientist finds that several numerical attributes in a healthcare dataset are highly correlated. Apply correlation-based discretization to reduce redundancy while preserving key patterns in the data.</td><td>CO 4</td><td>(4)</td></tr>
</table>

****

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-2-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
B250802/CN210D	**Programming in C++**	**EST**
Pre-requisite		
Algorithmic Thinking with Python		

COURSE OBJECTIVES	
1	To introduce the fundamentals of C++ programming, including syntax, data types, operators, input/output, and program structure.
2	To develop problem-solving skills using functions, control structures, arrays, pointers, and structures.
3	To equip students with object-oriented programming concepts, such as classes, objects, inheritance, polymorphism, and encapsulation.
4	To familiarize students with modern C++ features and STL, including templates, exception handling, containers, algorithms, and an awareness of advanced concepts like concurrency and coroutines.

COMPETENCY STATEMENT (CC)	
CC1	Apply fundamental and object-oriented concepts to solve programming problems.
CC2	Develop efficient C++ programs using modern features, templates, exception handling, and STL, with basic awareness of concurrency and coroutines.

COURSE OUTCOME (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	**Apply** the fundamental concepts, including syntax, data types, operators, control structures, functions, and basic I/O.	CC1	A	M, P	Rs, V
CO 2	**Apply** the concepts of arrays, pointers, strings, and structures, including dynamic memory allocation and passing to functions.	CC1	A	M, P	Rs, V
CO 3	**Implement** Object-Oriented programs using classes, objects, inheritance, polymorphism, and templates.	CC2	A	M, P	Rs, V
CO 4	**Apply** modern C++ features including STL containers, iterators, algorithms.	CC2	A	M	Rs, V
CO 5	**Understand** the features of lambda expressions, move semantics, constexpr, and basic concurrency in modern C++.	CC2	U	M	Rs

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation* ***Affective (Krathwohl)****: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

COURSE ARTICULATION MATRIX

CO	Knowledge Attitude Profile									Program Outcomes & Program Specific Outcomes													
	WK									PO											PSO		
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	3	3	2	-	2	-	-	-	-	3	3	2	-	2	-	-	-	-	-	-	3	2	-
2	-	3	3	3	2	2	-	3	-	-	3	3	2	2	2	-	-	-	-	-	3	2	-
3	-	3	-	3	-	-	-	3	-	-	3	3	3	2	2	2	-	-	-	-	3	3	-

4	-	2	2	3	3	2	2	3	2	-	2	2	3	3	3	2	2	-	-	-	3	2	-
5	-	2	2	3	3	-	-	3	2	-	2	2	3	3	3	2	2	-	-	-	3	2	-

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme						
							Theory			Practical			Total
L	T	J	P	S	C		CIA	ESE	Total	CIA	ESE	Total	
3	0	0	2	2	4	120	25	40	65	15	20	35	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)

Module	Title	Major Topics	Hrs
1	Fundamentals of C++ Programming	Introduction to C++ – Structure of a C++ program – Basic I/O – Tokens – Data Types – Operators – Expressions – Control structures (if, switch, loops) – Functions (call by value/reference, inline, default arguments) – Basics of recursion.	10
2	Derived Data Types and Memory Management	Arrays (1D, 2D, multidimensional) – Strings (character arrays, string class) – Structures and unions – Enumerations – Pointers (pointer arithmetic, pointers to functions, pointers to structures) – Dynamic memory allocation (new, delete, malloc/free) – Passing arrays, structures, and pointers to functions.	17
3	Object-Oriented Programming Concepts	Principles of OOP – Classes and objects – Constructors and destructors – Operator overloading – Function overloading – Inheritance (types, access specifiers) – Virtual functions – Polymorphism – Abstract classes – Templates (function and class).	17
4	Advanced Features and Standard Template Library (STL)	Standard Template Library (STL): containers (vector, list, map, set, stack, queue), iterators, algorithms – Exception handling – Lambda expressions – Move semantics – constexpr – Smart pointers – Multithreading and concurrency basics – Modern C++ best practices.	16

SELF-LEARNING / TEAM WORK

Sl. No	Self-learning / Team Work Description	Hrs
1	Explore differences between C++ and Python by writing equivalent programs (loops, functions, I/O).	5
2	Mini-task: Implement matrix operations using arrays, pointers, and structures in C++.	10
3	Team activity: Design a small Object-Oriented project (e.g., Library Management or Student Database) using classes, inheritance, and templates.	8
4	Self-study on Modern C++ features (STL containers, lambda, concurrency basics) and present findings in teams.	7

SUGGESTED LEARNING RESOURCES

Text Book

Sl. No.	Title of Book	Author	Publication
1	Programming: Principles and Practice Using C++	Bjarne Stroustrup	3rd Edition, Addison-Wesley, 2024.
2	The C++ Programming Language (4th Edition)	Bjarne Stroustrup	4th Edition, Pearson, 2013.
3	C++ Primer (5th Edition)	Stanley B. Lippman, Josée Lajoie, Barbara E. Moo	5th Edition, Addison-Wesley, 2012

Reference

Sl. No.	Title of Book	Author	Publication

1	Effective Modern C++	Scott Meyers	O'Reilly Media, 2014.
2	C++ Standard Library: A Tutorial and Reference	Nicolai M. Josuttis	2nd Edition, Addison-Wesley, 2012.
3	Accelerated C++: Practical Programming by Example	Andrew Koenig, Barbara E. Moo	Addison-Wesley, 2000.
4	Competitive Programming in C++	Steven Halim, Felix Halim	3rd Edition, Springer, 2013.
5	Effective Modern C++: 42 Specific Ways to Improve Your Use of C++11 and C++14	Scott Meyers	O'Reilly Media, 2014

Web Resource	
1	C++ Reference, https://en.cppreference.com/
2	Learn C++, https://www.learncpp.com/
3	GeeksforGeeks C++ Programming, https://www.geeksforgeeks.org/c-plus-plus/
4	Programming in Modern C++, IIT Kharagpur, https://nptel.ac.in/courses/106105234

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Module	Title	Topic	Mode of Delivery	CO	Learning Domain			Hrs
					C	P	A	
1	Foundations of C++	Introduction to C++ and applications (contrast with Python)	L	CO1	U			1
		Structure of a C++ program (main(), #include, compilation vs interpretation)	L	CO1	A	M	Rs	1
		Variables, constants (const, #define), and data types	L	CO1	A	M	Rs	1
		Operators: arithmetic, relational, logical	L	CO1	A	M	Rs	2
		Input/Output: cin, cout, formatting	L	CO1	A	M	Rs	2
		Functions: definition, return types, parameters; pass-by-value, pass-by-reference	L	CO1	A	M	Rs	3
2	Derived Data Types & Memory Management	Arrays: single & multi-dimensional	L	CO2	A	M	Rs	3
		Strings: char arrays vs string class	L	CO2	A	M	Rs	2
		Pointers: basics, pointer arithmetic	L	CO2	A	M	Rs	2
		Dynamic memory allocation (new/delete)	L	CO2	A	M	Rs	3
		Passing arrays and pointers to functions	L	CO2	A	M	Rs	2
		Structures: definition, member access, passing structures (value/ref)	L	CO2	A	M	Rs	3
3	Object-Oriented & Generic Programming	Classes & Objects: members, methods, constructors, destructors	L	CO3	A	M	Rs	3
		Function & operator overloading	L	CO3	A	M	Rs	2
		Inheritance: single & multiple (intro level)	L	CO3	A	M	Rs	3
		Polymorphism: overriding, virtual functions (intro)	L	CO3	A	M	Rs	3
		Templates: function and class templates	L	CO3	A	M	Rs	2
		Exception handling: try, catch, throw	L	CO3	A	M	Rs	4
4	Modern Features & Standard	STL Containers: vector, stack, queue, map, unordered_map	L	CO4	A	M	Rs	3
		Iterators & Algorithms (sort, find, accumulate)	L	CO4	A	M	Rs	3

	Template Library (STL)	Lambda expressions (basic use), range-based for loops, auto	L	CO5	A	M	Rs	2
		Move semantics: std::move, std::forward (intro)	L	CO5	A	M	Rs	3
		constexpr (basic usage)	L	CO5	A	M	Rs	2
		Concurrency awareness (std::thread, async, coroutines overview)	L	CO5	A	M	Rs	3

PRACTICAL SYLLABUS

Topic	Objective	CO	Learning Domain			Hrs
			C	P	A	
Basics of C++	Write, compile, and debug simple C++ programs using variables, operators, control structures, and functions.	CO1	U	M	Rs	3
Functions & I/O	Implement parameter passing (by value and reference), recursion, and formatted input/output.	CO1	A	M	V	5
Arrays & Strings	Implement programs with 1D/2D arrays, character arrays, and std::string operations.	CO2	A	M	Rs	3
Pointers & Memory	Demonstrate pointer arithmetic, dynamic memory (new, delete), and pointer-based array manipulation.	CO2	A	M	V	5
Structures	Create programs using structures, nested structures, and pass them to functions (by value and reference).	CO2	A	M	Rs	2
Classes & Objects	Develop programs using classes, constructors, destructors, and function/operator overloading.	CO3	A	M	Rs	3
Inheritance & Polymorphism	Implement single/multiple inheritance and virtual functions.	CO3	An	M	V	3
Templates & Exception Handling	Write programs with function/class templates and basic exception handling.	CO3	An	M	Rs	3
STL Containers	Use STL containers (vector, stack, queue, map) with iterators to solve problems.	CO4	A	M	Rs	3

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Fundamentals of C++ Programming		√	√				15
2	Derived Data Types and Memory Management		√	√				15
3	Object-Oriented Programming Concepts		√	√				15
4	Advanced Features and Standard Template Library (STL)		√	√				15
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.								

ASSESSMENT PATTERN

Assessment		Marks
Continuous Internal Assessment		40
1	Internal Examination	15
2	Continuous Lab Evaluation	10
3	Learning Activity	5
4	Regularity	5
5	Course Project	5
End Semester Examination - Lab		20
End Semester Examination _ Theory		40
Total		**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**B250802/CN210D**		
Course Name:	**Programming in C++**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Common to AI and AD			

(Answer any one full question from each module, each question carries 15 marks)				
No.		***Question***	***CO***	***Marks***
		MODULE I		
1		A student is developing a simple Electricity Billing System in C++. The program should read customer details (name, units consumed), calculate the total bill using a per-unit charge, and display the bill amount. Billing rules: Units ≤ 100 → ₹1.5 per unit 101 – 300 → ₹2.0 per unit Above 300 → ₹3.0 per unit Observe the scenario and answer the following questions.	CO 1	
	a	List the tokens and data types you would use in this program, and explain their roles in handling input and computation.		(3)
	b	Write a C++ function named ***float calculateBill(int units)*** that determines and returns the bill amount using if-else decision statements.		(4)
	c	Using call-by-reference, write a short code segment that reads the customer's name and units from the user, calls ***calculateBill()***, and displays the output in a formatted way.		(4)
	d	Update the billing system to classify the customer as ***"Low Usage", "Normal Usage",*** *or* ***"High Usage"*** based on total units consumed, and display the category along with the bill.		(4)
		OR		
2		You are helping a startup, EcoRide, design a C++ program for its electric cab booking app. The program estimates the total fare based on the distance travelled and whether the ride occurred during peak hours. Rules: • Base Fare = ₹50 • Per km = ₹12 • If ride is during peak hours, a 25% surcharge applies. • For rides longer than 20 km, offer a 10% discount on the total fare. The system should also handle multiple rides until the user chooses to stop. Observe the scenario and answer the following questions.	CO 1	
	a	List the input, process, and output components for this system and name two control structures that would be most appropriate.		(3)

	b	The developer has written a partial program for EcoRide but left the logic incomplete. Fill in the missing part of the code (***marked // TODO***) to complete the program logic.
		`#include <iostream>`
		`using namespace std;`
		
		`float calculateFare(float distance, bool peak) {`
		`  float fare = 50 + (12 * distance);`
		`  if (peak)`
		`  fare += fare * 0.25;  // Apply peak surcharge`
		`  if (distance > 20)`
		`  fare -= fare * 0.10;  // Apply long distance discount`
		`  return fare;`
		`}`
		
		`int main() {`
				(5)

```
    float dist;
    char peak, cont = 'Y';
    // TODO: Repeat fare calculation for multiple rides
    // HINT: Use a loop and function call
    _____
    _____
    _____
    _____
    _____
    _____
    return 0;
}
```

	c	For the following input: Distance: 25 Peak hour: Y Another ride? N Compute the final output manually.		(3)
	d	Modify the EcoRide program to display a fare category based on the total fare calculated for each ride: **"Economy Ride" if fare < ₹200** **"Standard Ride" if fare is between ₹200 and ₹500** **"Premium Ride" if fare > ₹500** Display the category along with the fare for each ride. ***(Hint: Use an if–else if–else ladder inside the loop.)***		(4)

MODULE II

3

A student wrote the following program to read and display integers using pointers, but it crashes during execution.

```
#include <iostream>
using namespace std;

int main() {
    int n;
    cout << "Enter number of elements: ";
    cin >> n;

    int *ptr;
    for (int i = 0; i < n; i++)
        cin >> *(ptr + i);

    for (int i = 0; i < n; i++)
        cout << *(ptr + i) << " ";

    delete[] ptr;
    return 0;
}
```

	a	Identify two errors in the code and correct them.	(3)
	b	Extend the corrected code to find and display both the smallest and largest numbers using pointer arithmetic only.	(4)
	c	For the above program, trace the memory layout of the pointer variable p if the user enters 4 numbers: Enter 4 numbers: 5 10 15 20 **a.** State the base address stored in pointer variable p (represent symbolically). **b.** Determine the address referred to by *(p + 2) assuming each int occupies 4 bytes. **c.** Identify the value located at the address corresponding to *(p + 2).	(3)
	d	Modify the corrected program to dynamically allocate memory for the integers using the new operator, and then create a user-defined function named ***displayReverse()*** that displays the elements in reverse order using pointer arithmetic (without indexing). Demonstrate the function call within ***main().***	(5)

CO2

OR

4		A C++ development team is designing a Student Performance Analyzer for teachers to calculate and review class averages. The system uses structures and arrays to store each student's marks in three subjects and determine the class topper. You are assisting in refining and documenting this module.		
	a	Match the following: Column A: A Array; B Structure; C '.' operator; D Infinite loop Column B: 1 while(false); 2 int arr(); 3 default access specifier is public; 4 while (true); 5 int arr[]; 6 Access member methods	CO2	(3)
	b	The partial algorithm below outlines the logic used to calculate each student's average marks and identify the topper. Start 1. Input number of students 2. For each student i = 0 to n – 1 2.1 ***(A)*** → _____ 2.2 Read 3 marks into array marks[3] 2.3 Initialize total = 0 2.4 For each mark j = 0 to 2 → total = total + marks[j] 2.5 ***(B)*** → _____ 2.6 If avg > highest then highest = avg, topper = name 3. ***(C)*** → _____ 4. **Stop** ***Complete the missing steps (A), (B), and (C).***		(3)
	c	Implement the above algorithm in C++ to read data for n students (name and 3 marks each), compute each student's average, and display the topper's name along with their average score.		(4)
	d	Modify the program to allocate memory for student records dynamically using the new operator instead of a fixed-size array. Demonstrate deallocation using delete[] after displaying the results.		(5)
		MODULE III		
5		A C++ development team is designing a simulation system to manage geometric shapes (like circles and rectangles). They initially implement it using function overloading but later modify it to use inheritance and virtual functions to make the code extensible. You are asked to analyze and implement parts of both approaches to understand the design trade-offs.		
	a	Read each description carefully and write the correct OOP concept it refers to. 1. Enables different implementations of a function with the same name, chosen based on parameter types at compile time. — Hint: ***Same name, different parameters*** — Concept: _____ 2. Allows child classes to inherit data and behavior from a parent class for code reusability. — Hint: ***Parent–child relationship*** — Concept: _____ 3. Ensures that the correct function is called at runtime depending on the object's actual type. — Hint: ***Achieved using virtual functions*** — Concept: _____	CO3	(3)
	b	You are given two alternate designs of a shape area calculator. Identify which one demonstrates compile-time polymorphism and which demonstrates runtime polymorphism. Justify your answer. ***Version 1:*** #include <iostream> using namespace std; class Area { public:		(3)

```
    float compute(float radius) {
        return 3.14 * radius * radius;
    }
    float compute(float length, float breadth) {
        return length * breadth;
    }
};
```

Version 2:

```
class Shape {
public:
    virtual float area() = 0;
};

class Circle : public Shape {
    float r;
public:
    Circle(float radius) : r(radius) {}
    float area() override { return 3.14 * r * r; }
};

class Rectangle : public Shape {
    float l, b;
public:
    Rectangle(float length, float breadth) : l(length), b(breadth) {}
    float area() override { return l * b; }
};
```

	c	Implement a menu-driven C++ program using the second (***version 2***) approach that: 1. Allows the user to choose between Circle and Rectangle. 2. Prompts for required dimensions. 3. Displays the computed area.		(5)
	d	Extend your program to include a Triangle class that inherits from Shape and overrides the area() function. ***The area should be computed as 0.5 * base * height.*** Demonstrate runtime polymorphism by calculating and displaying the area for all three shapes through a single base class pointer array.		(4)
		OR		
6		A fintech startup is developing a Bank Transaction Tracker in C++. The system should handle deposits and withdrawals, track account balances, and allow accounts to be compared using operator overloading. You are part of the development team responsible for completing and analyzing the implementation.	CO3	
	a	A developer wrote the following C++ code to model bank accounts but it produces errors and incorrect output. ***Identify and correct three errors.***		(3)

```
#include <iostream>
using namespace std;

class Account {
    string name;
    float balance;

public:
    Account(string n, float b) {
        name = n;
        balance = b;
    }

    void deposit(float amt) {
        balance + amt;
    }

    void display() {
```

		cout << name << " : " << balance << endl;
		}
		
		bool operator==(Account a) {
		return balance == a.balance;
		}
		};
		
		int main() {
		Account a1("John", 5000), a2("John", 5000);
		a1.deposit(1000);
		if (a1 == a2)
		cout << "Same balance";
		else
		cout << "Different balance";
		return 0;
		}		

	b	Read the following statements carefully and choose the correct option for each: Assertion (A) and Reason (R) are given for each case. Choose the correct option from below: 1. Both A and R are true, and R correctly explains A 2. Both A and R are true, but R does not explain A 3. A is true, but R is false 4. A is false, but R is true (a) A: A constructor in C++ is automatically called when an object is created. R: Constructors have the same name as the class and do not have a return type. (b) A: A destructor can take parameters to clean up specific resources. R: Destructors are used to release memory and resources before object destruction. (c) A: Operator overloading allows redefining existing operators for user-defined types. R: It changes the fundamental meaning of operators in all data types.		(3)
	c	Add an operator+() function to the Account class that combines the balances of two accounts and returns a new Account object named ***"JointAccount".*** Write the function definition and show its use in ***main().***		(4)
	d	Add a ***copy constructor*** to the Account class to create a duplicate account object with the same name and balance. Demonstrate its use in the main() function and show both original and copied account details.		(5)
MODULE IV				
7		Your team is developing a Smart Traffic Monitoring System using C++. The system stores traffic density readings from multiple junctions, processes them using STL containers, filters heavy traffic areas using lambda expressions, and ensures reliability with exception handling and smart pointers.	CO4 CO5	
	a	After a field test, one module of the system crashed due to memory leaks and uncaught runtime exceptions. Reflect on these issues and explain the role of: (a) Smart pointers in preventing memory-related failures. (b) Exception handling in enhancing reliability and fault tolerance in a real-time system.		3
	b	The Smart Traffic Monitoring System stores traffic densities of various junctions and performs analysis using STL algorithms. Some parts of the logic are missing. Complete the program by filling in the blanks with the correct logic or STL function calls. #include <iostream> #include <vector> #include <algorithm> #include <numeric> using namespace std;		4

		int main() {
		vector<int> density = {45, 90, 78, 100, 60, 30};
		
		// Step 1: Display all congested junctions (density >= 80)
		cout << "Congested Junctions: ";
		for_each(density.begin(), density.end(), [](int d) {
		if (_____) // (L1)
		cout << d << " ";
		});
		cout << endl;
		
		// Step 2: Find the junction with minimum density
		auto minIt = _____(density.begin(), density.end()); // (L2)
		cout << "Minimum Density: " << *minIt << endl;
		
		// Step 3: Compute total and average density
		int total = _____(density.begin(), density.end(), 0); // (L3)
		double avg = static_cast<double>(total) / _____; // (L4)
		cout << "Average Density: " << avg << endl;
		
		return 0;
		}		

	c	To make the system more robust, the team wants to handle invalid sensor readings (negative values) and improve memory safety using smart pointers. Extend the previous program accordingly.		(4)
	d	Add a feature to sort the traffic densities in descending order and display the sorted list. ***(Hint: Use the sort() algorithm with a lambda expression for comparison.)***		(4)
OR				
8		A program is being developed to manage students' names and exam scores efficiently using Modern C++ features and STL algorithms. Answer the following questions based on the scenario.	CO4 CO5	
	a	In modern C++, smart pointers and lambda expressions are used to make code safer and more expressive. Reflect on their roles in the context of this program: (a) Explain the advantage of using a unique_ptr or shared_ptr to manage the container that stores student data. (b) Describe with a lambda expression that can simplify operations such as sorting or filtering scores.		(4)
	b	Write a short program segment that: (a) Stores student name–score pairs in a suitable STL container. (b) Sorts them in descending order of score. (c) Displays the sorted list in the format Name: ___, Score: ___.		(4)
	c	After testing, you notice the program crashes when reading data due to invalid (negative) scores. Explain how exception handling could be added to improve program stability. Write a short code fragment to demonstrate this feature.		(3)
	d	Extend the program by adding a constexpr function ***maxScoreLimit()*** that returns the maximum allowed score (e.g., 100). Use it in the input validation logic to ensure no student's score exceeds this limit.		(4)

****

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**4-0-0-0-4**	**Version**	**25/0**	**Credits**	**4**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
B250904/CN200E	**DISCRETE MATHEMATICS**	**PCT**
Pre-requisite		
Basic knowledge of algebra, logic, and analytical reasoning skills.		

COURSE OBJECTIVES	
1	To equip students with the ability to analyse and solve problems using discrete mathematical techniques.
2	To give a deeper understanding of mathematical logic, set theory, and proof techniques such as direct proofs, proof by contradiction, and mathematical induction.

COMPETENCY STATEMENT (CC)	
CC1	Demonstrate the ability to apply propositional and predicate logic, proof techniques, and fundamental counting principles including permutations, combinations, and the pigeonhole principle to solve discrete mathematical problems.
CC2	Demonstrate proficiency in analysing sets, relations, functions, algebraic structures such as groups and fields, and applying generating functions to solve linear recurrence relations systematically.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO1	**Check** the validity of predicates in Propositional and Quantified Propositional Logic using truth tables, deductive reasoning and inference theory on Propositional Logic	CC1	A		Rs
CO2	**Solve** counting problems by applying the elementary counting techniques – Rule of Sum, Rule of Product, Permutation, Combination, Binomial Theorem, Pigeonhole Principle and Principle of Inclusion and Exclusion.	CC1	A		Rs
CO3	**Classify** binary relations into various types and illustrate an application for each type of binary relation, in Computer Science.	CC1	U		Rs
CO4	**Illustrate** an application for Partially Ordered Sets and Complete Lattices, in Computer Science	CC2	U		Rs
CO5	**Explain** Generating Functions and solve First Order and Second Order Linear Recurrence Relations with Constant Coefficients	CC2	A		Rs
CO6	**Illustrate** the abstract algebraic systems - Semigroups, Monoids, Groups, Homomorphism and Isomorphism of Monoids and Groups.	CC2	U		Rs

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

CO	Program Outcomes (PO) & Program Specific Outcomes (PSO) Correlation Matrix													
	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	3	3	3	3							2	3	2	
2	3	3	3	3							2	3	1	
3	3	3	3	3							2	3	2	

4	3	3	3	3							2	3	2	
5	3	3	3	3							2	3	1	
6	3	3	3	3							2	3	3	
Correlation [3 – High, 2 -Medium, 1 – Low]														

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					**Credit**	**Hours / Semester**	**Examination Scheme**		
							Theory		
L	**T**	**J**	**P**	**S**	**C**		**CIA**	**ESE**	**Total**
4	0	0	0	4	4	120	40	60	100
***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*									

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Sets, Functions, and Relations	Sets and Subsets, Venn Diagrams, Set Operations, Set Identities, Generalized Unions and Intersections, The Principle of Inclusion-Exclusion (Basic and Generalized versions), and applications. Function definition, Injections, Surjections and Bijections, Inverse Functions, and Compositions of Functions, Cardinality of Sets, Cantor diagonalization argument Relations and Their Properties, Composition of relations, n-ary Relations, Representing Relations Using Matrices, Equivalence Relations, Equivalence Classes, Partial Orderings, Hasse Diagrams, Maximal and Minimal Elements, Lattices **(Text 1 - Relevant topics from sections 2.1, 2.2, 2.3, 2.5, 8.5, 9.1-9.6)**	11
2	Mathematical logic and proofs	Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference Introduction to Proofs, Methods of Proving Theorems - Direct proof, Indirect proof (Proof by Contraposition), Proof by Contradiction, Proof by counter examples, The Pigeonhole Principle. **(Text 1 - Relevant topics from sections 1.1-1.8, 6.2)**	11
3	Induction and Recurrences	Mathematical Induction, Weak and Strong induction Recursive (Inductive) definitions and recurrence relations, Modelling with Recurrence Relations, Solving Linear Recurrence Relations (homogeneous and nonhomogeneous), Generating Functions, Using Generating Functions to Solve Recurrence Relations. **(Text 1 - Relevant topics from sections 5.1-5.3, 8.1-8.4)**	11
4	Group theory	Groups - Definition, Examples, and Elementary Properties, Abelian group, Permutation group, Subgroup, Homomorphisms, Isomorphisms, and Cyclic Groups, Cosets and Lagrange's Theorem. **(Reference Text 1 - Relevant topics from sections 11.4-11.10, 14.5-14.11)**	11

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Basic set theory revision: sets, subsets, power sets, set operations **(1 hour)**. Practice problems on set identities and Venn diagrams **(1 hour)**. Practice problems on Principle of Inclusion-Exclusion with applications **(2 hours)**, Practice problems on functions: injections, surjections, bijections, composition, and inverse functions **(1 hour)**. Study Cantor diagonalization argument and cardinality concepts **(1 hour)**. Practice problems on relations: properties, composition, matrix representation **(1 hour)**. Practice constructing Hasse diagrams for partial orders and identifying maximal/minimal elements in lattices **(1 hour).** **Team Work** - Model real-world relationships using functions and relations. Create Hasse diagrams for ordering systems (software dependencies, task scheduling, organizational hierarchies). Apply inclusion-exclusion principle to solve combinatorial problems in computer science applications **(1 hour).**	9

2	Practice constructing truth tables for complex propositional logic statements **(1 hour),** practice problems on propositional equivalences and logical laws **(2 hours),** practice problems on predicates, quantifiers, and nested quantifiers **(1 hour)**, practice applying rules of inference to construct valid arguments **(1 hour)**, practice direct proofs and proof by contraposition **(1 hour),** practice proof by contradiction and proof by counter examples **(1 hour)**, practice problems on pigeonhole principle with applications **(1 hour)**. **Team Work** - Formulate and prove mathematical statements using different proof techniques. Analyze real-life scenarios and apply pigeonhole principle (e.g., hashing collisions, network routing). Construct formal proofs for algorithm correctness using propositional logic and rules of inference **(1 hour)**.	9
3	Study mathematical induction principle and practice simple induction proofs **(1 hour),** practice weak induction problems (summation formulas, divisibility) **(1 hour),** practice strong induction problems **(1 hour)**, study recursive definitions and formulate recurrence relations from problem statements **(1 hour)**, practice solving first-order linear homogeneous recurrence relations **(1 hour),** practice solving first-order linear non-homogeneous recurrence relations (**1 hour),** study generating functions and their properties **(1 hour),** practice using generating functions to solve recurrence relations **(1 hour).** **Team Work** - Analyze algorithms and derive recurrence relations (divide-and-conquer, dynamic programming). Prove algorithm properties using mathematical induction. Apply generating functions to solve counting problems in combinatorics and analyze algorithm time complexity **(1 hour).**	9
4	Study group definition with examples (integers, matrices, permutations) **(1 hour),** practice verifying group properties and identifying abelian groups **(1 hour),** study permutation groups and practice composition operations **(1 hour)**, practice identifying and verifying subgroups **(1 hour)**, homomorphisms and isomorphisms with examples **(1 hour)**, practice problems on cyclic groups and generators **(1 hour)**. Study cosets and Lagrange's theorem **(1 hour)**, practice applications of Lagrange's theorem to find orders of elements and subgroups **(1 hour)**. **Team Work** - Explore applications of group theory in cryptography (RSA, Diffie-Hellman), coding theory, and computer graphics (transformations, symmetries). Analyze the algebraic structure of operations in modular arithmetic and error-correcting codes **(1 hour).**	9

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Discrete Mathematics and its Applications	Kenneth H. Rosen, Kamala Krithivasan	McGraw Hill, 8/e, 2021

Reference			
Sl. No.	Title of Book	Author	Publication
1	Schaum's Outline of Discrete Mathematics	Marc Lipson, Seymour Lipschutz	McGraw-Hill, 3/e, 2021
2	Discrete Mathematics	Kenneth A. Ross, Charles R.B. Wright	Pearson, 5/e, 2012

Web Resource	
1	https://nptelvideos.com/lecture.php?id=6033
2	https://nptelvideos.com/lecture.php?id=6024
3	https://nptelvideos.com/lecture.php?id=6051
4	https://nptelvideos.com/lecture.php?id=6058

DETAILED SYLLABUS *(Self-learning if any to be marked)*							
Module	Topic	Mode of Delivery	CO	Learning Domain			Hrs
				C	P	A	

1	Sets, notation, subsets, operations, Venn diagrams	L	CO3	U			1
	Basic set theory revision	S	CO3	U		Rs	2
	Set identities, laws, duality	L	CO3	U			1
	Practice: set identities and Venn diagrams	S	CO3	A		Rs	2
	Tutorial	T	CO3	A			1
	Inclusion-Exclusion (basic & generalized)	L	CO2	U			2
	Practice: Inclusion-Exclusion applications	S	CO2	A		Rs	2
	Functions: definition, injections, surjections, bijections	L	CO3	U			2
	Composition, inverse, cardinality, Cantor diagonalization	L	CO3	U			1
	Practice: functions problems	S	CO3	A		Rs	2
	Study: Cantor diagonalization	S	CO3	A		Rs	2
	Tutorial	T	CO3	A			1
	Relations: properties, composition, n-ary, matrices	L	CO3	U			2
	Practice: relations problems	S	CO3	A		Rs	2
	Equivalence relations, classes	L	CO3	U			1
	Partial orders, Hasse diagrams, lattices	L	CO4	U			1
	Practice: Hasse diagrams and lattices	S	CO4	A		Rs	2
	Tutorial	T	CO4	A			1
	Real-world modelling, Hasse diagrams, inclusion-exclusion	S	CO4	A		Rs	2
2	Propositions, connectives, truth tables	L	CO1	U			1
	Practice: truth tables (complex)	S	CO1	A		Rs	3
	Logical equivalences, laws of logic	L	CO1	U			1
	Principle of duality	L	CO1	U			1
	Practice: equivalences and laws	S	CO1	A		Rs	3
	Tutorial	T	CO1	A			1
	Predicates, quantifiers, negation, nested quantifiers	L	CO1	U			2
	Practice: predicates and nested quantifiers	S	CO1	A		Rs	2
	Tutorial	T	CO1	A			1
	Valid arguments, rules of inference, resolution	L	CO1	U			2
	Practice: rules of inference	S	CO1	A		Rs	3
	Tutorial	T	CO1	A			1
	Direct proof, contraposition, contradiction, counterexample	L	CO1	U			2
	Practice: proof techniques	S	CO1	A		Rs	2
	Tutorial	T	CO1	U			1
	Basic and generalized pigeonhole principle	L	CO2	A			1
	Practice: pigeonhole applications	S	CO2	A		Rs	2
	Proof construction, pigeonhole applications, algorithm correctness	L	CO2	U			1
3	Weak and Strong induction principles	L	CO1	U			2
	Study: induction principle, practice proofs	S	CO1	A		Rs	2
	Induction proofs: summation, divisibility, inequalities	L	CO1	U			2
	Practice: weak and strong induction	S	CO1	A		Rs	3
	Tutorial	T	CO1	A			1
	Recursive definitions and functions	L	CO4	U			2
	Study: recursive definitions, formulate recurrences	S	CO4	A		Rs	2
	Modelling with recurrence relations	L	CO5	U			1
	Solving linear homogeneous recurrences	L	CO5	U			1
	Practice: homogeneous recurrences	S	CO5	A		Rs	3
	Solving non-homogeneous recurrences	L	CO5	U			1
	Practice: non-homogeneous recurrences	S	CO5	A		Rs	3
	Tutorial	T	CO5	A			1
	Generating functions: properties, solving recurrences	L	CO5	U			1
	Study and practice: generating functions	S	CO5	A		Rs	3
	Tutorial	T	CO5	A			1

	Algorithm analysis, induction proofs, generating functions	L	CO5	U			1
4	Binary operations, group definition, properties, examples	L	CO6	U			2
	Study: group definition with examples	S	CO6	A		Rs	2
	Abelian groups	L	CO6	U			2
	Practice: verifying group and abelian properties	S	CO6	A		Rs	2
	Tutorial	T	CO6	A			1
	Permutations, cycle notation, composition	L	CO6	U			2
	Study and practice: permutation groups	S	CO6	A		Rs	2
	Tutorial	T	CO6	A			1
	Subgroups: definition, tests	L	CO6	U			1
	Practice: identifying subgroups	S	CO6	A		Rs	2
	Cyclic groups, generators, order	L	CO6	U			1
	Practice: cyclic groups	S	CO6	A		Rs	2
	Tutorial	T	CO6	A			1
	Homomorphisms and isomorphisms	L	CO6	U			1
	Study: homomorphisms and isomorphisms with examples	S	CO6	A		Rs	2
	Tutorial	T	CO6	A			1
	Cosets, Lagrange's theorem, applications	L	CO6	U			1
	Study and practice: Lagrange's theorem	S	CO6	A		Rs	2
	Tutorial	T	CO6	A			1
	Applications: cryptography, coding theory, graphics	L	CO6	U			1

TABLE OF SPECIFICATIONS (ToS) (ESE Question Paper Design)

Module	Module Title	Distribution of Marks (RBL)						Total Marks
		R	U	A	An	E	C	
1	Sets, Functions, and Relations	√	√	√				15
2	Mathematical logic and proofs	√	√	√				15
3	Induction and Recurrences	√	√	√				15
4	Group theory	√	√	√				15

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

Assessment		**Marks**
Continuous Internal Assessment		**40**
1	Internal Examination	25
2	Learning Activity	10
3	Regularity	5
4	Course Project	-
End Semester Examination		**60**
Total		**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**B250904/CN200E**		
Course Name:	**DISCRETE MATHEMATICS**		
Max. Marks	**60**	**Duration**:	**2 hours 30 minutes**
Common to CS, CY, AI, AD.			

(Answer any one full question from each module, each question carries 15 marks)

No.		***Question***	***CO***	***Marks***
		MODULE I		
1	a)	Define the following with one example each: (i) Universal set (ii) Power set (iii) Complement of a set	CO1	(2)
	b)	Match the following: **Column A Column B** 1. $A - B$ (a) All elements in A or B 2. $A \cup B$ (b) Elements in A but not in B 3. $A \cap B$ (c) Common elements of A and B 4. A' (d) Elements not in A	CO1	(3)
	c)	Prove the following set identity using laws of set algebra: $(A \cup B)' = A' \cap B'$	CO1	(4)
	d)	Construct a truth table for $(p \to q) \wedge (q \to r) \Rightarrow (p \to r)$. Comment on its validity.	CO1	(4)
	e)	Use mathematical induction to prove that $1 + 3 + 5 + \cdots + (2n - 1) = n^2$.	CO1	(2)
		OR		
2	a)	Define *tautology* and *contradiction* with an example.	CO1	(2)
	b)	Fill in the Blanks: 1. The negation of $p \to q$is _____. 2. The dual of $A + AB = A$is _____. 3. $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$represents the _____ law.	CO1	(3)
	c)	Determine whether the propositions $p \vee (p \to q)$and $q \vee (p \to q)$are equivalent using truth tables.	CO1	(4)
	d)	Prove that $\neg(p \vee q) \Leftrightarrow (\neg p \wedge \neg q)$by truth table.	CO1	(4)
	e)	Using the principle of duality, find the dual of $(A + B')(A' + B)$.	CO1	(2)
		MODULE II		
3	a)	Define the following: (i) Reflexive relation (ii) Symmetric relation (iii) Transitive relation	CO2 CO3	(2)
	b)	Match the Following: **Column A Column B** 1. Identity relation (a) $\forall a, b \in A, (a, b) \in R \Rightarrow (b, a) \in R$ 2. Symmetric relation (b) $\forall a \in A, (a, a) \in R$ 3. Transitive relation (c) $\forall a, b, c \in A, (a, b), (b, c) \in R \Rightarrow (a, c) \in R$ 4. Universal relation (d) $A \times A$	CO2 CO3	(3)
	c)	Let $A = \{1,2,3\}$and $R = \{(1,1), (1,2), (2,3), (3,3)\}$. Check whether $R$is reflexive, symmetric, and transitive.	CO2 CO3	(4)
	d)	Let $f: R \to R$be defined as $f(x) = 3x + 5$. Prove that $f$is one-to-one and onto.	CO2 CO3	(4)
	e)	If $f(x) = x^2 + 1$and $g(x) = \sqrt{x - 1}$, show that $g(f(x)) =\| x \|$for all $x \geq 0$.	CO2 CO3	(2)

		OR		
4	a)	Define *function*, *domain*, and *codomain*.	CO2 CO3	(2)
	b)	Fill in the Blanks: 1. If $f: A \to B$and $g: B \to C$, then $g \circ f: A \to C$is called the _____. 2. A one-to-one and onto function is called a _____. 3. The number of relations on a set of $n$elements is _____.	CO2 CO3	(3)
	c)	Let $A = \{1,2,3\}$and $B = \{4,5,6\}$. Define a relation $R = \{(1,4), (2,5), (3,6)\}$. Is R a function?	CO2 CO3	(4)
	d)	Prove that the inverse of a bijective function is also bijective.	CO2 CO3	(4)
	e)	If $f(x) = 2x + 3$, find $f^{-1}(x)$and verify that $f(f^{-1}(x)) = x$.	CO2 CO3	(2)
		MODULE III		
5	a)	Define *graph*, *loop*, and *degree of a vertex*.	CO4	(2)
	b)	Match the Following: **Column A** — **Column B** 1. Eulerian Graph — (a) Contains all vertices connected 2. Hamiltonian Graph — (b) Traverses each edge exactly once 3. Spanning Tree — (c) Traverses each vertex exactly once 4. Complete Graph — (d) $n(n-1)/2$ edges	CO4	(3)
	c)	Determine whether a simple graph with 5 vertices each of degree 3 exists. Justify your answer.	CO4	(4)
	d)	Draw a tree with 6 vertices having degree sequence (3,2,1,1,1,1). Verify that the sum of degrees equals $2(n-1)$.	CO4	(4)
	e)	Write an algorithm (or pseudo-code) for Depth-First Search (DFS) traversal of a graph.	CO4	(2)
		OR		
6	a)	Define *isomorphic graphs*. Give one example pair.	CO4	(2)
	b)	Fill in the Blanks: 1. In a simple connected planar graph, v - e + f = _____. 2. A connected graph without cycles is called a _____. 3. The number of edges in a complete graph with $n$vertices is _____.	CO4	(3)
	c)	Find the adjacency matrix and incidence matrix of the following graph: V = {A, B, C}, E = {AB, AC, BC}.	CO4	(4)
	d)	Use Kruskal's algorithm to find the minimum spanning tree for the following weighted graph: Vertices: {A, B, C, D}; Edges: AB=2, AC=3, AD=5, BC=4, CD=6.	CO4	(4)
	e)	Prove that a tree with $n$vertices has exactly $n-1$edges.	CO4	(2)
		MODULE IV		
7	a)	Define *semigroup*, *monoid*, and *group* with one example each.	CO5 CO6	(2)
	b)	Fill in the Blanks: 1. In a group, every element has a unique _____. 2. The identity element in Boolean algebra satisfies A + 0 = _____. 3. The complement law in Boolean algebra states that A + A' = _____.	CO5 CO6	(3)
	c)	Verify that $(Z, +)$is an abelian group but $(Z, \times)$is not.	CO5 CO6	(4)
	d)	Simplify the Boolean expression $F = A'B + AB' + A'B'$using Boolean laws.	CO5 CO6	(4)
	e)	Design the logic circuit for $F(A, B, C) = (A + B')(B + C)$.	CO5 CO6	(2)
		OR		
8	a)	Define *lattice* and *complemented lattice* with examples.	CO5 CO6	(2)

	b)	Match the Following: **Column A** **Column B** 1. Idempotent Law (a) $A + 0 = A$ 2. Identity Law (b) $A + A = A$ 3. Involution Law (c) $(A')' = A$ 4. Absorption Law (d) $A + AB = A$	CO5 CO6	(3)
	c)	Prove that $A + AB = A$using Boolean algebra postulates.	CO5 CO6	(4)
	d)	Find the minimal form of $F(A, B, C) = \sum m(0,2,5,6,7)$using Karnaugh Map.	CO5 CO6	(4)
	e)	Write the canonical POS and SOP form of $F(A, B) = A' + B.$	CO5 CO6	(2)

****

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**2-0-1-0-0**	**Version**	**25/0**	**Credits**	**3**
Course Code	**Course Name**						**Course Category**
B250908/CN220F	**ENTREPRENEURSHIP AND INTELLECTUAL PROPERTY RIGHTS**						**ESB**
Pre-requisite							
Course Code	**Course Name**						
Nil	Nil						
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Teamwork)							

COURSE OBJECTIVES
The course introduces the fundamentals of entrepreneurship and innovation, focusing on how ideas develop into ventures. It helps students identify and validate business opportunities, understand the role of Intellectual Property Rights (IPR) in protecting innovations and learn basic procedures for managing and commercializing intellectual property.

COMPETENCY & OUTCOMES		
Competency Statements	CC1	Develop entrepreneurial thinking and the ability to conceptualize, plan, and implement new ventures.
	CC2	Apply knowledge of Intellectual Property Rights (IPR) to protect and commercialize innovative ideas.

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Statement Mapping	Cognitive	Psychomotor	Affective
CO 1	**Explain** the fundamentals of entrepreneurship and innovation.	CC1	U	-	Re
CO 2	**Analyse** business models and plans for technology-based startups.	CC1	An	-	V
CO 3	**Explain** various forms of intellectual property.	CC2	U	-	Re
CO 4	**Apply** IPR concepts to protect, manage, and commercialize innovations.	CC2	A	-	Rs
CO 5	**Present** a project that evaluates business potential by applying suitable IP protection measures.	CC1, CC2	E	Ar	O

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

COURSE ARTICULATION MATRIX

CO	Knowledge Attitude Profile									Program Outcomes & Program Specific Outcomes													
	WK									PO											PSO		
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1										3					1		1	1		2			
2										3			2	1	2	1	2	2	2	3			

3										2			1	2	2	2	1	1	2	3			
4										3			2	2	2	2	2	1	2	3			
5										3			2	3	3	2	2	3	3	3			

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme			
							Theory			Total
L	T	J	P				CIA	ESE	Total	
32	-	28	-	30	90	3	60	40	100	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)

Module	Title	Major Topics	Contact Hours
1	Entrepreneurship Fundamentals	Introduction to Innovation and Entrepreneurship – Entrepreneurial mindset – Types of entrepreneurs – Idea generation – Design thinking – Startup ecosystem – Government initiatives.	8
2	Business Planning and Startup Management	Market research and validation – Business model canvas – Revenue and pricing strategies – Business plan preparation – Prototype and MVP development – Risk management.	8
3	Fundamentals of IPR	Introduction to IPR – Patents, Trademarks, Copyrights, Industrial Designs – Patentability, filing procedures – Patent databases and search – Infringement-Rights and obligations – Case studies.	8
4	IPR Management and Commercialization	IP strategy for startups – Licensing, technology transfer – IPR in digital era – Emerging trends in AI and software patents – Ethical issues and Indian IP policy framework.	8

SELF-LEARNING / TEAM WORK

Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Analysis of government initiatives for startups (Startup India, Kerala Startup Mission, MSME schemes) and their impact on young entrepreneurs.	3
2	Case study on successful Indian startups and analysis of their innovation and growth journey.	3
3	Survey on entrepreneurial mindset among students and analysis of key motivating factors.	3
4	Preparation of a Business Model Canvas (BMC) for a technology or engineering-based idea.	3
5	Role-play exercise on negotiation between inventor and investor for licensing a technology	3

6	Comparative study of patents, trademarks, and copyrights through real-world Indian examples.	3
7	Patent search activity using the Indian Patent Advanced Search System (InPASS) or Google Patents.	3
8	Study on IPR infringement cases in India (e.g., Ilaiyaraaja vs *Manjummel Boys*, Novartis vs Union of India) and lessons learned.	3
9	Case study on the commercialization of academic research through technology transfer.	3
10	Seminar or debate on AI-generated content and copyright ethics in the digital era.	3

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	The Engineering Handbook	Richard C.Dorf	CRC Press
2	Business Model Generation	Alexander Osterwalder & Yves Pigneur	Wiley
3	Innovation and Entrepreneurship for Engineers	Bharat Bhushan and Seema Bhushan	CRS Press
4	Indian Patent Law	P. Narayanan	Eastern Book Company
5	The Law of Copyright and Designs	B.L. Wadehra	Universal Law
6	Intellectual Property Rights (Including IPR in the Digital Age)	Prabuddha Ganguli	Tata McGraw-Hill Education
Web Resource			
1	https://onlinecourses.nptel.ac.in/noc25_mg81		
2	https://nptel.ac.in/courses/110107094		
3	https://onlinecourses.nptel.ac.in/noc22_hs59		

Module	**Major Topic & Sub Topic**	**Mode of Delivery**	**Relevant COs**	**Learning Domain Level**			**Teaching Hours**
				C	**P**	**A**	
1	Introduction to Innovation and Entrepreneurship – Meaning, need, and importance	L	CO1	U		Re	1
	Entrepreneurial mindset – Characteristics and motivation of entrepreneurs	L	CO1	U		Re	1
	Types of entrepreneurs – Intrapreneurs, social, tech-based, women entrepreneurs	L	CO1	U		Re	1
	Idea generation techniques – Creativity, brainstorming, problem identification	L	CO1	U		Re	1

	Design thinking – Empathy, define, ideate, prototype, and testing	L	CO1	U		Re	1
	Startup ecosystem – Incubators, accelerators, funding agencies	L	CO1	U		Re	1
	Government initiatives for startups – Startup India, Make in India, MSME schemes	L	CO1	U		Re	1
	Self-Learning 1	S	CO1	U		Re	
	Self-Learning 2	S	CO1	U		Re	
	Case study / activity – Successful Indian startups and their founders	L	CO1	U		Re	1
2	Market research and validation – Identifying customer needs	L	CO2	An		V	1
	Business model canvas – Key partners, activities, value proposition	L	CO2	An		V	1
	Revenue and pricing strategies – Cost-based and value-based pricing	L	CO2	An		V	1
	Business plan preparation – Structure and key components	L	CO2	An		V	1
	Self-Learning 3	S	CO2	An		V	
	Prototype and MVP development – Concept and significance	L	CO2	An		V	1
	Self-Learning 4	S	CO2	An		V	
	Risk management – Types of risks and mitigation plans	L	CO2	An		V	1
	Startup funding sources – Angel investors, venture capital, crowdfunding	L	CO2	An		V	1
	Self-Learning 5	S	CO2	An		V	
	Case study / activity – Analyze a startup's business model canvas	L	CO2	An		V	1
3	Introduction to IPR – Need, importance, and categories	L	CO3	U		Re	1
	Patents – Concepts, requirements, and types	L	CO3	U		Re	1
	Trademarks and Copyrights – Differences, examples, and protection	L	CO3	U		Re	1
	Industrial Designs and Geographical Indications – Overview	L	CO3	U		Re	1
	Self-Learning 6	S	CO3	U		Re	

	Patentability and filing procedures – Steps involved in India	L	CO3	U		Re	1
	Patent databases and search – Hands-on demonstration (Google Patents)- Infringement	L	CO3	U		Re	1
	Self-Learning 7	S	CO3	U		Re	
	Self-Learning 8	S	CO3	U		Re	
	Rights and obligations of patent holders	L	CO3	U		Re	1
	Case study – Patent disputes and lessons learned	L	CO3	U		Re	1
4	IP strategy for startups – Importance and methods	L	CO4	E	Ar	O	1
	Licensing and technology transfer – Process and agreements	L	CO4	E	Ar	O	1
	IPR in the digital era – Copyrights in AI, software, and digital content	L	CO4	E	Ar	O	1
	Emerging trends – AI-generated inventions, data protection, open-source issues	L	CO4	E	Ar	O	1
	Self-Learning 9	S	CO4	E	Ar	O	
	Self-Learning 10	S	CO4	E	Ar	O	
	Software patents – Challenges and case examples	L	CO4	E	Ar	O	1
	Ethical issues in IPR – Plagiarism, fair use, and data ethics	L	CO4	E	Ar	O	1
	Indian IP policy framework – Overview and updates	L	CO4	E	Ar	O	1
	Case study / seminar – IP commercialization success stories	L	CO4	E	Ar	O	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Entrepreneurship Fundamentals	8		√	√				10
2	Business Planning and Startup Management	8			√	√			10
3	Fundamentals of IPR	8		√	√				10
4	IPR Management and Commercialization	8			√	√			10

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN		
Assessment		**Marks**
Continuous Internal Assessment		**60**
1	Learning Activity	5
2	Regularity	5
3	Internal Examination	20
4	Course Project	25
End Semester Examination		**40**
Total		**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER B. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**B250908/CN220F**		
Course Name:	**ENTREPRENEURSHIP AND INTELLECTUAL PROPERTY RIGHTS**		
Max. Marks	**40**	**Duration**:	2 hours 30 minutes

PART - A

(Answer all questions. Each question carries 2 marks)

No.	***Question***	***CO***	***Marks***
1	The five stages of Design Thinking are _____, Define, Ideate, _____ and Test.	CO1	(2)
2	Compare entrepreneurs and intrapreneurs in terms of their approach to innovation	CO1	(2)
3	Analyse the role of market validation in reducing startup failure risk.	CO2	(2)
4	Evaluate the importance of Minimum Viable Product (MVP) development.	CO2	(2)
5	The criteria for patentability include novelty, _____ step and _____ applicability.	CO3	(2)
6	Analyse how Geographical Indications (GIs) help in protecting regional products such as ***Palakkadan Matta Rice*** from Kerala.	CO3	(2)
7	Match the terms in **Column A** with the appropriate descriptions in **Column B**. **Column A** / **Column B** (a) Licensing vs. Assignment — (i) Assessing economic worth of IP assets (b) Patent Pooling — (ii) Fair use, plagiarism, and data ownership (c) IP Ethics — (iii) Permission vs. complete ownership transfer (d) IP Valuation — (iv) Sharing IP among multiple holders	CO4	(2)
8	Suggest two ways companies like ***Adobe*** and ***Netflix*** can prevent plagiarism and digital piracy.	CO4	(2)

PART - B

(Answer any one full question from each module, each question carries 6 marks)

No.		***Question***	***CO***	***Marks***
MODULE I				
9		Kerala has witnessed a steady rise in youth-led entrepreneurship through initiatives like **Kerala Startup Mission (KSUM),** which provides incubation, mentorship, and seed funding support. Programs such as **Young Innovators Programme (YIP)** encourage school and college students to identify real-world problems and propose innovative solutions. Many student startups—ranging from agritech to renewable energy—have evolved from these programs and are now scaling globally		
	a)	Analyse how Kerala's startup ecosystem supports the development of an entrepreneurial mindset among students.	CO1	(2)
	b)	Explain how design thinking principles can be applied to initiatives like YIP to improve innovation outcomes		(2)

	c)	Evaluate the challenges faced by youth entrepreneurs in Kerala in accessing funding and markets.		(1)
	d)	Suggest one policy-level improvement that could further strengthen Kerala's entrepreneurial ecosystem.		(1)
		OR		
10		In Kerala, there has been a growing presence of social and women entrepreneurs who are redefining business with a focus on sustainability and inclusivity. Initiatives like **Kudumbashree** and **WE Mission** (Women Entrepreneurship Mission) have empowered thousands of women to start micro and small-scale ventures across sectors like food processing, handicrafts, and local tourism. Meanwhile, social entrepreneurs such as *G. Venu (Natanakairali)* and *Jose Kutty Panackal (Farmvent)* have used innovation to address social and environmental issues. These ventures not only create employment but also promote sustainable development aligned with the UN SDGs.		
	a)	Differentiate between social entrepreneurs and commercial entrepreneurs with suitable examples from Kerala	CO1	(2)
	b)	Analyse how programs like Kudumbashree and WE Mission contribute to women entrepreneurship development.		(2)
	c)	Evaluate the role of social entrepreneurship in achieving sustainable and inclusive growth in Kerala.		(1)
	d)	Suggest one initiative the state government can introduce to strengthen the social entrepreneurship ecosystem.		(1)
		MODULE II		
11		A group of engineering graduates from Kochi developed an **IoT-based smart irrigation system** that optimizes water usage for farmers in Palakkad. With the support of KSUM's incubation center and an angel investor from Thrissur, the team built a Minimum Viable Product (MVP). However, scaling the product across India required a clear business model, pricing strategy, and risk assessment plan**.**		
	a)	Construct the key components of a Business Model Canvas for this smart irrigation startup.	CO2	(3)
	b)	Suggest an appropriate pricing strategy and justify your choice.		(2)
	c)	Analyse two major risks this startup may face during national expansion and suggest mitigation strategies		(1)
		OR		
12		Founded in 2015, **Zomato** evolved from a simple restaurant discovery website to a multi-service platform offering food delivery, dining experiences, and grocery delivery. The startup adopted a commission-based revenue model, where it earned a percentage from restaurant orders, and later diversified into subscription models like Zomato Gold. Despite rapid expansion, Zomato faced major financial and operational challenges, including high delivery costs, customer retention issues, and intense competition from Swiggy. To remain sustainable, the company had to rethink its pricing strategy, manage investor expectations, and explore new sources of income such as advertising and cloud kitchens. This journey demonstrates how startup success depends not only on innovation but also on effective business planning, risk management, and strategic funding decisions.		
	a)	Analyse Zomato's business model and identify how it balances value creation for customers and revenue generation for the company	CO2	(3)
	b)	Evaluate the effectiveness of Zomato's diversification strategy (e.g., Zomato Gold, grocery delivery) in maintaining market competitiveness.		(2)
	c)	Suggest any two alternative revenue model Zomato could adopt to achieve long-term profitability.		(1)
		MODULE III		
13		In 2023, India's Patent Office rejected **Johnson & Johnson's** patent extension request for its popular tuberculosis (TB) drug **Bedaquiline**. The company had sought to extend its patent beyond the original expiry date, claiming a new version of the same compound. However, the Patent Office ruled that the new version did not meet the criteria of novelty and inventive step under the Indian Patent Act, **Section 3(d).** As a result, Indian manufacturers were		

	allowed to produce generic versions of Bedaquiline, reducing the cost of TB treatment from thousands of rupees per month to less than a few hundred. This decision was celebrated by public health organizations and patient-rights groups, as it made life-saving TB medicines affordable to thousands of patients in India and other developing nations.			
	a)	Explain why the Indian Patent Office rejected Johnson & Johnson's patent extension for Bedaquiline.	CO3	(3)
	b)	Analyse how Section 3(d) of the Patent Act helps prevent "evergreening" of pharmaceutical patents.		(2)
	c)	Evaluate the social and economic impact of this decision on TB treatment and Indian healthcare.		(1)
	OR			
14	In early 2024, a major copyright controversy emerged in the Indian film industry when legendary composer **Ilaiyaraaja** issued a legal notice to the producers of the Malayalam film ***Manjummel Boys***, which featured his iconic Tamil song *"Kanmani Anbodu Kaadhalan"* from the 1991 film *Guna*. The song, deeply emotional and nostalgic, was used in a key scene of *Manjummel Boys*, which later became a massive box-office success across India. According to Ilaiyaraaja, the filmmakers had not obtained his personal permission to use the song, even though they had secured a license from the audio label that owned the recording rights. He claimed that under the Indian **Copyright Act, 1957**, a composer retains moral and authorial rights over their work — including the right to be acknowledged and to object to unauthorized or distorted use. He argued that simply acquiring a "sound recording licence" from a music company does not override the composer's ownership of musical and lyrical rights. This case reignited a larger debate in India's creative industry about ownership, moral rights, and licensing practices. Many musicians and lyricists supported Ilaiyaraaja, asserting that composers often lose control of their creations to record labels. Others argued that such disputes could discourage filmmakers from reviving classic songs. Eventually, media reports suggested that the matter was settled out of court, with the *Manjummel Boys* team reportedly compensating Ilaiyaraaja around ₹60 lakhs for the use of the song. The controversy highlighted the urgent need for clearer copyright awareness and ethical licensing practices in Indian cinema.			
	a)	Explain the types of rights Ilaiyaraaja holds under the Copyright Act, 1957, including economic and moral rights	CO3	(2)
	b)	Analyse why obtaining permission from a record label may not be sufficient to legally use a musical composition in a film.		(2)
	c)	Evaluate how this case impacts future relationships between composers, producers, and music companies in the Indian film industry.		(1)
	d)	Suggest one measure — legal, educational, or institutional — that could help prevent such copyright disputes in India's creative sector.		(1)
	MODULE IV			
15	With rapid advances in **artificial intelligence (AI)**, India faces new challenges in defining ownership, authorship, and accountability for creative works generated by machines. AI tools such as **ChatGPT, Midjourney, and Bard** are now widely used by students, designers, and businesses. While these tools accelerate creativity and productivity, they also raise legal and ethical questions about originality, plagiarism, and copyright. In 2024, the Indian Ministry of Electronics and Information Technology initiated discussions on a framework for AI-generated content ownership and data protection, emphasising transparency and responsible innovation. Globally, courts and IP offices are divided: some countries allow limited copyright protection for AI-assisted works, while others — including India — still require human authorship as the basis for copyright registration. The debate highlights a social tension: how can society protect creators' rights while encouraging the open, democratic use of emerging technologies? Without clear IP policies, both human creators and innovators risk exploitation, plagiarism, and loss of credit for their work.			
	a)	Explain the challenges India faces in defining copyright ownership for AI-generated works.	CO4	(2)

	b)	Analyse the ethical implications of using AI tools for creative and academic content generation		(2)
	c)	Evaluate whether India should extend partial IP protection to AI-assisted works. Support your view with reasons.		(1)
	d)	Suggest one policy or guideline that could balance innovation and ethical IP use in the AI era.		(1)
OR				
16	Over the past decade, India has witnessed explosive growth in digital entertainment and online media platforms such as **Netflix, Hotstar, Zee5** and **SonyLIV**. However, this growth has been accompanied by a surge in digital piracy, which severely affects the creative economy. According to a 2024 report by the **Motion Picture Association** (MPA), India ranks among the top five countries in illegal film downloads and streaming site traffic. The Cinematograph (Amendment) Act 2023 introduced strict penalties — including imprisonment — for individuals or groups involved in unauthorised recording or exhibition of films. Despite these legal measures, piracy persists through mirror sites, Telegram channels, and illegal OTT apps. This issue raises broader ethical and social questions: while piracy deprives creators and investors of revenue, it also exposes the affordability gap in India's digital ecosystem. Many argue that reducing piracy requires not only enforcement but also accessible pricing models and awareness among youth about IP ethics.			
	a)	Explain how licensing and distribution rights contribute to fair commercialisation of digital content in India.	CO4	(2)
	b)	Analyse the effectiveness of India's new anti-piracy laws in addressing the social and economic impacts of film piracy.		(2)
	c)	Evaluate the ethical dilemma between access and ownership in the context of digital piracy.		(1)
	d)	Suggest one initiative that could reduce piracy while ensuring affordable access to digital content.		(1)

****

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**1-1-0-0-0**	**Version**	**25/0**	**Credits**	**1**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
B250908/CN900K	**LIFE SKILLS AND PROFESSIONAL COMMUNICATION**	**HMT**
Pre-requisite		
NIL		

COURSE OBJECTIVES	
1	To foster self-awareness and personal growth, promote effective participation in groups and teams, develop critical thinking, problem solving and decision making skills and cultivate the ability to exercise emotional intelligence
2	To enhance students' overall communication skills, enabling them to comprehend, interpret and express ideas clearly in diverse academic and professional settings
3	To equip students to build their profile in line with the professional requirements and standards.

COMPETENCY STATEMENT (CC)	
CC 1	Learners demonstrate essential life skills and professional communication skills, enabling them to adapt confidently to personal, academic, and professional challenges and contribute meaningfully to society.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	CC Mapping	Cognitive (C)	Psychomotor (P)	Affective (A)
CO 1	Evaluate self awareness to set effective goals and plans	CC 1	A		V
CO 2	Evaluate the ability to focus on strengthening the fundamentals of emotional quotient.	CC 1	A		V
CO 3	Apply techniques to enhance Critical Thinking, Problem-solving and Decision-making skills	CC 1	A		V
CO 4	Apply strategies to improve comprehension and communication skills	CC 1	A		Rs
CO 5	Present ideas using modern technological platforms	CC 1	A		V
CO 6	Establish a professional network using networking platforms	CC 1	An		O

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation*
***Affective (Krathwohl)**: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

CO	Program Outcomes (PO) & Program Specific Outcomes (PSO) Correlation Matrix													
	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1					2	2	2	2	3	1	1			
2							2	1	2		1			
3	1	2	1	2		2	1	3	2	2	1			
4						1		2	3	1	2			
5					1			2	3		2			
6						2		3	3		2			
Correlation [3 – High, 2 -Medium, 1 – Low]														

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Theory		
L	T	J	P	S	C		CIA	ESE	Total
1	1	0	0	0	1	30	100	-	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Personal Growth & Self-management	1.Group formation and self-introduction 2. Preparation of Gantt chart 3. Online personality development test 4.Role-storming exercise	5
2	Workplace & Interpersonal Skills	1.Presentation on instances of empathy 2.Networking with professionals to develop workplace skills 3. Role- Play 4. Report writing	7
3	Problem-Solving & Creative thinking	1.Identifying real-life problem that requires a technical solution 2. Six thinking hat exercises 3. Group Discussion 4.Video presentation on diversity aspects	9
4	English Language communication & Professional Development	1.Online Interview skills development session. 2. Listening test 3.Activities to improve English vocabulary of students 4.Video content for podcasts on technological interventions/research work tried out in Kerala context	9

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Take an online personality development test, self-reflect and report	1
2	Prepare a mind map based on the role-storming exercise	1
3	Students indulge in self-reflection and identify their own goal and prepare for their undergraduate journey	1

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	Life Skills & Personality Development	Maithry Shinde et.al.	Cambridge University Press
2	Emotional Intelligence: Why it can matter more than IQ	Daniel Goleman	Bloomsbury Publishing PLC
3	Think Faster, Talk Smarter: How to speak successfully when you are put on the spot	Matt Abrahams	Macmillan Business
4	Deep Work: Rules for focused success in a distracted world	Cal Newport	PIATKUS
5	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education

Reference			
Sl. No.	Title of Book	Author	Publication
1	Life Skills for Engineers	Remesh S., Vishnu R.G	Ridhima Publication
2	Soft Skills & Employability Skills	Sabina Pillai andAgna Fernandez	Cambridge University Press
3	Guide to writing as an Engineer	David F. Beer and David McMurrey	John Willey. New York
4	LinkedIn Profile Optimization	Donna Serdula	

Web Resource	
1	www.mindtools.com
2	TED Talks on Life Skills
3	www.linkedin.com/learning

DETAILED SYLLABUS *(Self-learning if any to be marked)*

Sl.No	Activity	Mode of Delivery	Group/ Individual (G/I)	Mark	COs	Learning Domain			Hrs
						C	P	A	
1.1	Group formation and self introduction among the group members	L	G			R		Re	2
1.2	Familiarizing the activities and preparation of the time plan for the activities	L	G			R		Re	
1.3	Preparation of Gantt chart based on the time plan	L, T	G	5	CO1	A		Re	
2.1	Take an online personality development test	L, T	I	2	CO1	U		V	3
2.2	Role-storming exercise 1: Students assume 2 different roles given below and write about their; ●Strengths ●Areas for improvement ●Concerns ●Areas in which he/she hesitates to take advice ●Goals/Expectations from the point of view of the following assumed roles: i) parent/guardian/mentor ii) friend/sibling/cousin	L, T	I	2	CO1	U		Rs	
2.3	Role-storming exercise 2: Students assume the role of their teacher and write about ●Skills required as a B.Tech graduate ●Attitudes, habits, approaches required and activities to be practiced	L, T	I	2	CO1	U		Rs	

	during their B.Tech years, in order to achieve the set goals								
2.4	Discuss the skills identified through role storming exercise by each one within their own group and improvise the list of skills	L, T	G	2	CO1	R		Re	
2.5	Exhibit/present the mind map prepared based on the role storming exercise in the class	L, T	G	2	CO1	U		Re	
3	Prepare a presentation on instances of empathy the students have observed in their own life or in other's life	L, T	I	5	CO2	U		V	3
4.1	Each student connects and networks with a minimum of 3 professionals from industry/ public sector organizations/ other agencies/NGOs /academia (at least 1 through LinkedIn)	L, T	I	2	CO2	U		Rs	4
4.2	Interact with them to understand their workplace details including •workplace skills required •their work experience •activities they have done to enhance their employability during their B.Tech years •suggestions on the different activities to be done during B.Tech years Prepare a documentation of this	L, T	I	4	CO2	U		Rs	
4.3	Discuss the different workplace details & work readiness activities assimilated by each through the interactions within their group and compile the inputs collected by the individuals Prepare the Minutes of the discussions	L, T	G	2	CO2	U		Rs	
4.4	Report preparation based on the discussions	L, T	G	3	CO4	R			
4.5	Perform a role-play based on the workplace dynamics assimilated through interactions and group discussions	L, T	G	4	CO3	U		Rs	
4.6	Students prepare an action plan for their undergraduate journey	L, T	I	2	CO1	R		Rs	

5.1	Select a real-life problem that requires a technical solution and list the study materials needed	L, T	G	2	CO3	A		Rs	3
5.2	Listen to TED talks & video lectures from renowned Universities related to the problem and prepare a one-page summary (Each group member should select a different resource)	L, T	I	2	CO4	U			
5.3	Use any online tech forum to gather ideas for solving the problem chosen	L, T	G	2	CO5	A		Rs	
5.4	Arrive at a possible solution using six thinking hat exercise	L, T	G	5	CO3	An		V	
5.5	Prepare a report based on the problem- solving experience	L,T	G	2	CO4	A			
6.1	LinkedIn profile creation	L, T	I	2	CO6	U			2
6.2	Resume preparation	L, T	I	5	CO6	A			
6.3	Self-introduction video	L,T	I	3	CO6	A		V	
7	Prepare a presentation on instances of demonstration of emotional intelligence	L, T	I	2	CO2	A		V	3
8	Prepare a short video presentation on diversity aspects observed in our society (3 to 5 minutes)	L, T	G	5	CO2 CO5	A		V	3
9	Take online Interview skills development sessions like robotic interviews; self-reflect and report	L, T	I	2	CO6	U		V	1
10	Take an online listening test, self reflect and report	L, T	I	2	CO6	U		Rs	1
11.1	Activities to improve English vocabulary of students	L, T	I/G	4	CO4	U		Re	4
11.2	Activities to help students identify errors in English language usage	L, T	I/G	2	CO4	U		Re	
11.3	Activity to help students identify commonly misspelled words, commonly mispronounced words and confusing words	L, T	I/G	2	CO4	U		Re	

11.4	Write a self-reflection report on the improvement in English language communication through this course	L, T	I	2	CO4	A		V	
11.5	Presentation by groups on the experience of using online collaboration tools in various group activities and time management experience as per the Gantt chart prepared	L, T	G	5	CO4 CO5	A		V	
12.1	Each group prepares video content for podcasts on innovative technological interventions/research work tried out in Kerala context by academicians/professionals/Govt. agencies/research institutions/private agencies/NGOs/other agencies	L, T	G	10	CO2 CO4 CO5	A		V	1
12.2	Upload the video content to podcasting platforms or YouTube	T	G	2	CO5	U			
12.3	Add the link of the podcast in their LinkedIn profile	T	G	2	CO5	U			

ASSESSMENT PATTERN		
Assessment		**Marks**
Continuous Internal Assessment		**100**
1	Internal Examination	
2	Learning Activity	**100**
3	Regularity	
4	Course Project	
End Semester Examination		
Total		**100**

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**0-0-0-2-0**	**Version**	**25/1**	**Credits**	**1**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
B250904/CN230U	**IT WORKSHOP**	**ESL**
Pre-requisite		
NIL		

COURSE OBJECTIVES
The IT Workshop lab course aims to familiarize students with basic computer hardware components and system setup, provide hands-on experience with Linux operating system commands and editors, and introduce essential development tools such as compilers, debuggers, and version control using Git. The course also enables learners to create and manage technical documents using LaTeX, perform basic networking tasks and file transfer between systems, develop foundational skills in web development using HTML, CSS, and JavaScript, explore data analysis and visualization using MATLAB, and instil awareness of fundamental cybersecurity practices.

COMPETENCY STATEMENT(CC)	
CC1	Apply the knowledge of computer hardware components, peripherals, and interfaces, to assemble, configure, and maintain functional computer systems and networking.
CC2	Troubleshoot system and network configurations using operating system commands and networking tools to ensure efficient operation and connectivity.
CC3	Design and develop web and implement version control and documentation tools for collaborative software development.
CC4	Familiarise text editors and perform program compilation and debugging

COURSE OUTCOMES					
Course Outcomes (CO): At the end of this course, learners will be able to:					
CO	**CO Statement**	**CC Mapping**	**Cognitive (C)**	**Psychomotor (P)**	**Affective (A)**
CO 1	Identify the key components of computer system and networking hardware used in modern computing environments.	CC1	U	I	Re
CO 2	Demonstrate the use of essential operating system commands to manage files, users, and processes effectively, after the installation and configuration of operating systems.	CC1, CC2	A	M	Rs
CO 3	Demonstrate file sharing and communication between computer systems.	CC2	A	P	V
CO 4	Deploy simple web pages using HTML, CSS, and JavaScript, by incorporating features such as form validation and image sliders on a local web server.	CC3	A	Ar	O
CO 5	Apply development and documentation tools such as Visual Studio Code, Matlab,Git, and LaTeX for effective coding, version control, collaboration, and preparation of professional technical documents.	CC3	A	Ar	Ch
CO 6	Practice basic cybersecurity measures like permissions and encryption.	CC4	A	P	V

CO 7	Apply text editors and debugging tools to write, compile and debug C programs.	CC4	A	Ar	O

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*
Psychomotor Domain (Dave's): *- **I**-Imitation, **M**-Manipulation, **P**-Precision, **Ar**-Articulation, **N**-Naturalisation* ***Affective (Krathwohl)****: - **Re**-Receiving, **Rs**-Responding, **V**-Valuing, **O**-Organization, **Ch**-Characterization*

CO	**Program Outcomes & Program Specific Outcomes Correlation Matrix**													
	PO											**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	2			2						1			
2	3	2	2		3				2		2			
3	3	3	2		3				2		2			
4	3	2	3		3				3	2	3			
5	2		2		3				3	3	3			
6	2				2						2			
7	2				2									
Correlation [3 – High, 2 -Medium, 1 – Low]														

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					**Credit**	**Hours / Semester**	**Examination Scheme**		
							Practical		
L	**T**	**J**	**P**	**S**	**C**		**CIA**	**ESE**	**Total**
			2		1		60	40	100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Hrs
1	Computer Systems & Linux Environment	Computer Hardware and Peripherals, Boot Process & OS Installation, Working with Text editors (Vim/ emac/ nano /Vi), C program compilation and debugging, Shell Programming (Bash)	12
2	Web Development Basics	HTML structure, tags, links, CSS styling and layout, Basic JavaScript interactivity, Hosting a web page locally	4
3	Development Environments Repositories & Documentation	Git basics: init, clone, commit, push, branch, Documentation with LaTeX: reports, equations, tables, Perform Import data, perform statistical analysis and visualize it using Matlab, Understand the concept of image representation as 2D matrix and perform image operations (imread()`, `imresize()`, `rgb2gray()`, `imshow()`, `imhist()`)	6
4	Networking and Security	Configure basic network and monitor it using Wireshark, Various types of cyber threats, its risk factors and defence mechanisms.	4

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Deploy webpages using HTML, CSS and JavaScript	2
2	Prepare a document for your webpage using Latex	2
3	Upload your code and document in your git	2

SUGGESTED LEARNING RESOURCES

Text Book			
Sl. No.	Title of Book	Author	Publication
1	The Architecture of Computer Hardware, Systems Software, & Networking: An Information Technology Approach.	Irv Englander	Wiley, 5/e, 2014
2	Mastering Git : Attain expert level proficiency with Git for enhanced productivity and efficient Collaboration	Jakub Narębski	Packt ,1/e, 2016
3	Web Design with HTML, CSS, JavaScript, and Jquery	Jon Duckett	Wiley, 1/e, 2014
4	MATLAB: Data Analysis and Visualization	Antonio Siciliano	World Scientific Publishing Co., 2008

Reference			
Sl. No.	Title of Book	Author	Publication
1	*Linux Command Line and Shell Scripting Bible*,	Richard Blum and Christine Bresnahan	Wiley, 2021, 4th Edition
2	Learning the vi and Vim Editors	Arnold Robbins	O'Reilly Media, 2016.
3	*Learning GNU Emacs*,	Debra Cameron	O'Reilly Media, 2004.
4	Network Security Essentials: Applications and Standard	William Stallings	Pearson, 2023
5	Digital Image Processing Using MATLAB	Rafael C. Gonzalez et al	Pearson

Web Resource	
1	https://www.tutorialspoint.com/computer_hardware/index.htm
2	https://www.cisco.com/c/en/us/solutions/small-business/resource-center/networking.html
3	https://www.wireshark.org/docs/wsug_html_chunked/
4	https://linuxconfig.org/bash-scripting-tutorial-for-beginners
5	https://www.w3schools.com/howto/howto_js_slideshow.asp
6	https://www.latex-project.org/help/
7	https://git-scm.com/doc
8	https://code.visualstudio.com/docs

PRACTICAL SYLLABUS						
Topic	Objective	CO	Learning Domain			Hrs
			C	A	P	
Computer Hardware and Peripherals	Familiarize with CPU, motherboard, storage, interface cards, I/O devices, and networking hardware	1	U	I	Re	2
Boot Process & OS Installation	Installation of Linux and Windows OS and Understand boot process	2	U	M	Rs	2
Working with Text editors (Vim/ emac/ nano /Vi)	Create program files, compile and debug it	7	A	P	V	2
C program compilation and debugging		7	A	P	V	2
Unix/Linux Basic Commands	Execute essential Unix/Linux commands to manage files, users, and processes	2	A	M	Rs	2
Shell Programming (Bash)	Write basic shell scripts to perform different tasks	4	C	Ar	O	2
Web Page Development	Create HTML, CSS, JS web pages with forms and validation	4	C	Ar	O	2
LaTeX & Documentation Tool	Prepare technical documents using LaTeX	5	A	Ar	Ch	2

Development Environments & Repositories	Use Matlab for statistical data analysis and its visualisation	5	A	Ar	Ch	2
	Use Git, Bitbucket for collaborative coding	5	A	Ar	Ch	2
Networking Configuration and monitoring	Configure basic network and monitor it using Wireshark	3	A	P	V	2
Cyber Threats and defense mechanism	Understand various types of cyber threats and enable learners to analyse risk factors and recommend suitable defence mechanisms.	6	A	P	V	2

ASSESSMENT PATTERN		
Assessment Method		**Marks**
Continuous Internal Assessment		**60**
1	Continuous Lab Evaluation	60
End Semester Examination		**40**
Total		**100**