MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM

Scheme for Artificial Intelligence and Machine Learning

SEMESTER 1

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T01	LINEAR ALGEBRA AND MULTI VARIABLE CALCULUS	3-1-0-3	4	4
B	B24ES1T01A	PROBLEM SOLVING & PROGRAMMING TECHNIQUES	2-1-0-2	3	3
C	B24PH1T01A	ENGINEERING PHYSICS (A)	2-1-0-2	3	3
D	B24CY1T01A	ENGINEERING CHEMISTRY (A)	2-1-0-2	3	3
E	B24ES1T02	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	2-2-0-2	4	4
F	B24ES1L02	BASIC ELECTRICAL AND ELECTRONICS WORKSHOP	0-0-2-2	2	1
G	B24ES1L01A	PROGRAMMING LAB	0-0-3-3	3	2
H	B24PH1L01A	ENGINEERING PHYSICS LABORATORY (A)	0-0-1-1	2	1
	B24CY1L01A	ENGINEERING CHEMISTRY LABORATORY (A)	0-0-1-1		
I	B24MC1T01	LIFE SKILLS	1-0-1-2	2	P/F
J	B24MC1T02	DESIGN THINKING	1-1-0-1	2	P/F
K	B24MC1L01	YOGA AND SPORTS	0-1-1-1	2	P/F
TOTAL				**30**	**21**

SEMESTER 2

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS	3-1-0-3	4	4
B	B24ES1T03A	COMPUTER AIDED ENGINEERING GRAPHICS	2-0-2-4	4	3
C	B24CS1T01	LOGIC SYSTEM DESIGN	3-1-0-3	4	4
D	B24CS1T02	INDUSTRIAL PROGRAMMING	2-1-0-2	3	3
E	B24CS1T03	OBJECT ORIENTED PROGRAMMING	3-1-0-3	4	4
G	B24CS1L01	INDUSTRIAL PROGRAMMING LAB	0-0-3-3	3	2
H	B24CS1L02	OBJECT ORIENTED PROGRAMMING LAB	0-0-3-3	3	2
I	B24MC1T03	PROFESSIONAL COMMUNICATION & ETHICS	2-0-1-3	3	P/F
J	B24MC1L02	IDEA LAB	0-0-2-2	2	P/F
TOTAL				**30**	**22**

SEMESTER 3

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T03C	DISCRETE MATHEMATICS	3-1-0-3	4	4
B	B24CS2T01	DATA STRUCTURES	3-1-0-3	4	4
C	B24CS2T02	COMPUTER ORGANIZATION AND ARCHITECTURE	3-1-0-3	4	4
D	B24CS2T03	COMPUTER NETWORKS	2-1-0-2	3	3
E	B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	3-0-0-3	3	3
G	B24CS2L03	DATA STRUCTURES LAB	0-0-3-3	3	2
H	B24CS2L04	NETWORKING LAB	0-0-3-3	3	2
I	B24MC2T04	UNIVERSAL HUMAN VALUE AND CONSTITUTIONAL RIGHTS	2-0-0-2	2	P/F
J	B24MC2T05	ENERGY CONSERVATION AND ENVIRONMENTAL SUSTAINABILITY	2-0-0-2	2	P/F
M		MINOR	3-1-0-3	4	
TOTAL				**32**	**22**

SEMESTER 4

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T04C	GRAPH THEORY	3-1-0-3	4	4
B	B24CS2T04	OPERATING SYSTEMS	3-1-0-3	4	4
C	B24CS2T05	FORMAL LANGAUGES AND AUTOMATA THEORY	3-1-0-3	4	4
D	B24CS2T06	DATABASE MANAGEMENT SYSTEMS	3-1-0-3	4	3
E	B24HU2T03	ENTREPRENEURSHIP AND SOFTWARE MANAGEMENT SYSTEMS	2-1-0-2	3	3
F	B24CD2T01	MACHINE LEARNING CONCEPTS	2-1-0-2	3	3
G	B24CS2L05	LOGIC SYSTEM DESIGN AND OPERATING SYSTEMS LAB	0-0-3-3	3	2
H	B24CS2L06	DATABASE LAB	0-0-3-3	3	2
M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
TOTAL				**36**	**25**

SEMESTER 5

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CD3T01	DATA ANALYTICS	3-1-0-3	4	4
B	B24AM3T01	BIG DATA PROCESSING	3-1-0-3	4	4
C	B24CS3T03	COMPILER DESIGN	3-1-0-3	4	4
D	B24CS3T04	ALGORITHM ANALYSIS AND DESIGN	3-1-0-3	4	4
E	B24CS3T05	ARTIFICIAL INTELLIGENCE	2-1-0-2	3	3
F	B24CS3P1x	PROGRAMME ELECTIVE I	2-1-0-2	3	3
G	B24CD3L07	DATA ANALYTICS LAB	0-0-3-3	3	2
H	B24AM3L08	MACHINE LEARNING LAB	0-0-3-3	3	2
M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
TOTAL				**36**	**26**

PROGRAMME ELECTIVE I

B24CS3P11	PROGRAMMING PARADIGMS (Bucket-I)
B24CS3P12	NUMBER THEORY (Bucket-II)
B24CS3P13	INTERNET OF THINGS (General-I)
B24CS3P14	DISTRIBUTED COMPUTING (General-II)

Note:- Six programme electives are offered from semester 5 onwards as per the curriculum. This curriculum envisages to offer a learner an opportunity to earn proficiency in one of two areas in Computer Science, namely Software Engineering (Bucket -I) and Security in Computing (Bucket -II). Six courses each from the above areas are included through Elective Buckets. Also learners have the option to choose general elective courses which are categorised as General-I and General-II instead of courses in buckets. Learners can choose any one of the buckets in semester 5 and they have to follow the same bucket in the subsequent semesters. Once they are out of the bucket by choosing General courses as electives, they will not be allowed to choose the subjects from any of the bucket. For example, a learner who is interested in the Software Engineering area may opt to take the elective courses -Programming Paradigms from Elective-I in S5, Object Modeling and Design from Elective-II in S6 and Software Performance and Scalability from Elective-III & Software Testing Architecture from Elective-IV in S7 and Business Analytics from Elective-V & Software Testing Platforms and Tools from Elective-VI in S8. The department may offer Elective Courses to enable students to utilize this opportunity, depending on the availability of faculty.

SEMESTER 6

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CD3T06	DATA MINING	3-1-0-3	4	4
B	B24AM3T07	CONCEPTS OF NATURAL LANGAUGE PROCESSING	3-1-0-3	4	4

C	B24AM3T08	DATA HANDLING AND VISUALIZATION	3-1-0-3	4	4
D	B24AM3T09	ROBOTICS AND INTELLIGENCE SYSTEMS	3-1-0-3	4	4
E	B24CS3P2x	PROGRAMME ELECTIVE II	2-1-0-2	3	3
F	B24CS3G1x	OPEN ELECTIVE I	2-1-0-2	3	3
G	B24AM3L09	ARTIFICIAL INTELLIGENCE LAB	0-0-3-3	3	2
H	B24CS3L10	MINI PROJECT	0-0-3-3	3	2
M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
TOTAL				**36**	**26**

PROGRAMME ELECTIVE II

B24CS3P21	OBJECT MODELLING AND DESIGN (Bucket-I)
B24CS3P22	CRYPTOGRAPHY AND NETWORK SECURITY (Bucket-II)
B24CS3P23	LAN TECHNOLOGIES (General-I)
B24CS3P24	WEB MINING (General-II)

OPEN ELECTIVE I

B24CS3G11	INTRODUCTION TO DATASTRUCTURES
B24CS3G12	COMPUTER GRAPHICS
B24CS3G13	DIGITAL IMAGE PROCESSING

SEMESTER 7

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CD4T01	DEEP LEARNING TECHNIQUES	2-1-0-2	3	3
B	B24CS4P3x	PROGRAMME ELECTIVE III	2-1-0-2	3	3
C	B24CS4P4x	PROGRAMME ELECTIVE IV	2-1-0-2	3	3
D	B24CS4G2x	OPEN ELECTIVE II	2-1-0-2	3	3
E	B24HU4T04	DISASTER MANAGEMENT AND INDUSTRIAL SAFETY	2-1-0-2	3	3
G	B24AM4L11	NATURAL LANGAUGE PROCESSING LAB	0-0-3-3	3	2
H	B24AM4L12	PROJECT PHASE 1	0-0-6-6	6	3
J	B24AM4L13	SEMINAR	0-0-4-4	4	2
K	B24AM4T02	VIVA VOCE	0-0-0-0	-	1

M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
TOTAL				**36**	**23**

PROGRAMME ELECTIVE III

B24CS3P31	SOFTWARE PERFORMANCE AND SCALABILITY (Bucket-I)
B24CS3P32	INFORMATION AND DATA SECURITY (Bucket-II)
B24CS3P33	HIGH PERFORMACE COMPUTING (General-I)
B24CS3P34	MODERN DATABASES (General-II)

PROGRAMME ELECTIVE IV

B24CS3P41	SOFTWARE TESTING ARCHITECTURE (Bucket-I)
B24CS3P42	CYBER FORENSICS (Bucket-II)
B24CS3P43	EMBEDDED SYSTEMS (General-I)
B24CS3P44	CLIENT SERVER COMPUTING (General-II)

OPEN ELECTIVE II

B24CS3G21	INTRODUCTION TO DATABASE
B24CS3G22	BASICS OF LAN TECHNOLOGIES
B24CS3G23	INTRODUCTION TO MOBILE COMPUTING

SEMESTER 8

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A,B,C		INTERNSHIP & MOOC COURSES(3 NUMBERS)			9
OR					
A	B24CS4P5x	PROGRAMME ELECTIVE V	2-1-0-2	3	3
B	B24CS4P6x	PROGRAMME ELECTIVE VI	2-1-0-2	3	3
C	B24CS4G3x	OPEN ELECTIVE III	2-1-0-2	3	3
AND					
H	B24AM4L14	PROJECT PHASE II	0-0-12-12	12	6
M		MINOR PROJECT*	0-0-3-3	3	
N		HONORS PROJECT*	0-0-6-6	6	
TOTAL				**30**	**15**

PROGRAMME ELECTIVE V

B24CS3P51	BUSINESS ANALYTICS (Bucket-I)
B24CS3P52	CLOUD SECURITY (Bucket-II)
B24CS3P53	BIOMETRICS (General-I)
B24CS3P54	PROGRAMMING IN R (General-II)

PROGRAMME ELECTIVE VI

B24CS3P61	SOFTWARE TESTING PLATFORMS AND TOOLS (Bucket-I)
B24CS3P62	BLOCK CHAIN TECHNOLOGIES (Bucket-II)
B24CS3P63	MOBILE COMPUTING (General-I)
B24CS3P64	SOFT COMPUTING (General-II)

OPEN ELECTIVE III

B24CS3G31	INTRODUCTION TO OPERATING SYSTEMS
B24CS3G32	BASICS OF CLIENT SERVER COMPUTING
B24CS3G33	INTRODUCTION TO DISTRIBUTED COMPUTING

PROGRAMME ELECTIVE LISTS

Elective	BUCKET–I (Software Engineering)	BUCKET–II (Security in Computing)	General-I	General-II
I	PROGRAMMING PARADIGMS	NUMBER THEORY	INTERNET OF THINGS	DISTRIBUTED COMPUTING
II	0BJECT MODELING AND DESIGN	CRYPTOGRAPHY AND NETWORK SECURITY	LAN TECHNOLOGIES	WEB MINING
III	SOFTWARE PERFORMANCE AND SCALABILTY	INFORMATION AND DATA SECURITY	HIGH PERFORMACE COMPUTING	MODERN DATABASES
IV	SOFTWARE TESTING ARCHITECTURE	CYBER FORENSICS	EMBEDDED SYSTEMS	CLIENT SERVER COMPUTING
V	BUSINESS ANALYTICS	CLOUD SECURITY	BIOMETRICS	PROGRAMMING IN R
VI	SOFTWARE TESTING PLATFROMS AND TOOLS	BLOCK CHAIN TECHNOLOGIES	MOBILE COMPUTING	SOFT COMPUTING

MINOR

SEMESTER	BUCKET - I (Programming Methodologies)	BUCKET – II (Machine Learning)	BUCKET – III (Networking)
III	PYTHON PROGRAMMING	MATHEMATICS FOR MACHINE LEARNING	DATA COMMUNICATION CONCEPTS
IV	OBJECT ORIENTED PROGRAMMING IN JAVA	INTRODUCTION TO MACHINE LEARNING	INTRODUCTION TO COMPUTER NETWORKS
V	DATABASE PROGRAMMING	CONCEPTS IN DEEP LEARNING	CLIENT SERVER SYSTEMS
VI	WEB TECHNOLOGIES	PYTHON FOR MACHINE LEARNING	WIRELESS NETWORKS AND IOT APPLICATIONS
VII	MINI PROJECT	MINI PROJECT	MINI PROJECT
VIII	MINI PROJECT	MINI PROJECT	MINI PROJECT

Note:-Learners can choose any one of the buckets in semester 3 and they have to follow the same bucket in the subsequent semesters.

HONOURS

SEMESTER	BUCKET- I (Computer Vision)	BUCKET- II (Computational Biology)	BUCKET- III (Formal Methods)
IV	ADVANCED TOPICS IN COMPUTER GRAPHICS	COMPUTATIONAL FUNDAMENTALS FOR BIOINFORMATICS	PRINCIPLES OF PROGRAM ANALYSIS AND VERIFICATION
V	ADVANCED CONCEPTS IN COMPUTER VISION	MACHINE LEARNING IN COMPUTATIONAL BIOLOGY	PRINCIPLES OF MODEL CHECKING
VI	IMAGE AND VIDEO PROCESSING	COMPUTATIONAL HEALTH INFORMATICS	THEORY OF COMPUTABILITY AND COMPLEXITY
VII	SURVEILLANCE VIDEO ANALYTICS	COMPUTER AIDED DRUG DESIGN	LOGIC FOR COMPUTER SCIENCE
VIII	MINI PROJECT	MINI PROJECT	MINI PROJECT

Note:-Learners can choose any one of the buckets in semester 4 and they have to follow the same bucket in the subsequent semesters.

MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.Tech
Artificial Intelligence and Machine Learning

SEMESTER 1

SYLLABUS

SEMESTER 1

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T01	LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS	3-1-0-3	4	4
B	B24ES1T01A	PROBLEM SOLVING & PROGRAMMING TECHNIQUES	2-1-0-2	3	3
C	B24PH1T01A	ENGINEERING PHYSICS (A)	2-1-0-2	3	3
D	B24CY1T01A	ENGINEERING CHEMISTRY (A)	2-1-0-2	3	3
E	B24ES1T02	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	2-2-0-2	4	4
F	B24ES1L02	BASIC ELECTRICAL AND ELECTRONICS WORKSHOP	0-0-2-2	2	1
G	B24ES1L01A	PROGRAMMING LAB	0-0-3-3	3	2
H	B24PH1L01A	ENGINEERING PHYSICS LABORATORY (A)	0-0-1-1	2	1
	B24CY1L01A	ENGINEERING CHEMISTRY LABORATORY (A)	0-0-1-1		1
I	B24MC1T01	LIFE SKILLS	1-0-1-2	2	P/F
J	B24MC1T02	DESIGN THINKING	1-1-0-1	2	P/F
K	B24MC1L01	YOGA AND SPORTS	0-1-1-1	2	P/F
TOTAL				**30**	**21**

B24MA1T01	LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course introduces students to some basic mathematical ideas and tools which are at the core of any engineering course. A brief course in Linear Algebra familiarises students with some basic techniques in matrix theory which are essential for analyzing linear systems. The calculus of functions of one or more variables taught in this course are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Prerequisites: Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Solve systems of linear equations, diagonalize matrices and characterise quadratic forms (Cognitive Knowledge level: Apply)
CO 2	Compute the partial and total derivatives and maxima and minima of multivariable functions(Cognitive Knowledge Level : Apply)
CO 3	Compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas. (Cognitive Knowledge Level : Apply)
CO 4	Compute the derivatives and line integrals of vector functions and learn their applications(Cognitive Knowledge Level : Apply)
CO 5	Evaluate surface and volume integrals and learn their inter-relations and applications. (Cognitive Knowledge Level : Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	1	1					1		1
CO 2	3	2	1	1	1					1		1
CO 3	3	2	1	1	1					1		1
CO 4	3	2	1		1							1
CO 5	3	2	1	1	1					1		1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (Linear Algebra)

(Text 2: Relevant topics from 7.3, 7.4, 7.5, 8.1,8.3,8.4)
Systems of linear equations, Solution by Gauss elimination, row echelon form and rank of a matrix, fundamental theorem for linear systems (homogeneous and non-homogeneous, without proof), Eigen values and eigenvectors. Diagonalization of matrices, orthogonal transformation, quadratic forms and their canonical forms.

MODULE 2 (Multivariable Calculus-Differentiation)

(Text 1: Relevant topics from sections 13.3, 13.4, 13.5, 13.8)

Partial derivatives, partial derivatives of functions of more than two variables, higher order partial derivatives, differentials and local linearity, The chain rule, Maxima and Minima of functions of two variables, extreme value theorem (without proof), relative extrema.

MODULE 3 ((Multivariable Calculus-Integration))

(Text 1: Relevant topics from sections 14.1, 14.2, 14.3, 14.5, 14.6, 14.8)

Double integrals (Cartesian), reversing the order of integration, Change of coordinates (Cartesian to polar), finding areas using double integrals, mass and centre of gravity of inhomogeneous laminas using double integral. Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates (computations involving spheres, cylinders).

MODULE 4 (Calculus of vector functions)

(Text 1: Relevant topics from sections 12.1, 12.2, 12.6, 13.6, 15.1, 15.2, 15.3)

Vector valued function of single variable, derivative of vector function and geometrical interpretation, motion along a curve-velocity, speed and acceleration. Concept of scalar and vector fields, Gradient and its properties, directional derivative, divergence and curl, Line integrals of vector fields, work as line integral, Conservative vector fields, independence of path and potential function(results without proof).

MODULE 5 (Vector integral theorems)

(Text 1: Relevant topics from sections 15.4, 15.5, 15.6, 15.7, 15.8)

Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals and finding areas. Surface integrals over surfaces of the form z

= g(x, y), y = g(x, z) or x = g(y, z) , Flux integrals over surfaces of the form z = g(x, y), y = g(x, z) or x = g(y, z), divergence theorem (without proof) and its applications to finding flux integrals, Stokes' theorem (without proof) and its applications to finding line integrals of vector fields and work done.

Text Books

1. H. Anton, I. Biven, S. Davis, "Calculus", Wiley, 10^{th} edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10^{th} edition, John Wiley & Sons, 2015.

Reference Books

4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9^{th} Edition, Pearson, Reprint,2002.
5. J. Stewart, Essential Calculus, Cengage, 2^{nd} edition, 2017.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43^{rd} Edition, 2015.
7. Peter O Neil, Advanced Engineering Mathematics, 7^{th} Edition, Thomson, 2007.
8. Veerarajan T. Engineering Mathematics for first year", Tata McGraw - Hill, 2008.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total	45 hours
1	**Linear Algebra**	9
1.1	Systems of linear equations, Solution by Gauss elimination	1
1.2	Row echelon form, finding rank from row echelon form, fundamental theorem for linear systems	2
1.3	Eigen values and eigen vectors	2
1.4	Diagonalization of matrices	2
1.5	Orthogonal transformation, quadratic forms and their canonical forms.	2
2	**Multivariable Calculus - Differentiation**	9
2.1	Partial derivatives	2
2.2	Differentials, Local Linear approximations	2

2.3	Chain rule, total derivative	2
2.4	Maxima and minima	3
3	**Multivariable Calculus - Integration**	9
3.1	Double integrals (Cartesian)-evaluation	2
3.2	Change of order of integration in double integrals, change of coordinates (Cartesian to polar)	2
3.3	Finding areas, mass and centre of gravity of plane laminas	2
3.4	Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates.	3
4	**Calculus of Vector Functions**	9
4.1	Vector valued function of a scalar variable - derivative of vector valued function of scalar variable t-geometrical meaning	2
4.2	Motion along a curve-speed, velocity, acceleration	1
4.3	Gradient and its properties, directional derivative, divergence and curl	3
4.4	Line integrals with respect to arc length, line integrals of vector fields. Work done as line integral	2
4.5	Conservative vector field, independence of path, potential function	1
5	**Vector Integral Theorems**	9
5.1	Green's theorem and it's applications	2
5.2	Surface integrals, flux integral and their evaluation	3
5.3	Divergence theorem and applications	2
5.4	Stokes theorem and applications	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): Solve systems of linear equations, diagonalize matrices and characterise quadratic forms.

1. A is a real matrix of order 3×3 and $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$. What can you say about the solution of $AX = 0$ if rank of A is 2 ? 3 ?

2. Given A = $\begin{bmatrix} 3 & 0 & 2 \\ 0 & 2 & 0 \\ -2 & 0 & 0 \end{bmatrix}$, find an orthogonal matrix P that diagonalizes A.

3. The matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ has an eigenvalue 5 with corresponding eigenvector

   $X = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$. Find A^5X.

Course Outcome 2 (CO 2): Compute the partial and total derivatives and maxima and minima of multivariable functions.

1. Find the slope of the surface $z = x^2y + 5y^3$ in the x-direction at the point $(1, -2)$.
2. Given the function $w = xy + z$, use the chain rule to find the instantaneous rate of change of w at each point along the curve $x = \cos t$, $y = \sin t$, $z = t$.
3. Determine the dimension of rectangular box open at the top, having a volume 32 cubic ft and requiring the least amount of material for it's construction.

Course Outcome 3 (CO 3): Compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas.

1. Evaluate $\iint_D (x + 2y)\, dA$ where D is the region bounded by the parabolas

   $y = 2x^2$ and $y = 1 + x^2$.
2. Explain how you would find the volume under the surface $z = f(x, y)$ and over a specific region D in the xy plane using triple integral?
3. Find the mass and centre of gravity of a triangular lamina with vertices (0,0), (2,1), (0,3) if the density function is $f(x, y) = x + y$.

Course Outcome 4 (CO 4): Compute the derivatives and line integrals of vector functions and learn their applications

1. How would you calculate the speed, velocity and acceleration at any instant of a particle moving in space whose position vector at time t is $\mathbf{r}(t)$?
2. Find the work done by the force field $\mathbf{F} = (e^x - y^3)\ \mathbf{i} + (\cos y + x^3)\ \mathbf{j}$ on a particle that travels once around the unit circle centered at origin having radius 1.

3. When do you say that a vector field is conservative? What are the implications if a vector field is conservative?

Course Outcome 5 (CO 5): Evaluate surface and volume integrals and learn their inter-relations and applications

1. Write any one application each of line integral, double integral and surface integral.
2. Use the divergence theorem to find the outward flux of the vector field $\mathbf{F}(x, y, z) = z\mathbf{k}$ across $x^2 + y^2 + z^2 = a^2$.
3. State Greens theorem. Use Green's theorem to express the area of a plane region bounded by a curve as a line integral.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24MA1T01

Course Name: LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS

Common to all branches

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Determine the rank of the matrix $\begin{bmatrix} 1 & 2 & -1 \\ -2 & -4 & 2 \\ 3 & 6 & -3 \end{bmatrix}$

2. Write down the eigen values of A = $\begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$

3. Find f_x(1,3) and f_y(1,3) for the function $f(x, y) = 2x^3y^2 + 2y + 4x$.

4. Show that the function $u(x, t) = sin(x - ct)$ is a solution of the equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.

5. Use double integral to find the area of the region enclosed between the parabola $y = \frac{x^2}{2}$ and the line $y = 2x$.

6. Use polar coordinates to evaluate the area of the region bounded by $x^2 + y^2 = 4$, the line y = x and the y axis in the first quadrant.

7. Is the vector $\mathbf{r}$ where $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ conservative. Justify your answer.

8. Find a unit vector normal to the surface $x^3 + y^3 + 3xyz = 3$ at the point (1,2,-1).
9. What is the outward flux of $\mathbf{F}(x, y, z) = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ across any unit cube.
10. What is the relationship between Green's theorem and Stokes theorem?

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Solve the following system of equations
y + z - 2w = 0
2x - 3y - 3z + 6w = 2
4x + y + z - 2w = 4 7

(b) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & 2 & 0 \end{bmatrix}$ 7

OR

12. (a) Diagonalize the matrix $\begin{bmatrix} -1 & 2 & -2 \\ 2 & 4 & 1 \\ 2 & 4 & 1 \end{bmatrix}$ 7

(b) What kind of conic section the quadratic form $3x^2 + 22xy + 3y^2 = 0$ represents? Transform it to principal axes. 7

13. (a) Find the local linear approximation to $f(x, y) = \sqrt{x^2 + y^2}$ at the point (3,4). Use it to approximate $f(3.04, 3.98)$. 7

(b) Let $w = \sqrt{x^2 + y^2 + z^2}$, x = cos$\theta$, y = sin$\theta$, z = tan$\theta$. Use chain rule to find $\frac{dw}{d\theta}$ when $\theta = \frac{\pi}{4}$ 7

OR

14. (a) Let $z = f(x, y)$ where $x = rcos\theta$, $y = rsin\theta$, prove that

$$\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial r}{\partial \theta}\right)^2$$

7

(b) Locate all relative maxima, relative minima and saddle points of $f(x, y) = xy + \frac{a^3}{x} + \frac{b^3}{y}$,$(a \neq 0, b \neq 0)$. 7

15. (a) Evaluate $\iint\limits_D (2x^2y + 9y^3)\, dx\, dy$ where D is the region bounded by $y = \frac{2}{3}x$ and $y = 2\sqrt{x}$.

(b) Evaluate $\int_0^4 \int_{\sqrt{y}}^2 e^{x^3}\, dx\, dy$ by changing the order of integration. 7

OR

16. (a) Find the volume of the solid bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 4$ and $z = 0$. 7

    (b) Evaluate $\iiint \sqrt{1 - x^2 - y^2 - z^2}\, dx\, dy\, dz$, taken throughout the volume of the sphere $x^2 + y^2 + z^2 = 1$ 7

17. (a) Prove that the force field $\mathbf{F} = e^y\mathbf{i} + xe^y\mathbf{j}$ is conservative in the entire xy-plane. 7

    (b) Find the work done in moving a particle along a straight line from (0,0,0) to (2,1,3) by the force $\mathbf{F} = 3x^2\mathbf{i} + (2xz - y)\mathbf{j} + z\mathbf{k}$ 7

OR

18. (a) Find the divergence of the vector field $\mathbf{F} = x^3y^2z\mathbf{i} + xyz^3\mathbf{j} + xyz^2\mathbf{k}$ at (1,1,1). 7

    (b) Find the work done by the force field $\mathbf{F}$(x, y, z) = xy$\mathbf{i}$ + yz$\mathbf{j}$ + xz$\mathbf{k}$ along C where C is the curve $\mathbf{r}(t) = t\mathbf{i} + t^2\mathbf{j} + t^3\mathbf{k}$. 7

19. (a) Use divergence theorem to find the outward flux of the vector field $\mathbf{F} = 2x\mathbf{i} + 3y\mathbf{j} + z^3\mathbf{k}$ across the unit cube bounded by x = 0, y = 0, z = 0, x =1, y = 1, z = 1. 7

    (b) Find the circulation of $\mathbf{F}$ = (x-z)$\mathbf{i}$ + (y - x)$\mathbf{j}$ + (z-xy)$\mathbf{k}$ using Stokes theorem around the triangle with vertices A(1,0,0), B(0,2,0) and C(0,0,1). 7

OR

20. (a) Use divergence theorem to find the volume of the cylindrical solid bounded by $x^2 + 4x + y^2 = 7$, $z = -1$, $z = 4$ given the vector field $\mathbf{F} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ across surface of the cylinder. 7

    (b) Use Stokes theorem to evaluate $\int_c F.dr$ where $\mathbf{F} = x^2\mathbf{i} + 3x\mathbf{j} - y^3\mathbf{k}$ where C is the circle $x^2 + y^2 = 1$ in the xy-plane with counterclockwise orientation looking down the positive z-axis. 7

<table>
<tr><td rowspan="2">B24ES1T01A</td><td rowspan="2">PROBLEM SOLVING AND PROGRAMMING TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>2</td><td>3</td><td>2024</td></tr>
</table>

Preamble

This course shall prepare Engineering Graduates to write versatile C programs for solving computational problems that they come across in their professional life. The subject covers the basics of C programming, array handling, string manipulations, function creation, structure and pointer operations and file processing. On completing this course a learner will be able to write efficient C programs to solve real world computational problems.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Analyze a computational problem and try to solve it using algorithms, flowcharts and also develop C programs from them using Arithmetic, Logical, Relational and Bitwise operators. (Cognitive Knowledge Level: Understand)
CO 2	Develop C programs with branching and looping statements for processing arrays and matrices (Cognitive Knowledge Level: Apply)
CO 3	Divide a given computational problem into a number of modules and develop functions to find the solution to the computational problem and also create programs for string processing (Cognitive Knowledge Level: Apply)
CO 4	Develop C programs which use structures and pointers for data processing and parameter passing (Cognitive Knowledge Level: Apply)
CO 5	Develop C programs for file processing (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3		1		1				1
CO 2	3	3	3	3		1		1				1
CO 3	3	3	3	3		1		1				1
CO 4	3	3	3	3		1		1				1
CO 5	3	3	3	3		1		1				1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (6 hours)

Problem solving:

Problem solving using Algorithms, Pseudocode and Flowcharts.

C fundamentals:

Character set, Constants, Identifiers, Keywords, Basic data types, Variables, Operators and its precedence, Bitwise operators, Expressions, Statements, Input and Output statements– Structure of a C program– simple programs.

MODULE 2 (9 hours)

Control statements:

If, if-else, nested if, switch, while, do-while, for, break & continue, nested loops. Single dimensional arrays – defining an array, array initialization, accessing array elements, Enumerated data type, Two-dimensional arrays – defining a two-dimensional array – Programs for matrix processing - Programs for Sequential search, Bubble sort.

MODULE 3 (8 hours)

Strings:

Declaring a string variable, reading and displaying strings, string related library functions – Programs for string matching.

Functions:

Function definition, function call, function prototype, parameter passing – Recursion – Passing array to function. Macros: Defining and calling macros.

MODULE 4 (8 hours)

Structures:

Defining a structure variable, accessing members, array of structures, passing structure to function. Union, Pointers: declaration, operations on pointers, passing pointer to a function, accessing array elements using pointers, processing strings using pointers, pointer to pointer, array of pointers, pointer to function, pointer to structure, Dynamic memory allocation.

MODULE 5 (4 hours)

Files:

Different types of files in C – Opening & Closing a file – Writing to and Reading from a file – Processing files – Library functions related to file – fseek(), ftell(), fread(), fwrite(). Storage Class associated with variables: automatic, static, external and register.

Text Books

1. Programming with C - Byron S. Gottfried, Tata McGraw Hill
2. Computer Programming in C - Kerninghan & Ritchie, PHI

Reference Books

1. Programming in C - Stephen C. Kochan, CBS publishers.
2. Programming in C – E. Balaguruswamy , Mc Graw Hill.
3. Let us C – Yashwant Kanetkar, BPB.
4. A Book on C – Al Kelley and Ira Pohl, Addison-Wesley.
5. Mastering Turbo C - Stan Kelly Bootle, BPB Publications.
6. Pointers in C - Yashwant Kanetkar, BPB.
7. The Spirit of C- by Munish cooper, Jaico Books.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	35 Hours
	Module 1: C fundamentals	6 hour
1.1	Problem solving using Algorithms, Pseudocode and Flowcharts.	1 hour
1.2	C fundamentals: Character set, Constants, Identifiers.	1 hour

1.3	Keywords, Basic data types, Variables.	1 hour
1.4	Operators and its precedence, bitwise operators.	1 hour
1.5	Expressions, Statements, Input and Output statements.	1 hour
1.6	Structure of a C program– simple programs.	1 hour
	Module 2: Control statements:	9 hours
2.1	Control statements: if, if-else, nested if .	1 hour
2.2	Switch, while loop, do-while loop.	1 hour
2.3	For loop, break & continue statements, nested loops.	1 hour
2.4	Single dimensional arrays – defining an array, array initialization, accessing array elements.	1 hour
2.5	Two-dimensional arrays – defining a two-dimensional array.	1 hour
2.6	Programs for matrix processing.	1 hour
2.7	Programs for sequential search.	1 hour
2.8	Bubble sort.	1 hour
2.9	Enumerated data type.	1 hour
	Module 3: Strings and Funtions	8 hour
3.1	Strings: declaring a string variable, reading and displaying strings.	1 hours
3.2	String related library functions.	1 hour
3.3	Programs for string matching.	1 hour
3.4	Functions: Function definition, Function call.	1 hour
3.5	Function prototype, Parameter passing.	1 hour
3.6	Recursion.	1 hour
3.7	Passing array to function.	1 hour
3.8	Macros: Defining and calling macros.	1 hour
	Module 4: Structures	8 hours
4.1	Structures: defining a structure variable, accessing members.	1 hour
4.2	Array of structures, passing structure to function.	1 hour
4.3	Union.	1 hour
4.4	Pointers: declaration, operations on pointers, pointer to a function.	1 hour

4.5	Accessing array elements using pointers, Processing strings using pointers.	1 hour
4.6	Pointer to pointer, Array of pointers.	1 hour
4.7	Pointer to function, Pointer to structure.	1 hour
4.8	Dynamic memory allocation.	1 hour
	Module 5:Files	4 hours
5.1	Different types of files in C, Opening & Closing a file.	1 hour
5.2	Writing to and Reading from a file, Processing file.	1 hour
5.3	Library functions related to file – fseek(), ftell(), fread(), fwrite().	1 hour
5.4	Storage Class associated with variables: automatic, static, external and register.	1 hour

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Write an algorithm and pseudocode to check if a given number is an Armstrong number or not
2. Draw a flow chart to check if a given number is an Armstrong number or not

Course Outcome 2 (CO 2):

1. Write a C program to find the smallest number, largest number and the number of occurrences from a set of numbers
2. Write a C program to add two matrices

Course Outcome 3 (CO 3):

1. Write a C program to find whether a string is present in another string
2. Write functions to accept an N X N matrix and find the row sum and column sum of the matrix

Course Outcome 4 (CO 4):

1. Write a C program to find the difference between two time intervals using structure
2. Write a C program to check if a given string is palindrome using pointers.

Course Outcome 5 (CO 5):

1. Write a C program to count the number of lines in a file
2. The name of some students and their marks in 5 subjects are given in a file. Write a C program to read the student details and calculate the total marks and write the name and total marks to another file

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

First SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24ES1T01A

Course Name: PROBLEM SOLVING AND PROGRAMMING TECHNIQUES

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Draw a flow chart to find the largest of three numbers.
2. Write a C program to convert Fahrenheit temperature to Celsius.
3. Differentiate between while loop and do-while loop.
4. Write a C program to find all the factors of a number.
5. Explain any 3 string handling functions using examples.
6. Differentiate between macros and functions.
7. What are the advantages of using structure in C language..
8. Explain pointer to a pointer with an example.
9. Write any three file handling functions in C.
10. What is a static variable? When should it be used?

PART B

Answer any one question from each module. Each question carries 14 marks.

11. Explain linear search with an example. Draw a flowchart and write pseudo code to perform linear search on an array of numbers. 14

OR

12. (a) Write a C program to find the area of a triangle given the length of three sides of the triangle. 7
    (b) Write a C program to find the Area and Circumference of a Circle given the radius of the circle. 7

13. (a) Write a C program to find the transpose of a matrix. 7
    (b) Write a C program to sort an array of numbers using bubble sort 7

OR

14. (a) Write a C program to find the sum of first and last digit of a number. 7
    (b) Write a C program to print all the prime numbers between 100 to 200. 7

15. (a) Explain any 4 string handling functions in C programming. 7
    (b) Write a C program to reverse a string without using string handling functions. 7

OR

16. (a) What is the purpose of function declaration and function definition and function call? With examples illustrate their syntax 7
    (b) What is recursion? Write a C program to display Fibonacci series using recursive function. 7

17. (a) Write a C program to: 7
       i. Create a structure with fields: Name, Address, Date of Birth.
       ii. Read the above details for five students from user and display the details.
    (b) Differentiate between array of pointers and pointer to an array.. 7

OR

18. (a) What are the different dynamic memory allocation functions available in C language. 7
    (b) Write a C program to reverse a string using pointers. 7

19. (a) What are different storage classes in C? Give examples for each. . 7
    (b) Explain any 5 file handling functions in C? 7

OR

20. (a) Write a C program to count number of lines in a text file. 7
    (b) Write a C program to read a text file and replace all vowels in the text file with character 'x' and write it to another file.. 7

B24PH1T01A	**ENGINEERING PHYSICS (A)**	**L**	**T**	**P**	**S**	**CREDIT**	**YEAR OF INTRODUCTION**
		2	1	0	2	3	2024

Preamble

The aim of this course is to equip students with a solid foundation in physics principles and knowledge of their engineering applications. This will enhance the students' ability to analyze and solve complex engineering problems. Ultimately, the goal is to produce graduates who are well prepared to tackle real world engineering challenges with a deep understanding of the underlying physical principles.

Prerequisites

Higher secondary level Physics and Mathematics

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand the principle and structure of lasers and the working of optical fibers. (Cognitive Knowledge Level: Apply)
CO 2	Analyze the behavior of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices. (Cognitive Knowledge Level: Apply)
CO 3	Quantitatively grasp fundamental semiconductor principles such as energy band theory, carrier statistics and transport phenomena and thus explain the structure and conduction in intrinsic semiconductors. (Cognitive Knowledge Level: Apply)
CO 4	Understand the influence of doping on the energy structure, carrier statistics and transport phenomena and thus explain the structure and conduction in extrinsic semiconductors. (Cognitive Knowledge Level: Apply))
CO 5	Understand the formation and structure of junctions and explain the working of solid state lighting devices. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1			1					1
CO 2	3	2	1	1								1
CO 3	3	2	1	1								1
CO 4	3	2	1	1								1
CO 5	3	1	1				1					1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 20 Marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Laser & Fibre Optics:

Optical processes - Absorption, Spontaneous emission and stimulated emission, - Einstein's relations. Principle of laser - conditions for sustained lasing - components of laser - Population inversion - energy source - Pumping, Metastable states - active medium, optical resonator. Construction and working of Ruby laser. Optic fiber-Principle of propagation of light, Numerical aperture – Derivation. Applications of fibers - Intensity modulated sensors.

MODULE 2 (8 hours)

Quantum Mechanics:

Introduction - Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only), Wave function, its properties and physical interpretation, Formulation of time dependent and time independent Schrodinger equations, Particle in a one dimensional box - Derivation of energy eigenvalues and normalized wave function.

MODULE 3 (8 hours)

Semiconductor Physics I :

Electrical Conduction in solids - Density of states function (no derivation), the Fermi-Dirac Probability function, Fermi energy and its physical significance, Charge carriers in semiconductors - Equilibrium distribution of electrons and holes, the n0 and p0 equations, Intrinsic carrier concentration ni, Intrinsic Fermi level position and its dependence on temperature.

MODULE 4 (7 hours)

Semiconductor Physics II :

Extrinsic semiconductors - P type semiconductor, N type semiconductor, Carrier concentration in N type semiconductor, Variation of fermi level with temperature, Variation of fermi level with donor concentration, Carrier concentration in P type semiconductor, Variation of fermi level with temperature, Variation of fermi level with acceptor concentration.

MODULE 5 (6 hours)

Semiconductor Devices:

Formation of PN junction, Energy band diagram of PN junction - Qualitative description of charge flow across a PN junction - Forward and reverse biased PN Junctions, Photonic devices (Qualitative treatment only) - Light Emitting Diode, Photo detectors (Junction and PIN photodiodes), Solar cells.

Text Books

1. 1. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015.
2. 2. M.N. Avadhanulu, P.G. Kshirsagar, TVS Arun Murthy, "A Textbook of Engineering Physics", S.Chand & Co., Revised Edition, 2019.
3. Flask: 3. Donald A. Neamen, "Semiconductor Physics and Devices - Basic Principles", McGraw Hill, Fourth Edition, 2012.

Reference Books

4. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003.
5. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015.
6. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016.
7. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015.
8. S.M. Sze, "Physics of Semiconductor Devices", John Wiley & Sons, 1969.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	35 Hours
	Module 1: Laser and Fibre Optics	7 hours.
1.1	Optical processes - Absorption, Spontaneous emission and stimulated emission, - Einstein's relations	2 hour.

1.2	Principle of laser - conditions for sustained lasing - components of laser - Population inversion - energy source - Pumping, Metastable states - active medium, optical resonator.	2 hour.
1.3	Construction and working of Ruby laser.	1 hour.
1.4	Optic fiber-Principle of propagation of light, Numerical aperture – Derivation	1 hour.
1.5	Applications of fibers - Intensity modulated sensors .	1 hour.
	Module 2: Quantum Mechanics	7 hours.
2.1	Introduction - Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only),	1 hour
2.2	Wave function, its properties and physical interpretation.	1 hour
2.3	Formulation of time dependent and time independent Schrodinger equations, Particle in a one dimensional box - Derivation of energy eigenvalues and normalized wave function, Numerical Problems.	5 hour
	Module 3: Semiconductor Physics I	8 hours
3.1	Electrical Conduction in solids - Density of states function (no derivation), the Fermi-Dirac Probability function, Fermi energy and its physical significance	2 hour
3.2	Charge carriers in semiconductors - Equilibrium distribution of electrons and holes, the n0 and p0 equations.	3 hour
3.3	Intrinsic carrier concentration ni, Intrinsic Fermi level position and its dependence on temperature.	3 hour
	Module 4: Semiconductor Physics II	8 hours
4.1	Extrinsic semiconductors - P type semiconductor, N type semiconductor.	2 hour
4.2	Carrier concentration in N type semiconductor, Variation of fermi level with temperature, Variation of fermi level with donor concentration	3 hour
4.3	Carrier concentration in P type semiconductor, Variation of fermi level with temperature, Variation of fermi level with acceptor concentration	3 hour
	Module 5: Semiconductor Devices	6 hours

5.1	Formation of PN junction, Energy band diagram of PN junction - Qualitative description of charge flow across a PN junction - Forward and reverse biased PN Junctions, the ideal diode equation (no derivation).	3 hour
5.2	Photonic devices (Qualitative treatment only) - Light Emitting Diode, Photo detectors (Junction and PIN photodiodes), Solar cells.	3 hour

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Describe the principle of LASER.
2. Why are metastable levels needed in a LASER?
3. Write a note on intensity modulated sensors.

Course Outcome 2 (CO 2):

1. Describe the physical significance of wave function.
2. State HUP for position and momentum
3. How does the size of a box affect the permitted energy levels of a particle?

Course Outcome 3 (CO 3):

1. Determine the number of quantum states in silicon between $(E_V - kT)$ and E_V at T=300K.
2. Describe the concept of Fermi level and its physical significance..
3. Calculate the probability that an energy state above E_F is occupied by an electron. Let T= 300 K. Determine the probability that an energy level 3kT above the Fermi energy is occupied by an electron.

Course Outcome 4 (CO 4):

1. Describe the variation of Fermi level with temperature in an extrinsic semiconductor.

2. Determine the Fermi level and the max. doping concentration for which the Boltzmann approximation is still valid.

3. Sketch a graph of n_0 versus temperature for an n-type material.

Course Outcome 5 (CO 5):

1. Describe the formation of the depletion region.

2. Draw the I-V characteristics of a solar cell..

3. Describe the advantage of a PIN diode over a PN diode when used as a photo detector.

MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24PH1T01A

Course Name:ENGINEERING PHYSICS (A)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the term population inversion.
2. Describe the principle of operation of optic fibers.
3. State Heisenberg's Uncertainty principle for conjugate variables.
4. Write the time independent Schrodinger equation.
5. What is meant by Fermi level?.
6. Write the Fermi-Dirac distribution function..
7. What are the factors affecting the Fermi level in an extrinsic semiconductor?
8. Plot the variation in E_F against donor concentration in an n-type semiconductor.
9. Sketch the energy bands in an unbiased, reverse-biased and forward-biased PN junction.
10. What is meant by a space charge region?

PART B

Answer any one question from each module. Each question carries 14 marks.

1. (a) Define numerical aperture of an optic fiber and derive an expression for the NA of a step index fiber with a neat diagram.. 10

   (b) Calculate the numerical aperture and acceptance angle of a fiber with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fiber is inside water of refractive index 1.33. 4

OR

2. (a) Outline the construction and working of Ruby laser. 10

   (b) Calculate the N.A. of an optic fiber having core index of 1.54 and cladding index of 1.5 4

3. (a) Derive time dependent Schrodinger equation. 10

   (b) An electron is confined to a one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. 4

OR

4. (a) Derive the expression for the energy eigenvalues for a particle confined within a box of width L. 10

   (b) b. Find the de-Broglie wavelength of an electron whose kinetic energy is 15eV. 4

5. (a) Derive the equations for the thermal equilibrium concentrations of electrons and holes in terms of the Fermi energy 10

   (b) b. Calculate the density of states per unit volume with energies between 0 eV and 1 eV. 4

OR

6. (a) Derive the equation for the intrinsic carrier concentration. 10

   (b) b. Let T=300 K. Determine the probability that an energy level 3kT above the Fermi energy is occupied by an electron 4

7. (a) Derive the fundamental relationship $n_0 p_0 = n_i^2$. 10

   (b) Consider silicon at T=300 K and assume that $N_c = 2.8 \times 10^{19} cm^{-3}$ and $N_v = 1.04 \times 10^{19} cm^{-3}$. Assuming that the Fermi energy is 0.25 eV below the conduction band and that the bandgap energy of silicon is 1.12 eV, determine the type of silicon under consideration. 4

OR

8. (a) Derive the equations for n_0 and p_0 in terms of impurity doping concentrations.10

   (b) Silicon at T=300 K contains an acceptor impurity concentration of $N_a = 10^{16} cm^{-3}$. Determine the concentration of donor impurity atoms that must be added so that the silicon is n type and the Fermi level is 0.20 eV below the conduction-band edge. 4

9. (a) Describe the structure of energy bands in a PN junction under zero bias, forward bias and reverse bias and explain why conduction is possible only when it is forward-biased. 10

   (b) b. Write the ideal diode equation and draw the corresponding I-V characteristics. 4

OR

10. (a) Explain the structure of an LED and explain the process of emission of light from the same with the help of the energy band diagram. 10

    (b) b. Briefly describe the working of a PIN junction photodiode and explain its advantage over a PN junction photodiode. 4

B24CY1T01A	Engineering Chemistry (A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble:

This basic science course will assist the students to acquire understanding in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like electrochemistry, nanomaterials, energy production, energy storage, OLED etc. Moreover, the students will be able to know analytical methods like various spectroscopic techniques, SEM etc. This will empower them to develop abilities and skills that are relevant to the study and practice of chemistry in their respective field of engineering.

Prerequisites: NIL

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Develop a comprehensive understanding of nanoscale materials, including their synthesis, fundamental properties and diverse applications. (Cognitive Knowledge Level: Apply)
CO 2	Understand the principles and applications of various spectroscopic techniques and microscopic techniques such as SEM. (Cognitive Knowledge Level: Apply)
CO 3	Demonstrate an inclusive understanding of the principles of electrochemistry and corrosion. Also gain knowledge about various corrosion control methods. (Cognitive Knowledge Level: Apply)
CO 4	Learn about the basics of energy harvesting methods and its application. Apply the knowledge of battery, hydrogen generation and fuel cells in engineering. (Cognitive Knowledge Level: Apply)
CO 5	Apply the knowledge of conducting polymers and advanced materials in engineering. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	2	2	1	1	2					1
CO 2	1	2	2	1	2		2					1
CO 3	3	2	3	1	2	2	1					2
CO 4	3	2	3	2	3	3	3	1	1			2
CO 5	2	1	3	1	3	1	2	1				2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (% Marks)	**Test 2 (% Marks)**	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Fundamentals of Nanomaterials

Introduction - Classification - Based on dimension and structural composition - Nanoscale materials – Introduction - Properties and applications of Quantum dots, Graphene and Carbon nanotubes (CNT) – General Properties and applications of nanomaterials - Synthesis of nanomaterials – Top-Down and Bottom-Up approaches – Physical methods of synthesis - Mechanical milling, Laser ablation and Sputtering - Chemical methods of synthesis – Sol-Gel, co-precipitation and reduction.

MODULE 2 (8 hours)

Spectroscopic and Microscopic Techniques

Introduction - Types of spectrum - Electromagnetic spectrum - Molecular energy levels - Beer-Lambert's law – Numerical problems based on Beer-Lambert's law - Electronic spectroscopy (UV-vis) – Principle, instrumentation and applications - Types of electronic transitions - Vibrational spectroscopy (IR) – Principle and applications - Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Force constant equation for diatomic molecules - Numerical problems based on force constant - Microscopic techniques - Scanning Electron Microscope (SEM) - Principle, instrumentation, working and applications.

MODULE 3 (7 hours)

Introduction to Electrochemistry and Corrosion Science

Introduction - Reference electrodes - Calomel electrode - Construction and working - Electrochemical series - Applications – Nernst equation for single electrode and cell (Derivation not required) – Applications – Effect of temperature on emf - Numerical problems based on Nernst equation - Corrosion – Introduction - Galvanic series - Types of corrosion – Galvanic and pitting corrosion - Corrosion control methods - Cathodic protection - Sacrificial anodic protection and impressed current cathodic protection – Electroplating of Copper - Electroless plating of Copper – Anodizing of Aluminium.

MODULE 4 (7 hours)

Energy Storage and Harvesting Technologies

Cells and batteries – Primary and secondary cells – Na-ion battery and Li-ion battery - Construction, working, advantages and applications – Hydrogen generation – Electrolysis of water - Fuel cells – Introduction - Construction and advantages of H_2-O_2 fuel cell, Phosphoric acid fuel cell and Polymer Electrolyte Membrane Fuel Cell (PEMFC) - Supercapacitors - Classification - Construction and applications in hybrid vehicles.

MODULE 5 (7 hours)

Advanced Materials and Devices for Engineering Applications

Conducting polymers – Introduction - Classification - Intrinsically and extrinsically conducting polymers - Conduction mechanism – Band theory - Polyaniline and polypyrrole - Synthesis, properties and applications – Molecular devices based on conducting polymers – Diodes, Field Effect Transistor and Actuators - Introduction and applications - OLED – Construction, working and advantages - Smart materials - Thermo and light responsive materials - Introduction and examples - Sensors – Physical, chemical and biosensors – Introduction and applications.

Text Books

1. Jain and Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 17^{th} edition 2015.

2. Shashi Chawla, "A Text Book of Engineering Chemistry", Dhanpat Rai and Co. (P) Limited, 2017.

3. Muhammed Arif, Annette Fernandez, Kavitha P. Nair, "Engineering Chemistry", Owl Books, 2019.

4. Ahad J., "Engineering Chemistry", Jai Publication, 2019.

5. Roy K. Varghese, "Engineering Chemistry", Crown Plus Publishers, 2019.

6. Soney C. George, Rino Laly Jose, "Text Book of Engineering Chemistry", S. Chand and Company Pvt. Ltd., 2019.

7. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web Book)", 2018.

Reference Books

8. T. Pradeep, "NANO: The Essentials: Understanding Nanoscience and Nanotechnology", McGraw-Hill, 2008.

9. B. Rogers, J. Adams, S. Pennathur, "Nanotechnology: Understanding Small Systems" , CRC Press, 2014.
10. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
11. J. Goldstein, "Scanning Electron Microscopy and Microanalysis", Springer, 2012.
12. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7^{th} Edition, 2005.
13. Samuel Glasstone, "An Introduction to Electrochemistry", East-West Press Pvt. Ltd., 2006.
14. Pietro Pedeferri, "Corrosion Science and Engineering", Springer Link, 2018.
15. B. Sunden, "Hydrogen, Batteries and Fuel Cells", Elsevier Inc., 2019.
16. B. Sorensen and G. Spazzafumo, "Hydrogen and Fuel Cells - Emerging Technologies and Applications", Elsevier Ltd., 2018.
17. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4^{th} Revised Edition,1996.
18. J. Janata, "Principles of Chemical Sensors" Springer, New York, NY, 2009.
19. F-G. Banica, "Chemical Sensors and Biosensors: Fundamentals and Applications", John Wiley and Sons, 2012.
20. M. Schwartz, "Smart Materials", CRC Press, 2008.
21. Y. Zhao, T. Ikeda, "Smart Light-Responsive Materials", Wiley, 2009.
22. V. Khutoryanskiy, T. Georgiou, "Temperature-Responsive Polymers: Chemistry, Properties and Applications", Wiley, 2018.
23. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10^{th} edn., 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	36 Hours
	Module 1 (Fundamentals of Nanomaterials)	7 hours
1.1	Introduction - Classification - Based on dimension and structural composition.	1 hour

1.2	Nanoscale materials – Introduction - Properties and applications of Quantum dots, Graphene and Carbon nanotubes (CNT) – General properties and applications of nanomaterials.	3 hours
1.3	Synthesis of nanomaterials – Top-Down and Bottom-Up approaches – Physical methods of synthesis - Mechanical milling, Laser ablation and Sputtering - Chemical methods of synthesis – Sol-Gel, co-precipitation and reduction.	3 hours
	Module 2 (Spectroscopic and Microscopic Techniques)	8 hours
2.1	Introduction - Types of spectrum - Electromagnetic spectrum - Molecular energy levels - Beer-Lambert's law – Numerical problems based on Beer-Lambert's law.	3 hours
2.2	Electronic spectroscopy (UV-vis) – Principle, instrumentation and applications - Types of electronic transitions - Vibrational spectroscopy (IR) – Principle and applications - Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Force constant equation for diatomic molecules - Numerical problems based on force constant.	4 hours
2.3	Microscopic techniques - Scanning Electron Microscope (SEM) - Principle, instrumentation, working and applications.	1 hour
	Module 3 (Introduction to Electrochemistry and Corrosion Science)	7 hours
3.1	Introduction - Reference electrodes - Calomel electrode - Construction and working - Electrochemical series - Applications – Nernst equation for single electrode and cell (Derivation not required) – Applications – Effect of temperature on emf - Numerical problems based on Nernst equation.	3 hours
3.2	Corrosion – Introduction - Galvanic series - Types of corrosion – Galvanic and pitting corrosion - Corrosion control methods - Cathodic protection - Sacrificial anodic protection and impressed current cathodic protection.	2 hours
3.3	Electroplating of Copper - Electroless plating of Copper – Anodizing of Aluminium	2 hours
	Module 4 (Energy Storage and Harvesting Technologies)	7 hours
4.1	Cells and batteries – Primary and secondary cells – Na-ion battery and Li-ion battery - Construction, working, advantages and applications.	2 hours

4.2	Hydrogen generation – Electrolysis of water - Fuel cells – Introduction - Construction and advantages of H_2-O_2 fuel cell, Phosphoric acid fuel cell and Polymer Electrolyte Membrane Fuel Cell (PEMFC).	3 hours
4.3	Supercapacitors - Classification - Construction and applications in hybrid vehicles.	2 hours
	Module 5 (Advanced Materials and Devices for Engineering Applications)	7 hours
5.1	Conducting polymers – Introduction - Classification - Intrinsically and extrinsically conducting polymers - Conduction mechanism – Band theory - Polyaniline and polypyrrole - Synthesis, properties and applications.	3 hours
5.2	Molecular devices based on conducting polymers – Diodes, Field Effect Transistors, and Actuators - Introduction and applications - OLED – Construction, working and advantages.	2 hours
5.3	Smart materials - Thermo and light responsive materials - Introduction and examples - Sensors – Physical, chemical and biosensors – Introduction and applications.	2 hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What are carbon nanotubes? Give two applications.
2. Comment on the structure of graphene.
3. How nanomaterials are classified based on structural composition?

Course Outcome 2 (CO 2):

1. State Beer-Lambert's law.
2. Calculate and sketch the vibrational modes of CO_2.
3. What are the limitations of SEM?

Course Outcome 3 (CO 3):

1. How equilibrium constant is determined using electrochemical series?
2. Write the representation and reactions of calomel electrode.
3. Give any two differences between electrochemical series and galvanic series.

Course Outcome 4 (CO 4):

1. Compare Na-ion and Li-ion batteries.
2. List the applications of PEM fuel cell.
3. Discuss the classification of supercapacitors.

Course Outcome 5 (CO 5):

1. Explain the preparation and properties of polypyrrole.
2. Discuss the working of OLED.
3. Compare physical and chemical sensors.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24CY1T01A

Course Name: ENGINEERING CHEMISTRY (A)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Discuss the properties and applications of quantum dots.
2. How carbon nanotubes are classified based on structure?
3. State Beer-Lambert's law.
4. List the important applications of IR spectroscopy.
5. Explain how galvanic series can be used in corrosion control?
6. What is calomel electrode? Give the reduction reaction.
7. How does a PEM fuel cell differ from the other types of fuel cells?
8. Distinguish between primary and secondary cells with examples.
9. Give example and explain the importance of light responsive smart materials.
10. What are biosensors? Give their applications.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Explain two methods of chemical synthesis for nanomaterials. 8
    (b) Discuss the classification of nanomaterials based on dimension. 6

OR

12. (a) What are nanoscale materials? Give the properties and applications of quantum dots and graphene. 9
    (b) Explain the sputtering method for the synthesis of nanomaterials. 5
13. (a) Explain the principle, instrumentation and working of SEM. 8
    (b) Calculate the force constant of HCl molecule, if it shows IR absorption at 2138 cm^{-1}. Given that atomic masses of hydrogen and chlorine are 1 u and 35 u respectively. 6

OR

14. (a) Illustrate the vibrational modes of CO_2 and H_2O. Justify its IR activity. 9
    (b) Explain the various energy levels associated with a molecule. 5
15. (a) How electroless plating of copper is carried out? Give the procedure and reactions. 8
    (b) Write the cell reactions and calculate the emf of the cell Cu/Cu^{2+} (1M) // Ag^+ (0.01M) // Ag at 30^{o}C. Given E^0 Cu^{2+}/Cu = 0.34 V and E^0 $Ag^+/Ag = 0.8V$. 6

OR

16. (a) What is cathodic protection? Explain two methods. 9
    (b) Write the Nernst equation for Daniel cell and explain the effect of temperature on emf. 5
17. (a) Discuss the construction, working and advantages of Li-ion battery. 9
    (b) What is electrolysis of water? 5

OR

18. (a) With a neat diagram explain the construction and working of Hydrogen-Oxygen fuel cell. 8
    (b) Explain the classification of supercapacitors. 6
19. (a) Discuss the construction and working of OLED with a diagram. 9
    (b) Explain the synthesis, properties and applications of polyaniline. 5

OR

20. (a) Elaborate the classification and applications of conducting polymers. 8
    (b) What are smart materials? Give examples for heat responsive materials. 6

B24ES1T02	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	2	0	2	4	2024

Preamble

This course aims to (1) fundamentals of circuit analysis, electrical components, machines, power systems, and safety practices (2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an introduction to digital electronics. Completing the course, students gain the necessary knowledge for more advanced courses and practical applications

Prerequisites

Physics and Mathematics (Pre-university level)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand the essential circuit components and the fundamental circuit laws governing electrical circuits. (Cognitive Knowledge Level: Understand)
CO 2	Recall the basics of electromagnetism and the fundamentals of electrical machines and three-phase systems. (Cognitive Knowledge Level: Remember)
CO 3	Apply the basic knowledge of household wiring components and analyze electrical wiring layout for small residential buildings. (Cognitive Knowledge Level: Apply)
CO 4	dentify the active and passive electronic component and their specifications (Cognitive Knowledge Level: Understand)
CO 5	Design and analyze Rectifiers and Voltage amplifiers (Cognitive Knowledge Level: Apply)
CO 6	Explain the elements of digital system abstractions such as digital representations of information, digital logic and Boolean algebra (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	1		1	1	1	1	1	1	1
CO 2	3	3	2	1		1	1	1	1	1	1	1
CO 3	3	2	2	1		1	1	1	1	1	1	1
CO 4	2	1	1									1
CO 5	2	1	1									1
CO 6	2	1	1									1

Assessment Pattern

	BASIC ELECTRICAL			**BASIC ELECTRONICS**		
Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (% Marks)	**Test 2 (% Marks)**		**Test 1 (% Marks)**	**Test 2 (% Marks)**	
Remember	20	20	20	20	20	20
Understand	30	30	30	30	30	30
Apply	50	50	50	50	50	50
Analyse						
Evaluate						
Create						

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 subdivisions. The pattern for end semester examination for part II is same as that of part I.

SYLLABUS

MODULE 1 (7 hours)

DC Electric Circuits

Passive components - R, L, and C, Sources - current and voltage sources, Resistances in series and parallel, current and voltage division rule, Ohm's Law, Kirchoff's Laws (Numerical problems).

Alternating Current Fundamentals

Generation of single-phase voltage - frequency, time period, average value, RMS value (sine wave concept only), Form and peak factors-Phasor representation of R,L,C, RL, RC, and RLC circuits - concept of impedance, power - active, reactive, and apparent, power factor (Numerical problems).

MODULE 2 (8 hours) DC Machines and Transformers

Faraday's laws, Lenz's law, statically and dynamically induced EMF. DC Generator-construction and working principle, types, applications. DC motor - working principle, types of DC motors, applications. Transformer (single-phase only) - Construction, types-Working principle. Construction types **Three-Phase AC Systems**

Generation of three-phase voltages - phase sequence, Y-Δ connection (balanced only), relation between line and phase quantities, three-phase power, Single line diagram of a power system from generation to distribution.

MODULE 3 (8 hours) Electrical wiring design

Electrical wiring system in domestic building - types of wiring, cables, Conduits, Switches and Outlets, switch boards, and distribution boards. Common power ratings of domestic gadgets, Codes and standards- Salient features of NEC, NBC and IE rule, NEC Symbols used in electrical wiring layout. Electrical lay out (single line diagram) for low- class domestic installation. Electrical load calculation- connected load method (Numerical problems).

Electrical Installation in Buildings

Protection devices - MCB, MCCB, ELCB/RCCB and RCBO- Principle of Operation-Rating and Specification, fuses-working and types. Electrical hazards and safety Precautions-Earthing & need of earthing, types.

MODULE 4 (8 hours) Introduction to Electronics Components

Overview of the Evolution and Applications of Electronics. Familiarization of basic electronic components: Resistors, Capacitors, Inductors: Types, Specifications, Standard values, Color Coding.

Introduction to Semiconductor devices

Understanding PN Junction diode: Structure and Principle of Operation, V-I Characteristics, Diode Current equation (Simple problems), Special Diode: Zener Diode, Break down mechanisms, Bipolar junction Transistor: NPN and PNP Structure, Principle of operation of NPN Transistor

MODULE 5 (7 hours) Introduction to Basic electronic circuits:

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator, Input and Output Characteristics of Common Emitter Configuration, Amplifier: RC Coupled Amplifier using Voltage divider bias- Frequency Response-Bandwidth

MODULE 6 (7 hours) Introduction to Digital Electronics

Number Systems: Decimal, Binary, Octal, and Hexadecimal number systems, Number Base Conversions, Binary Arithmetic: Addition, Subtraction, Multiplication, Logic gates, Universal Gates, Truth table, Realization of NOT gate using transistor

Text Books

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering,” 3rd Edition, Tata McGraw Hill.”Electric Circuits & Networks”, Pearson Education, 2009.
2. J. B. Gupta, “Theory and Performance of Electrical Machines” 15th Edition, S. K. Katarina & Sons.

3. M.K. Giridharan, Electrical System Design.
4. Chinmoy Saha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
5. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.

Reference Books

1. C. L. Wadhwa, "Basic Electrical Engineering," 4th Edition, New Age International Publisher
2. V. N. Mittle, "Basic Electrical Engineering," Tata McGraw Hill.
3. V. K. Mehta & Rohit Mehta, "Principles of Electrical Engineering," 6th Edition, S. Chand & Co. PVT. LTD
4. S. K. Bhattacharya, "Basic Electrical and Electronics Engineering," 2nd Edition, Pearson Education.
5. D C Kulshreshtha, "Basic Electrical Engineering," 2nd Edition Tata McGraw Hill.
6. Del Toro V, "Electrical Engineering Fundamentals," 2nd Edition, New Delhi Prentice Hall of India.
7. Hughes, "Electrical and Electronic Technology", 10th Edition, Pearson Education.
8. R. K. Rajput, "Basic Electrical Engineering," 2nd Edition, Laxmi Publications PVT. LTD
9. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
10. Bernard Grob, Basic Electronics, McGraw Hil

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
	Module 1: DC Electric Circuits & Alternating Current Fundamentals:	7 hours.
1.1	DC Electric Circuits: Passive Components - R, L, and C, sources - current and voltage sources	1 hour.

1.2	Resistances in series and parallel, current and voltage division rule (Numerical problems).	1 hour.
1.3	Ohm's Law, Kirchoff's Laws (Numerical problems).	2 hours
1.4	Alternating Current Fundamentals: Representation of sinusoidal waveforms - frequency, time period, average value, RMS value.	1 hour.
1.5	Phasor representation of R, RL, RC, RLC circuits - concept of impedance, power - active, reactive and apparent, power factor (Numerical problems).	2 hours
	Module 2:DC Machine and Three-Phase AC Systems:	8 hours.
2.1	Electromagnetic Induction: Faraday's laws, Lenz's law, statically and dynamically induced EMF	1 hour
2.2	DC Machines: Construction and working principle - DC Generator – Types-applications.	2 hours
2.3	DC motor - Construction and working principle-Types-applications	1 hour
2.4	Transformers (single phase only): Working principle.	1 hour
2.5	Three-Phase AC Systems: Generation of three-phase voltages - phase sequence.	1 hour
2.6	Y-Δ connection (balanced only), relation between line and phase quantities, three phase power.	2 hours
	Module 3: Electrical wiring design & Electrical Installation in Buildings:	8 hours
3.1	Electrical wiring design: Electrical wiring system in domestic building - types of wiring, cables, Conduits, Switches and Outlets, switch boards, and distribution boards.	1 hour
3.2	Common power ratings of domestic gadgets, Codes and standards- Salient features of NEC, NBC and IE rule, NEC Symbols used in electrical wiring layout.	1 hour
3.3	Electrical lay out (single line diagram) for low- class domestic installation. Electrical load calculation-connected load method (Numerical problems).	2 hours
3.4	Electrical Installation in Buildings: Protection devices - MCB, MCCB, ELCB/RCCB and RCBO- Principle of operation, fuses-working and types & 2 hours	
3.5	lectrical hazards and safety precautions-Earthing & need of earthing, types, Electrical Safety & Precautions	2 hours

3.6	Average value, rms value, form and peak factors of trapezoidal and sinusoidal waveforms - Numerical problems.	2 hours
3.7	Phasor representation of sinusoidal quantities - phase difference, addition and subtraction of sinusoids.	1 hour
3.8	Symbolic Representation: cartesian, polar and exponential forms.	1 hour
	Module 4: Introduction to Semiconductor devices	8 hours
4.1	Overview of the Evolution and Applications of Electronics.	1 hours
4.2	Familiarization of basic electronic components: Resistors, Capacitors, Inductors: Types, Specifications, Standard values, Color Coding.	3 hour
4.3	Understanding PN Junction diode: Structure and Principle of Operation	1 hour
4.4	V-I Characteristics, Diode Current equation (Simple problems	1 hours
4.5	Special Diode: Zener Diode, Break down mechanisms	1 hours
4.6	Bipolar junction Transistor : NPN and PNP Structure, Principle of operation of NPN Transistor	1 hours
	Module 5: Introduction to Basic electronic circuits:	7 hours
5.1	Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator.	4 hour
5.2	Input and Output Characteristics of Common Emitter Configuration	1 hours
5.3	Amplifier: RC Coupled Amplifier using Voltage divider bias- Frequency response-Bandwidth .	2 hours
	Module 6: Introduction to Digital Electronics:	7 hours
6.1	Number Systems: Decimal ,Binary, Octal, and Hexadecimal number systems, Number Base Conversions	2 hours
6.2	Binary Arithmetic : Addition, Subtraction, Multiplication	2 hours
6.3	Logic gates, Universal Gates, Truth table .	2 hours
6.4	Realization of NOT gate using transistor .	1 hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Solve problems based on series and parallel circuits.
2. Solve problems based on current and voltage division rules
3. Solve problems using Kirchoff's laws.
4. Phasor representation of R, RL, RC and RLC circuits
5. Problems on rms and average values of periodic waveforms.
6. Problems related to power and power factor.

Course Outcome 2 (CO 2):

1. Construction and working of DC generator and DC motor.
2. Different types and applications of DC generator and DC motor.
3. Working principle of single-phase transformer.
4. Problems on three-phase line & phase quantities for a balanced load.

Course Outcome 3 (CO 3):

1. Electrical wiring system in domestic building.
2. Codes and standards
3. Electrical lay out (single line diagram).
4. Electrical load calculation- connected load method (Numerical problems).
5. Protection devices and its principle of operation.
6. Electrical hazards and safety Precautions-Earthing & need of earthing, types, Electrical Safety & Precautions.

Course Outcome 4 (CO 4):

1. Explain the significance of color coding in identifying the values of resistors.
2. Describe the structure of a PN junction diode and its principle of operation
3. Describe the structure of a PN junction diode and its principle of operation

Course Outcome 5 (CO 5):

1. What is the need of voltage divider biasing in an RC coupled amplifier?
2. Analyze the importance of selection of operating point in the context of a BJT amplifier.
3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 6 (CO 6):

1. Convert 203:5210 to binary and hexadecimal.
2. Implement an AND gate using NOR gate
3. Define logic gates and explain their fundamental role in digital electronics

MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: : B24ES1T02

Course Name:BASICS OF ELECTRICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

PART 1: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

PART A

Answer all questions. Each question carries 4 marks.

1. State and explain Kirchhoff's laws with examples.
2. Differentiate between statically and dynamically induced emf.
3. Derive the relation between line and phase current in a 3-phase delta-connected system.
4. Distinguish between MCB and MCCB.
5. What is the need for earthing? Describe the different types of earthing.

PART B

Answer any one full question . Each question carries 10 marks.

6. For the circuit shown below, determine the current flows through all the resistors using Kirchoff's law. 10

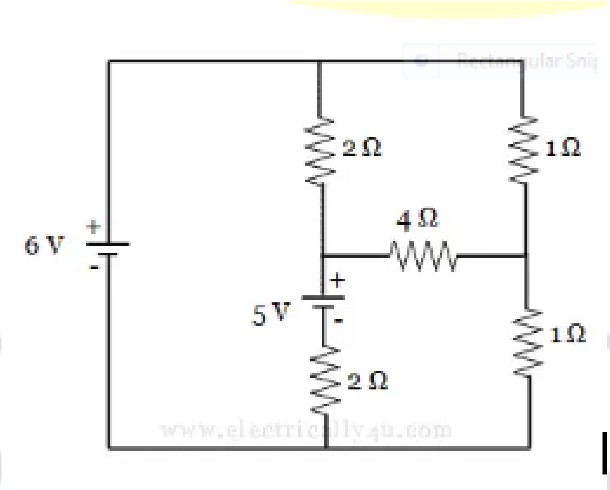


Figure 1:

OR

7. A resistance of 10Ω and inductance of 0.3H and a capacitance of 100μF are connected in series across 230V, 50Hz single-phase supply. Calculate the 10
   (a) Impedance of the circuits
   (b) Current through the circuits
   (c) Voltage across R, L, and C
   (d) Power consumed by the circuit.

8. A 3-phase, 400V, 4 wire system has a balanced star connected load with impedance Z=15+j10Ω each. Find the line currents and the total power consumed by the load. 10

OR

9. (a) State Faraday's laws of electromagnetic induction. 4
   (b) Explain the construction and working principle of DC motor. 6

   .

10. What is the role of NEC and NBC in building design? 10

OR

11. (a) Explain the different types of wiring. 5
    (b) What are the different NEC symbols used in electrical wiring layout? 5

PART 2:BASICS OF ELECTRONICS ENGINEERING

PART A

Answer all questions. Each question carries 4 marks.

1. (a) Identify the colour code for the given resistor values.
   i. $1\Omega + 5$
   ii. $3.3\text{k}\Omega + 1$
   (b) Identify the capacitor value with unit.
2. Explain the break down mechanisms of Zener diode
3. Briefly Discuss the block diagram of a DC power supply.
4. For a NPN transistor α =0.98 and I_B=100 μA . Find I_E and I_C
5. Which gates are called universal gates and why?

PART B

Answer any one full question . Each question carries 10 marks.

6. (a) Explain with necessary diagrams the principle of operation of NPN transistor 5
   (b) Write the diode current equation, If the reverse saturation current of Germanium diode at room temperature is 0.4 micro ampere. Determine the current flowing through the diode when 0.2V is applied at room temperature. 5

OR

7. (a) Plot and explain the V-I characteristics of a PN junction Diode 5
   (b) Describe the color coding of a resistor with suitable example. 5

8. With necessary diagrams explain the working of a full wave bridge rectifier 10

OR

9. Describe the input and output characteristics of Common emitter configuration. 10
10. Convert the following numbers to binary 10
   (a) $EE9_{16}$
   (b) $FD654 - 1_6$
   (c) 33_{10}
   (d) 17_{10}
   (e) 1142_8

OR

11. Draw the symbol and truth table of AND, OR, NAND, NOR and XOR

B24ES1L02	**BASIC ELECTRICAL AND ELECTRONICS WORKSHOP**	**L**	**T**	**P**	**S**	**CREDIT**	**YEAR OF INTRODUCTION**
		0	0	2	2	1	2024

Preamble

The course aims to 1) impart fundamentals of electrical wiring, safety measures, and troubleshooting to students. 2) expose student to the concepts various wiring methods and distribution systems.3) gives the basic introduction of electronic hardware systems and provides hands-on training with familiarization, identification, testing, assembling, dismantling, fabrication and repairing such systems by making use of the various tools and instruments available in the Electronics Workshop.

Prerequisite

Nil

Course Outcomes

After the completion of the course the student will be able to

CO 1	Identify electrical symbols, measuring instruments, accessories, and tools used for electrical wiring. (Cognitive Knowledge Level: Apply)
CO 2	Understand the substation, distribution system, and safety measures against electrical shocks and select the fuse unit for a given electrical circuit.(Cognitive Knowledge Level – Understand)
CO 3	Estimate and develop the electric circuits for wiring domestic and industrial buildings. .(Cognitive Knowledge Level – Apply)
CO 4	Demonstrate proficiency in identifying various electronic components, including active, passive, electrical, electronic, and electromechanical components (Cognitive Knowledge Level-Understand)
CO 5	Develop and illustrate electronic circuit diagrams using recognized standards such as BIS/IEEE symbols and utilize Electronic Design Automation (EDA) tools for schematic capture and simulation. (Cognitive Knowledge Level-Apply)
CO 6	Design and fabricate electronic circuits on boards, trouble shooting of minor problems in electronic equipment and handling of test and measuring equipment (Cognitive Knowledge Level-Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	3	1		3	1	1	3	3	2	3
CO 2	3	2	3	1		3	1	1	3	3	2	3
CO 3	3	3	3	3		3	1	1	3	3	3	3
CO 4	3	1	1	1					1	1		2
CO 5	3	2	2	1	2				2	1		2
CO 6	3	2	2	1	2				2	1		1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	70	30	1 hour

Continuous Internal Evaluation Pattern

Attendance 20 marks

Class Work/ Assessment Viva-Voce 50 marks

Viva voce / test 30 marks

End Semester Examination Pattern

The college will internally conduct end semester examination. Separate ESE ‘s will be held for Electrical workshop and Electronics workshops, each in the form of a one-hour written / objective exam. The total marks for this course is equally divided between the Electrical and Electronics workshop.

SYLLABUS

LIST OF EXPERIMENTS
PART I

ELECTRICAL

1	(a) Familiarization with electrical symbols, measuring instruments, lighting and wiring accessories, tools, and various wiring systems. (b) Familiarization with earthing in electrical installations ,precautions against electric shock phenomenon and safety procedures .
2	Realization of domestic wiring (a) Wiring of one lamp controlled by one switch and a 3-pin plug socket controlled independently. (b) Wiring of one lamp controlled by two switches (Staircase wiring).
3	(a) Realization of Industrial wiring - Wiring of three lamps controlled by three switches (Godown wiring). (b) Study of fuse, MCB, ELCB,RCCB and selection of fuse rating for circuits with medium and high power.
4	Wiring of the distribution board, including the power plug, an isolator, MCB, and ELCB for 1000 W power.
5	Measurement of low-medium-high resistance using the megger and voltmeter-ammeter method.
6	Visit the on-campus substation and familiarize with the supply system, transformer, HT Panel, and distribution system.

Reference Books

1. H Cotton, Advanced Electrical Technology, Reem Publications, 2011.
2. Suresh Kumar K.S, Electrical Circuit and Networks, Pearson Education, New Delhi, 2009.
3. EW. Golding, Electrical Measurements and Measuring Instruments, 5th ed. Reem Publications, 2011.
4. A course in electrical installation estimating and costing, J Bh Gupta, 9th editon , 2012

PART II
ELECTRONICS

1	Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Relays, Crystals, Displays, Heat sink etc.) .
2	Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia ,XCircuit, LT SPICE).
3	Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers etc.]
4	Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.
5	Interconnection methods using Bread board and soldering practice. [Soldering - types - selection of materials and safety precautions, soldering practice in general purpose PCB/lug strip] .
6	Design and fabrication of a single sided PCB for a Fixed voltage power supply with transformer, rectifier, capacitor filter and Zener regulator. Assemble and test the circuit.

Reference Books

1. ”Electronic Devices and Circuit Theory” by Robert L. Boylestad and Louis Nashelsky.
2. ”Fundamentals of Electronic Circuits” by Charles K. Alexander and Matthew N.O. Sadiku.
3. ”The Soldering Handbook” by M.W. Schwartz.
4. “Electronic Devices”, by Thomas L.Floyd Ninth Edition.
5. “Basic electronics and linear circuits”, by N.N.Bharagava, D.C.Kulshreshtha, S.C.Gupta, TataMcGraw-Hill,1994.

B24ES1L01A	PROGRAMMING LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The course aims to provide students with exposure to problem solving through C Programming. The students will have hands on experience in C programming, array handling, string manipulations, function creation, structure and pointer operations and file processing. After the lab sessions the student will be able to analyze complex problems and find solutions for real word problems.

Prerequisite

Nil

Course Outcomes

After the completion of the course the student will be able to

CO 1	C programs with branching and looping statements for processing arrays and matrices. (Cognitive Knowledge Level: Apply)
CO 2	Divide a given computational problem into a number of modules and develop functions to find the solutions to the computational problem and also create programs for string processing (Cognitive Knowledge Level: Apply)
CO 3	Construct C programs for searching and sorting (Cognitive Knowledge Level: Apply)
CO 4	Develop C programs which use structures and pointers for data processing and parameter passing (Cognitive Knowledge Level: Apply)
CO 5	Develop C programs for file processing (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3		1		1				1
CO 2	3	3	3	3		1		1				1
CO 3	3	3	3	3		1		1				1
CO 4	3	3	3	3		1		1				1
CO 5	3	3	3	3		1		1				1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Viva-Voce/ Test	15 marks
Lab Record	5 marks

SYLLABUS

LIST OF EXPERIMENTS

1	Familiarization of Linux Commands.
2	Familiarization of IO console. a) Write a C program to display the Personal details. b) Write a C program to Add two numbers c) Write a C program to evaluate the arithmetic expression using command line arguments
3	Familiarization of Operators. a) Write a C program to evaluate bitwise operations on given numbers. b) Write a C program to swap two numbers using XOR operation. c) Write a C program to find the largest of three numbers using conditional operator.
4	Write a C program for the salary increment of an employee (eg: if the given salary is > 50000, 20 % increment)
5	Write a menu driven program to perform the Calculator operations, namely addition, subtraction, multiplication, division and square of a number.

6	Write a C program to check the given number is Armstrong or not and find the reverse of the number
7	Write a C program to find the sum of first N natural numbers using array.
8	Write a C program a) To read an array of size n and display in reverse order. b) Display the sum and average of the array elements.
9	Write a C program to read an array of size n and display the prime numbers in the array.
10	Write a C program to read n integers, store them in an array and search for an element in the array using Linear Search.
11	Write a C program to read n integers, store them in an array and sort the elements using Bubble Sort.
12	Write a C program to read a string (word), store it in an array and check whether it is a palindrome word or not.
13	Write a C program to read two strings (each one ending with a $ symbol), store them in arrays and concatenate them without using library functions.
14	Write a C program to read a string (ending with a $ symbol), store it in an array and count the number of vowels, consonants and spaces in it.
15	Write a C program to read a string (word), store it in an array and obtain its reverse by using a user defined function.
16	Write a menu driven program for performing matrix addition, multiplication and finding the transpose. Use functions to a) Read a matrix. b) Find the sum of two matrices. c) Find the product of two matrices d) Find the transpose of a matrix and e) Display a matrix.
17	Find the factorial of a given Natural Number n using recursive and non-recursive functions.
18	Write a C Program to find the largest of three numbers using Macros.
19	Using structure, read and print data of n employees (Name, Employee Id and Salary).

20	Write a C program to declare a union containing 5 string variables (Name, House Name, City Name, State and Pin code) each with a length of C_SIZE (user defined constant).Then, read and display the address of a person using a variable of the union.
21	Write a C program to read the student details using structure and display the information through the user defined function.
22	Do the following using pointers a) add two numbers. b) swap two numbers using a user defined function.
23	Read and display the elements of an array using pointers, Compute the sum of the elements stored in the array using pointers and user defined function.
24	Create a file and perform the following a) Write data to the file. b) Read the data in a given file & display the file content on console . c) append new data and display on console
25	Open a text file and count the number of characters, words and lines in it; and store the result in another file.
26	Find the substring from the given text file and replace it with another string.

Reference Books

1. Programming in C - Stephen C. Kochan, CBS publishers.
2. Programming in C – E. Balaguruswamy , Mc Graw Hill.
3. Let us C – Yashwant Kanetkar, BPB.
4. A Book on C – Al Kelley and Ira Pohl, Addison-Wesley.
5. Mastering Turbo C - Stan Kelly Bootle, BPB Publications.
6. Pointers in C - Yashwant Kanetkar, BPB.
7. SThe Spirit of C- by Munish cooper, Jaico Books.

B24PH1L01A & B24CY1L01A	**ENGINEERING PHYSICS LAB (A) & ENGINEERING CHEMISTRY LAB (A)**	**L**	**T**	**P**	**S**	**CREDIT**	**YEAR OF INTRODUCTION**
		0	0	2	2	1	2024

PART I

ENGINEERING PHYSICS LAB (A)

Preamble

This course is designed to complement and enhance the students' understanding of fundamental principles in physics through hands-on experimentation and practical application. The primary aim of this laboratory course is to provide students with an experience that bridges the gap between theoretical concepts and real-world challenges. By actively engaging in experiments, students will develop crucial skills in observation, measurement, analysis, problem-solving and team work. These skills are essential in preparing students to tackle complex engineering problems in their future career.

Prerequisite

Nil

Course Outcomes

After the completion of the course the student will be able to

CO 1	Develop analytical / experimental skills and impart prerequisite hands-on experience for engineering laboratories. (Cognitive Knowledge Level: Apply)
CO 2	Understand the need for precise measurement practices for data recording. (Cognitive Knowledge Level: Apply)
CO 3	Understand the principle, concept, working and applications of relevant technologies and compare results with theoretical calculations. (Cognitive Knowledge Level: Apply)
CO 4	Develop technical skills associated with the usage of modern scientific tools. (Cognitive Knowledge Level: Apply)
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and interpreting the results. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1			1			1	2			1
CO 2	3	1			1			1	2	1		1
CO 3	3	1			1			1	2	1		1
CO 4	3	1			2			1	3			1
CO 5	3	1			1			3	3			1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
50	35	15	30 minutes

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment Viva-Voce	25 marks
End semester examination (Internally by the college)/ Test	15 marks

End Semester Examination Pattern

The college will internally conduct an end semester examination in the form of a 30 minutes written objective examination.

SYLLABUS

LIST OF EXPERIMENTS

1	WDSO-Measurement of frequency and amplitude of wave forms.
2	Optic Fiber -Measurement of Splice Loss.
3	Junction Diode - Measurement of E_R.
4	Photoelectric cell - Calculation of Planck's constant.
5	Optic Fiber - Measurement of Numerical Aperture.
6	I-V characteristics of solar cells.
7	Optic Fiber - Measurement of Bending Loss.
8	LED Characteristics.

Reference Books

1. S.L. Gupta and Dr. V. Kumar, "Practical Physics with viva voice", Pragati Prakashan Publishers, Revised Edition, 2009.
2. M.N. Avadhanulu, A.A. Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand & Co, 2008.
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014 .
4. P. R. Sasikumar, "Practical Physics", PHI Ltd., 2011.
5. D.R Mehta, "Laboratory Manual Physics", D.K Publishing House.

PART II

ENGINEERING CHEMISTRY LAB (A)

Preamble

The aim of this course is to develop a scientific approach and to bridge the gap between theoretical chemistry and the applications of chemistry in the field of engineering. This course is designed to familiarize the students with experimental skills through hands-on training, and the students will demonstrate an understanding of the practical applications of these skills while carrying out the research projects in their respective branch of engineering.

Prerequisite

Nil

Course Outcomes

After the completion of the course the student will be able to

CO 1	Understand and practice fundamental techniques in chemistry to generate experimental skills. (Cognitive Knowledge Level: Apply)
CO 2	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments. (Cognitive Knowledge Level: Apply)
CO 3	Acquire the ability to understand different methods of chemical synthesis and instrumental techniques to solve various engineering problems. (Cognitive Knowledge Level: Apply)
CO 4	Function as a team member, communicate effectively and engage in further learning while carrying out the experiment. (Cognitive Knowledge Level: Apply)
CO 5	Understand the importance of chemistry in the curriculum and how it addresses the social, economical and environmental problems. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	2		1	1	1							2
CO 2	2	2	2	2	1							2
CO 3	2	2	2	1	2							2
CO 4	2								3	3	2	3
CO 5	2	1				2	3					3

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
50	35	15	30 minutes

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment Viva-Voce	25 marks
End semester examination (Internally by the college)/ Test	15 marks

End Semester Examination Pattern

The college will internally conduct an end semester examination in the form of a 30 minutes written objective examination.

SYLLABUS

LIST OF EXPERIMENTS
(MINIMUM FOUR EXPERIMENTS ARE MANDATORY)

1	Determination of molar absorptivity of a compound.
2	Potentiometric redox titration.
3	Verification of Nernst equation using Daniel cell.
4	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} ions in the solution.
5	Electroplating with copper.
6	Synthesis of iron oxide nanoparticles.
7	Estimation of sodium ions by flame photometry.
8	Synthesis of conducting polyaniline from aniline.

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Roy K. Varghese, "Engineering Chemistry Laboratory Manual", Crown plus Publishers, 2019.
5. Soney C. George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd., New Delhi, 2019.

6. S. M. Ashraf, "A Laboratory Manual of Polymers" I. K. International Publishing House Pvt. Ltd., 2008
7. Ulrich Schubert, Nicola Hüsing, "Material Synthesis: A Practical Guide", Springer Vienna, 2008.
8. Anu Tresa Sunny, Prajitha Velayudhan, Sabu Thomas, "Colloidal metal Oxide Nanoparticles: Synthesis, Characterization and Applications", Elsevier Science, 2019.

B24MC1T01	LIFE SKILLS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		1	0	1	2	P/F	2024

Preamble

This Course is aimed at equipping individuals with the essential competencies to navigate life's challenges with resilience and positivity. This course, embarks on a profound exploration of personal development, fostering self-awareness, meaningful connections, and the ability to navigate the complexities of both the abstract and the concrete aspects of life. It aims to enhance employability by providing practical insights and hands-on experiences that will empower one to apply these principles effectively in one's personal and professional endeavors.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Empower individuals with the knowledge and practical skills needed to navigate life challenges and to cope with emotions and stress. (Cognitive Knowledge Level: Apply))
CO 2	To lead a fulfilling life as a professional and to balance work and personal aspects embracing a holistic approach to well being. (Cognitive Knowledge Level: Apply)
CO 3	Gain a deep understanding of themselves and others, fostering effective communication and interpersonal relationships. (Cognitive Knowledge Level: Apply)
CO 4	Provide a solid foundation in leadership principles and team dynamics. (Cognitive Knowledge Level: Apply)
CO 5	Basic understanding of financial concepts for financial well being. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1			1			2			2			3
CO 2						1		2	3			2
CO 3						2			3	3		
CO 4									3			2
CO 5		1	1								3	

Assessment Pattern

Bloom's Category	**Continuous Assessment**	**End Semester Examination (% Marks)**
	Test (%Marks)	
Remember	20	20
Understand	20	20
Apply	30	30
Analyse	30	30
Evaluate		
Create		

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
100	50	50	2 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (1 numbers)	25 marks
Regular assessment	15 marks

Regular assessment

Group Discussion (Marks: 9)
Create groups of about 6 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation are as follows:

1. Communication Skills: 3 marks
2. Subject Clarity: 2 marks
3. Group Dynamics: 2 marks
4. Behaviors & Mannerisms: 2 marks

Presentation Skills (Marks: 6)
Identify a suitable topic and ask the students to prepare presentation (preferably a powerpoint presentation) for about 10 minutes. Parameters to be used for evaluation are as follows

1. Communication Skills: 2 marks
2. Platform Skills: 2 marks
3. Subject Clarity/Knowledge: 2 marks

End Semester Examination Pattern

Part A: Short answer question (20 marks)
There will be one question from each MODULE (four questions in total, five marks each). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows:

1. Content Clarity/Subject Knowledge
2. Presentation style
3. Organization of content

Part B: Case Study (30 marks)
The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:

1. Analyze the case situation
2. Key players/characters of the case
3. Identification of the problem (both major& minor if exists)

4. Bring out alternatives
5. Analyze each alternative against the problem
6. Choose the best alternative
7. Implement as solution
8. Conclusion
9. Answer the question at the end of the case

SYLLABUS

MODULE 1 (6 hours)

Overview of Life Skills:

Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress- Four A's of stress management, Gratitude Training, Coping with emotion- PATH method and relaxation techniques.

MODULE 2 (6 hours)

Life Skills for Professionals:

positive thinking, right attitude, Experience, attention to detail, having the big picture, learning skills, research skills, setting goals and achieving them, perseverance, motivation, self-motivation, and motivating others, IQ, EQ, and SQ , Collaboration, continuous learning, unlearning and relearning, cross cultural communication, social media etiquettes, Financial Literacy.
Time Management: Prioritizing tasks, setting realistic goals and managing time effectively, work life balance.
Holistic Thinking: imagination, intuition, lateral thinking, Multiple intelligence, spirituality, family bonding, living peacefully.

MODULE 3 (6 hours)

Leadership:

Leadership traits, Styles of Leadership, VUCA Leadership, Transactional vs Transformational Leaders, managing diverse stakeholders, crisis management, Effective Leaders.
Group and Team Dynamics: Group vs Team, Team Dynamics, Virtual teams, managing

team performance and managing conflicts, Intrapreneurship

MODULE 4 (6 hours)

Financial Literacy:

Time value of money, power of compounding, Future value of a single cash flow, effective versus nominal rate, Future value of an annuity, present value of a single cash flow, Present value of an annuity.

Reference Books

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, “Personality Development & Soft Skills”, Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, ”Life Skills for Engineers”, McGraw Hill Education (India) Private Ltd.,2016.
4. Caruso, D. R. and Salovey P, “The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership”, John Wiley & Sons, 2004.
5. Kalyana, “Soft Skill for Managers”; First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, “The First Book of Life Skills”; First Edition, Embassy Books, 2016.
7. Shalini Verma, “Development of Life Skills and Professional Practice”; First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, ”Emotional Intelligence”; Bantam, 2006.
9. Remesh S., Vishnu R.G., ”Life Skills for Engineers”, Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, “Soft Skills for Everyone”, Cengage Learning India Pvt Ltd; 1 edition, 2011.
11. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 editions, 2015.
12. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013
13. Prasanna Chandra, “Fundamentals of Financial Management”, McGraw Hill Education (India) Private Ltd,2020
14. Edward de Bono, “Lateral Thinking”
15. Howard Gardener, “Multiple Intelligences”

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	24 Hours
	Module 1	(6 hours.)
1.1	Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making	1
1.2	Problem solving, Effective communication, interpersonal relationship, coping with stress- Four A's of stress management.	1
1.3	Gratitude Training, Coping with emotion- PATH method and relaxation techniques	1
1.4	Activity- Presentation, Group discussion	3
	Module 2	(6 hours)
2.1	Life skills for professionals: positive thinking, right attitude, Experience, attention to detail, having the big picture, learning skills, research skills, setting goals and achieving them, perseverance, motivation, self-motivation, and motivating others,	1
2.2	IQ, EQ, and SQ, Collaboration, continuous learning, unlearning and relearning, cross cultural communication, social media etiquettes, Financial Literacy.	1
2.3	Time management: Prioritizing tasks, setting realistic goals and managing time effectively, work life balance.	1
2.4	Holistic Thinking: imagination, intuition, lateral thinking, Multiple intelligence, spirituality, family bonding, living peacefully.	1
2.5	Activity- Presentation, Group discussion.	2
	Module 3	(6 hours)
3.1	Leadership: Leadership traits, Styles of Leadership, VUCA Leadership, Transactional vs Transformational Leaders, managing diverse stakeholders, crisis management, Effective Leaders.	1 hour

3.2	Group and Team Dynamics: Group vs Team, Team Dynamics, Virtual teams, managing team performance and managing conflicts, Intrapreneurship	1
3.3	Activity- Presentation, Group discussion	4
	Module 4	(6 hours)
4.1	Financial Literacy: Time value of money, power of compounding, Future value of a single cash flow.	1
4.2	Effective versus nominal rate, Future value of an annuity.	1
4.3	Present value of a single cash flow, Present value of an annuity.	1
4.4	Activity- Presentation, Group discussion	3

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What are the life skills identified by WHO?
2. List the 4 A's of stress management.
3. Differentiate between Critical thinking and Creative thinking.

Course Outcome 2 (CO 2):

1. What are the life skills that a professional should have?
2. Explain how time management can help in work life balance.
3. What is the difference between intuition and lateral thinking?What is the value of L after you run the code below?

Course Outcome 3 (CO 3):

1. How a person can grow as a leader in an organization?
2. Discuss the term "Crisis management".
3. What are the differences between a team and a group?

Course Outcome 4 (CO 4):

1. A finance company advertises that it will pay a lumpsum of Rs. 10000 at the end of 6 years to investors who deposit annually Rs. 1000. What interest rate is implicit in this offer?
2. How much should be deposited at the beginning of each year for 10 years in order to provide a sum of Rs. 50000 at the end of 10 years?
3. Suppose you deposit Rs. 10000 with an investment company which pays 8 percent interest with quarterly compounding. How much will this deposit grow in 5 years?

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24MC1T01

Course Name: LIFE SKILLS

Max. Marks: 50 Duration: 2 hours

PART A

Answer all questions. Each question carries 5 marks.

1. Stress is the emotional or physical tension the body creates when presented with events or thoughts that cause worry, frustration, anger or nervousness. When stress exceeds the ability to cope, balance in the mind and body need to be restored. Discuss how stress management can act as an effective tool to accomplish this.
2. "The only limit to our realization of tomorrow is our doubts of today." – Franklin D. Roosevelt. Critically assess how cultivating positive thinking and maintaining a right attitude can transform professional challenges into opportunities for growth.
3. Discuss leadership styles that are effective for successful management of multicultural groups and teams.
4. Mr. Vinay plans to send his son for higher studies abroad after 10 years. He expects the cost of these studies to be Rs. 100000. How much should he save annually to have a sum of Rs. 100000 at the end of 10 years if the interest rate is 12 percent?

PART B

Read carefully the following case and answer the questions given below. Each question carries 6 marks.

1. Based on the case study given below, answer the following questions: It occurred on the night of 2–3 December 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh. Over 500,000 people were exposed to Methyl Isocyanate (MIC) gas and other chemicals. A runaway reaction had occurred in a storage tank of Methyl Isocyanate (MIC), which was used to manufacture a pesticide. The valves of the tank had burst, and a cloud of poisonous gas had escaped. The winds carried it to nearby shanty towns and the populous city of Bhopal, where thousands of people either died in their sleep or woke and died while fleeing. Those who survived suffered from burning eyes and lungs. Local medical facilities were not equipped for the disaster, and over the next few weeks' thousands more died. The killer gas spread through the city, sending residents scurrying through the dark streets. No alarm ever sounded a warning, so that local people were not informed the situation, and no evacuation plan was prepared. When victims arrived at hospitals breathless and blind, doctors did not know how to treat them, as UCIL had not provided emergency information. Perhaps most importantly at the time of the tragedy, the staff did not realize the gravity of the situation and even took a break for tea after the leak had been noticed, thinking they would have plenty of time to fix it. The operator in the control room did not notify his supervisor when the temperature began to rise inside the tank and the entire situation remained unattended for at least an hour. The disaster raised some serious ethical issues. The pesticide factory was built in the midst of densely populated settlements. UCIL chose to store and produce MIC, one of the deadliest chemicals (permitted exposure levels in USA and Britain are 0.02 parts per million), in an area where nearly 120,000 people lived. The MIC plant was not designed to handle a runaway reaction. When the uncontrolled reaction started, MIC was flowing through the scrubber (meant to neutralize MIC emissions) at more than 200 times its designed capacity.

   (a) Critique the communication strategy (or lack thereof) employed by UCIL during the disaster. How did the absence of timely warnings and information affect the outcome?

   (b) Assess the ethical implications of UCIL's decision to build a pesticide plant in a densely populated area. How should corporate responsibility have been exercised in this context?

   (c) As an engineer, comment on the drawback of the design which may have the reason for the tragedy.

   (d) Evaluate the leadership displayed by UCIL's management during the Bhopal disaster. How did their response, or lack thereof, impact the outcome of the crisis?

   (e) Reflect on the lessons learned from the Bhopal disaster. What key takeaways should industries and governments derive from this incident to enhance safety and prevent future catastrophes?

B24MC1T02	DESIGN THINKING	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		1	1	0	1	P/F	2024

Preamble

This course gives students a comprehensive understanding of the iterative design process and its real-world applications. It covers the fundamentals of design thinking, including concept development, brainstorming, and creativity enhancement. Emphasizing customer needs identification and human-centered design principles, it explores product conceptualization and evaluation, along with prototyping techniques. Additionally, the course addresses ethical considerations and challenges within the design thinking process through diverse case studies. By the end of the course, students will gain practical insights into design thinking methodologies, preparing them to effectively tackle complex design challenges.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Exhibit/show a thorough understanding of the fundamental principles of the design thinking methodology. (Cognitive Knowledge Level: Understand)
CO 2	Utilize diverse techniques effectively to generate creative concepts, adopting innovation and ideation. (Cognitive Knowledge Level: Apply)
CO 3	Analyze real-world challenges and develop a practical design thinking framework suitable for their professional endeavors. (Cognitive Knowledge Level: Create)
CO 4	Demonstrate expertise in ideating prototypes, models, and proof-of-concept iterations. (Cognitive Knowledge Level: Apply)
CO 5	Show proficiency in conceptualizing, organizing, leading, and executing interdisciplinary projects that address societal issues through innovative solutions. (Cognitive Knowledge Level: Analyze)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	2	1			1	1	1		1	3
CO 2	2	2	2	1			1	1	1	1	1	2
CO 3	2	2	2	1			1	1	1		2	2
CO 4	2	2	2	1			1	1	1	1	1	2
CO 5	2	3	2	2		2	1	3	3	3	2	2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test (%Marks)	**Case Study Presentation (Marks) (%Marks)**	
Remember	10		10
Understand	10		10
Apply	10		10
Analyse	10		10
Evaluate			
Create		15	10

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
100	50	50	2 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (1 numbers)	25 marks
Regular assessment	15 marks

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 4 questions carrying 5 marks each. Part B contains 2 questions from each module out of which 1 to be answered and can have maximum 2 sub- divisions. Questions from Module 1&2 carries 8 marks each and Module 3&4 carries 7 marks.

SYLLABUS

MODULE 1 (5 hours)

Design Thinking Approach:

Introduction to Design Thinking; Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test; The double-diamond Model of design by British Design Council.

Developing concepts:

Steps to develop concepts from functions; Brainstorming: Mechanism of brainstorming, Ideation; Creativity: How to increase level of creativity.

MODULE 2 (6 hours)

Design Process: Requirements: Identifying customer needs and requirements, market analysis, defining goals; Product concepts: establishing functions, task specifications.
Solution Concept: conceptualization, evaluating alternatives; embodiment design; Analysis and optimization; experiment; marketing. Human-centred design process.

MODULE 3 (6 hours)

Concepts Evaluation:: Evaluating conceptual alternatives: Pugh's Evaluation matrix, decision matrix with examples, QFD and house of quality.
Prototyping: Prototypes, Models and Proofs of concepts; What is Prototype? Why Prototype? Building models and prototypes, Rapid Prototyping; Lean startup method for prototype development; Testing prototypes and models and proving concepts.

MODULE 4 (7 hours)

Ethics in Design: Understanding obligations, code of ethics, familiarity with several code of ethics such as ASCE, ASME, IEEE, VDI etc. code of ethics and moral frameworks.
Challenges in Design Thinking: Design thinking case studies detailing the various aspects detailed above are to be discussed. The case studies are suggested to be from the below listed areas but not to be limited to: Consumer package goods; Education; Financial Services; Health care; Journalism; Non-Profit organizations; Retail; Technology; Transportation sector; Self-improvement.

Text Books

1. Yousef Haik & Tamer M Shahin, "Engineering design process", Course Technology, 2010.
2. Clive L Dym, Patrick Little & Elizabeth J Orwin, "Engineering Design-A Project based Introduction", Wiley, 2014.
3. Don Norman, "The Design of Everyday Things", Basic Books; 2nd edition, 2013.
4. Christian Mueller-Roterberg, "Handbook of Design Thinking: Tips and Tools for how to design thinking", 2018.

Reference Books

1. Daniel Kahneman, "Thinking Fast and Slow", Farrar, Straus & Giroux, 201.
2. Rod Judkins, "The art of Creative Thinking", Penguin Publishing Group, 2016.
3. Donella H Meadows, "Thinking in Systems", Chelsea Green Publishing, 2008.
4. Tim Brown, "Change by Design", HarperCollins, 2019.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	24 Hours
	Module 1	(5 hours)
1.1	Design Thinking Approach: Introduction to Design Thinking; Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test	1 hour
1.2	The double-diamond Model of design by British Design Council	1 hour
1.3	Developing concepts: Steps to develop concepts from functions	1 hour
1.4	Brainstorming: Mechanism of brainstorming, Ideation	1 hour
1.5	Creativity: How to increase level of creativity	1 hour
	Module 2	(6 hours)

2.1	Design Process: Requirements: Identifying customer needs and requirements, market analysis, defining goals	1 hour
2.2	Product concepts: establishing functions, task specifications	1 hour
2.3	Time management: Prioritizing tasks, setting realistic goals and managing time effectively, work life balance.	1 hour
2.4	Solution Concept: conceptualization, evaluating alternatives	1 hour
2.5	Embodiment design; Analysis and optimization; experiment; marketing	1 hour
2.6	Human centred design process	1 hour
	Module 3:	(6 hours)
3.1	Concepts Evaluation: Evaluating conceptual alternatives: Pugh's Evaluation matrix, decision matrix with examples.	1 hour
3.2	Prototypes, Models and Proofs of concepts	1 hour
3.3	What is Prototype? Why Prototype? Building models and prototypes, Rapid Prototyping	1 hour
3.4	Lean startup method for prototype development; Testing prototypes and models and proving concepts	1 hour
3.5	QFD and House of Quality	1 hour
	Module 4:	(7 hours)
4.1	Ethics in Design: Understanding obligations, code of ethics, familiarity with several code of ethics such as ASCE, IEEE, VDI etc. code of ethics and moral frameworks	1 hour
4.2	Challenges in Desing thinking	1 hour
4.3	Design thinking case studies detailing the various aspects	5 hour

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Describe design thinking and list the different stages in a design thinking process.
2. Illustrate the double-diamond Model of design.
3. Describe how to develop concepts from functions and Mechanism of brainstorming.

4. How to increase the level of creativity and the process of forming ideas from conception to implementation?

Course Outcome 2 (CO 2):

1. How to narrow down to the best design considering the customer needs and requirements, market analysis and defining goals?
2. Illustrate the process of product concepts, forming ideas and embodiment design.
3. Explain the Human-centred design process.

Course Outcome 3 (CO 3):

1. Describe the concept evaluation using Pugh's Evaluation matrix, and decision matrix with examples.
2. Explain the ideation of prototypes, models, and proofs of concepts.
3. Illustrate the concept of Rapid Prototyping, the Lean startup method for prototype development and testing of prototypes.

Course Outcome 4 (CO 4):

1. Discuss as an engineer, how ethics play a decisive role in design.
2. Analyze the Challenges in Design thinking.
3. Illustrate the development of a product by passing through the different stages of the design thinking Process.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24MC1T02

Course Name: DESIGN THINKING

Max. Marks: 50 Duration: 2 hours

PART A

Answer all questions. Each question carries 5 marks.

1. Demonstrate the basic concept of brainstorming and the rules developed for brainstorming session.
2. Briefly explain what is product and solution concepts in design process.
3. Distinguish between prototypes and models.
4. Explain the importance of ethics in design.

PART B

Answer any one question from each module.

11. (a) What do you mean by design thinking and why it is needed. How does the design thinking approach help engineers. 8

OR

12. (a) Summarize different stages of design thinking process using appropriate examples.. 8

13. (a) Illustrate different phases of extensive prescriptive model of design process. 8

OR

14. (a) Identifyl the customer requirements with the help of refrigerator as example, 8

15. (a) How concepts evaluation can be done using Pugh's evaluation matrix. Compare Pugh's evaluation matrix with the decision matrix. 7

OR

16. (a) List the different methods in which the prototype of a product can be generated and tested. 7

17. (a) Design a device/machine that will crush aluminum cans. The device must be fully automatic. The device should switch on automatically, crush the can automatically, eject the crushed can automatically and switch off automatically. 7

OR

18. (a) Design a new shopping cart that can be used primarily in grocery stores. The shopping cart should solve the common problems in the available carts. There is a tendency to conserve parking space by not designating a return cart area. Leaving cart in the parking lots may lead to serious accidents and car damage. Many customers do not fill their carts when shopping; however, they do not like to carry baskets. Other customers like to sort products as they shop. 7

B24MC1L01	Yoga and Sports	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	1	1	1	P/F	2024

Preamble

This course enables the learners to understand how to attain physical fitness, mental well-being, and holistic growth through the combined benefits of yoga and sports. The topics covered in this course are Yoga & Lifestyle Physical fitness, wellness and exercise programmes, First aid and Postures & nutrition. This course helps the students to develop appreciation of physical activity as a lifetime pursuit and a means to better health.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Demonstrate the need of physical activities and Yoga for the strength, flexibility, and relaxation of mind and body. (Cognitive Knowledge Level :Apply)
CO 2	Use scientific principles of exercise and training in daily routine. (Cognitive Knowledge Level :Apply)
CO 3	Apply first aid promptly and appropriately whenever and wherever the need arises.(Cognitive Knowledge Level :Apply)
CO 4	Identify the importance of the components of health-related fitness (Cognitive Knowledge Level : Understand)
CO 5	Understand the importance of postures and nutrition (Cognitive Knowledge Level :Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1								2	3	2		2
CO 2								3	3	2		2
CO 3						2		3	3	3		2
CO 4								3	3	2		2
CO 5								3	3	2		2

Mark Distribution

Total Marks	CIE Marks
50	50

Continuous Internal Evaluation Pattern

Attendance	10 marks
Regular assessment	40 marks

SYLLABUS

MODULE 1 (6 hours)

Yoga & Lifestyle:

Meaning and importance of Yoga. Introduction-Asanas: Pranayama, Meditation and Yogic Kriyas. Yoga for concentration and related Asanas (Sukhasana; Tadasana; Padmasana and Shashankasana). Relaxation Techniques for improving concentration-Yog-nidra.Asanas as preventive measure.Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.Obesity: Procedure, Benefits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.Back pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.

MODULE 2 (6 hours)

Physical fitness and exercise:

Meaning and importance of physical fitness and wellness. Components of physical fitness and health related fitness. Exercise for improving speed, strength, endurance, and flexibility and co ordinative abilities.Exercises to prevent back pain, tennis elbow, shoulder injury and knee pain, Neck pain.Fitness test battery for speed, strength, endurance, flexibility.Importance of weight training.Warming up and cooling down.How to deal with every day stress.

MODULE 3 (6 hours)

First aid:

First aid and principles of first aid.First aid measure for the following: Bleeding through Nose, Snakebite, Dog Bite, Electric Shock, Burns and Drowning.Common injuries and their management: Wounds, Cuts, Sprain, Fracture and Dislocation. Cardio Pulmonary Resuscitation (CPR).How to prevent muscle cramps and its management.How to carry an injured person.

MODULE 4 (6 hours)

Postures and nutrition:

Posture and its importance.Common Postural Deformities-Knock Knee, Flat Foot, Round Shoulders, Lordosis, Kyphosis, Bow Legs and Scoliosis.Corrective Measures for Postural Deformities. Balanced diet, malnutrition and Deficiency diseases. Hydration

Text Books

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light on Yoga by B.K.S. Iyengar.
3. Health and Physical Education- NCERT (11th and 12th Classes)

Reference Books

4. Physiological aspects of sports training and performance by Jay Hoffman.
5. Periodization theory and methodology of training by Tudor O Bompa and G Grisgery Haff.
6. Essential of strength training and conditioning by Thomas Baechle E R, Roger W Earle.
7. A practice guide to emergency first aid, safety injuries, illnesses by Montreal.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	**Topic**	**No. of Lecture/ Tutorial Hours**
	Total Hours	24 Hours
	Module 1 (6 hours.)	
1.1	Meaning and importance of Yoga.Introduction-Asanas, Pranayama, Meditation and Yogic Kriyas.Yoga for concentration and related Asanas (Sukhasana; Tadasana; Padmasana and Shashankasana) Relaxation Techniques for improving concentration-Yog-nidra. Asanas as preventive measures.	2 hour

1.2	Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.	1 hour
1.3	Obesity: Procedure, Benefits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.	1 hour
1.4	Back pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana	2 hour
	Module 2 (6 hours)	
2.1	Meaning and importance of physical fitness and wellness, Components of physical fitness and health related fitness	1 hour
2.2	Exercise for improving speed, strength, endurance, and flexibility and co ordinative abilities	1 hour
2.3	Exercises to prevent back pain, shoulder injury and knee pain.	2 hour
2.4	Fitness test battery for speed, strength, endurance, flexibility.	1 hour
2.5	Importance of weight training, Warming up and cooling down.	1 hour
	Module 3: (6 hours)	
3.1	First aid and principles of first aid.First aid measure for the following: Bleeding through Nose, Snakebite, Dog Bite, Electric Shock, Burns and Drowning.	2 hour
3.2	Common injuries and their management: Wounds, Cuts, Sprain, Fracture and Dislocation	2 hour
3.3	Cardio pulmonary resuscitation (CPR).	1 hour
3.4	How to prevent muscle cramps and its management.How to carry an injured person	1 hour
	Module 4: (6 hours)	
4.1	Posture and its importance.Common Postural Deformities-Knock Knee, Flat Foot, Round Shoulders.	2 hour
4.2	Lordosis, Kyphosis, Bow Legs and Scoliosis.Corrective Measures for Postural Deformities.	2 hour
4.3	Balanced diet, malnutrition and deficiency disease, Hydration.	2 hour

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Demonstrate yoga asanas for life style problems
2. Create a PPT presentation on various yoga asanas
3. Group Activity - Group discussion about the need and benefits of physical activities and Yoga for the strength, flexibility, and relaxation of mind and body.

Course Outcome 2 (CO 2):

1. Analyze the exercise activities of at least five famous personalities and give a PPT presentation about how each one of them uses physiological principles related to exercise and training in daily routine.
2. Conduct a survey on how the following categories of people follow physiological principles related to exercise and training in daily routine.
   - (a) Sports person
   - (b) Working woman
   - (c) Students
   - (d) Ladies in the age group of 25-35, 35-45,45- 55,55-65, above 65
   - (e) Gents in the age group of 25-35, 35-45,45- 55,55-65, above 65

Course Outcome 3 (CO 3):

1. With a role play, illustrate various first aid activities that can be followed at various situation in life. In each illustration, try to give emphasis on dos and don'ts to be followed in each situation.

Course Outcome 4 (CO 4):

1. Observe at least 10 students in your class and identify Common Postural
2. Deformities each one of them have. Also identify good posters they follow. Have a discussion with each one of them to identify whether they have already recognized it or not. Make a report about it.

MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.Tech
Artificial Intelligence and Machine Learning

SEMESTER 2

SYLLABUS

SEMESTER 2

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS	3-1-0-3	4	4
B	B24ES1T03A	COMPUTER AIDED ENGINEERING GRAPHICS	2-0-2-4	4	3
C	B24CS1T01	LOGIC SYSTEM DESIGN	3-1-0-3	4	4
D	B24CS1T02	INDUSTRIAL PROGRAMMING	2-1-0-2	3	3
E	B24CS1T03	OBJECT ORIENTED PROGRAMMING	3-1-0-3	4	4
G	B24CS1L01	INDUSTRIAL PROGRAMMING LAB	0-0-3-3	3	2
H	B24CS1L02	OBJECT ORIENTED PROGRAMMING LAB	0-0-3-3	3	2
I	B24MC1T03	PROFESSIONAL COMMUNICATION & ETHICS	2-0-1-3	3	P/F
J	B24MC1L02	IDEA LAB	0-0-2-2	2	P/F
TOTAL				**30**	**22**

B24MA1T02	**ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS**	**L**	**T**	**P**	**S**	**CREDIT**	**YEAR OF INTRODUCTION**
		3	1	0	3	4	2024

Preamble:

This course introduces the concepts and applications of differential equations, sequence and series including power series and basic transforms such as Laplace and Fourier transforms. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include differential equations, sequence, series and transforms. The topics treated in this course have applications in all branches of engineering.

Prerequisites: Nil

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients (Cognitive Knowledge Level: Apply)
CO 2	Perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent (Cognitive Knowledge Level: Apply)
CO 3	Determine the Taylor and Fourier series expansion of functions and learn their applications. (Cognitive Knowledge Level: Apply)
CO 4	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering (Cognitive Knowledge Level: Apply)
CO 5	Compute Laplace transform and apply them to solve ordinary differential equations arising in engineering (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1		1							1
CO 2	3	2	1		1							1
CO 3	3	2	1		1							1
CO 4	3	2	1		1							1
CO 5	3	2	1		1							1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (Ordinary Differential Equations)

(Text 2: Relevant topics from sections 2.1, 2.2, 2.5,2.6, 2.7, 2.10, 3.1, 3.2, 3.3)

Homogenous linear differential equation of second order, superposition principle, general solution, homogenous linear ODEs with constant coefficients-general solution. Solution of Euler-Cauchy equations (second order only). Existence and uniqueness (without proof). Non homogenous linear ODEs-general solution, solution by the method of undetermined coefficients(for the right hand side of the form x^n,e^{kx},$sinax$, $cosax$ and their linear combinations) , methods of variation of parameters. Solution of higher order equations-homogeneous and non-homogeneous with constant coefficients using method of undetermined coefficients.

MODULE 2 (Sequences and Series)

(Text 1: Relevant topics from sections 9.1, 9.3, 9.4, 9.5, 9.6)

Convergence of sequences and series, convergence of geometric series and p-series (without proof), tests of convergence (comparison, limit comparison, ratio and root tests without proof); Alternating series and Leibnitz test, absolute and conditional convergence.

MODULE 3 (Fourier Series)

(Text 1: Relevant topics from sections 9.8, 9.9. Text 2: Relevant topics from sections 11.1, 11.2, 11.6)

Taylor series (without proof, assuming the possibility of power series expansion in appropriate domains), Binomial series and series representation of exponential, trigonometric, logarithmic functions (without proofs of convergence); Fourier series, Euler formula, Convergence of Fourier series (without proof), half range sine and cosine series.

MODULE 4 (Fourier Transforms)

(Text 2: Relevant topics from sections 11.7, 11.8, 11.9)

Fourier integral representation, Fourier sine and cosine integrals. Fourier sine and cosine transforms, inverse sine and cosine transform. Fourier transform and inverse Fourier transform, basic properties. The Fourier transform of derivatives. Convolution theorem (without proof).

MODULE 5 (Laplace Transforms)

(Text 2: Relevant topics from sections 6.1, 6.2 ,6.3, 6.4, 6.5)

Laplace Transform and its inverse, Existence theorem (without proof), linearity, Laplace transform of basic functions, first shifting theorem, Laplace transform of derivatives and integrals, solution of differential equations using Laplace transform, Unit step function, Second shifting theorem. Dirac delta function and its Laplace transform, Solution of ordinary differential equation involving unit step function and Dirac delta functions. Convolution theorem (without proof) and its application to finding inverse Laplace transform of products of functions.

Text Books

1. H. Anton, I. Biven, S. Davis, "Calculus", Wiley, 10^{th} edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10^{th} edition, John Wiley& Sons, 2016.

Reference Books

3. J. Stewart, "Essential Calculus", Cengage,2^{nd} edition, 2017.
4. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9^{th} Edition, Pearson, Reprint,2002.
5. Peter O Neil, "Advanced Engineering Mathematics", 7^{th} Edition, Thomson, 2007.
6. Louis C Barret, C Ray Wylie, "Advanced Engineering Mathematics", Tata McGraw Hill, 6^{th} edition, 2003.
7. Veerarajan T,"Engineering Mathematics for first year", Tata McGraw - Hill, 2008.
8. B.S. Grewal,"Higher Engineering Mathematics", Khanna Publishers, 43 Edition, 2015.
9. Ronald N. Bracewell, "The Fourier Transform and its Applications", McGraw – Hill International Editions, 2000.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
1	**Module 1: Ordinary Differential Equations**	9
1.1	Homogenous linear equation of second order, Superposition principle, general solution.	1
1.2	Homogenous linear ODEs of second order with constant coefficients.	2
1.3	Second order Euler-Cauchy equation.	1
1.4	Non homogenous linear differential equations of second order with constant coefficient-solution by undetermined coefficients, variation of parameters.	3
1.5	Higher order equations with constant coefficients.	2
2	**Module 2: Sequences and Series**	9
2.1	Convergence of sequences and series, geometric and p-series.	2
2.2	Test of convergence (comparison, ratio and root).	4
2.3	Alternating series and Leibnitz test, absolute and conditional convergence	3
3	**Module 3: Fourier series**	9
3.1	Taylor series, Binomial series and series representation of exponential, trigonometric, logarithmic functions.	3
3.2	Fourier series, Euler formulas, Convergence of Fourier series (Dirichlet's conditions)	3
3.3	Half range sine and cosine series.	3
4	**Module 4: Fourier Transforms**	9
4.1	Fourier integral representation.	1
4.2	Fourier Cosine and Sine integrals and transforms.	2
4.3	Complex Fourier integral representation, Fourier transform and its inverse transforms, basic properties.	3
4.4	Fourier transform of derivatives, Convolution theorem	3
5	**Module 5: Laplace Transforms**	9

5.1	Laplace Transform , inverse Transform, Linearity, First shifting theorem, transform of basic functions.	2
5.2	Transform of derivatives and integrals.	1
5.3	Solution of Differential equations, Initial value problems by Laplace transform method.	2
5.4	Unit step function - Second shifting theorem.	1
5.5	Dirac Delta function and solution of ODE involving Dirac delta function.	2
5.6	Convolution and related problems.	1
	Total	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): Solve homogeneous and nonhomogeneous linear equation with constant coefficients.

1. Find the general solution to $2x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} - 3y = 0$ given that $y_1(x) = \frac{1}{x}$ is a solution.
2. Solve the initial value problem $x^2y'' - 3xy' + 4y = 0$ given that $y(1) = \pi, y'(1) = 4\pi$
3. By the method of undetermined coefficients, solve $y'' - 2y' + y = e^x cos2x$

Course Outcome 2 (CO 2): Perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent.

1. Find the sum of the series $\sum_{n=1}^{\infty} \frac{1}{9n^2+3n-2}$,if it is convergent.
2. Examine the convergence of $\sum_{n=1}^{\infty} \left(\frac{n}{n+1}\right)^{n^2}$
3. Determine whether the series $\sum_{n=1}^{\infty} \frac{(-1)^n n^4}{4^n}$ is absolutely convergent.

Course Outcome 3 (CO 3): Determine the power series expansion of a given function.

1. Find the Taylor's series representation of $f(x) = sin\pi x$ about $x = 1$
2. Determine the binomial series representation of $\frac{1}{\sqrt{(2+x)^3}}$

3. Find the Fourier series of the periodic function $f(x)$ of period 2, where
$f(x) = \begin{cases} -1 & -1 \le x \le 0 \\ 2x & 0 \le x \le 1 \end{cases}$ and deduce that $1 + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$.

Course Outcome 4 (CO 4): Determine the Fourier transforms of functions and apply them to solve problems arising in engineering .

1. Find the Fourier integral representation of function defined by $f(x) = e^{-x}$ for $x > 0$ and $f(x) = 0$ for $x < 0$.
2. What are the conditions for the existence of Fourier Transform of a function $f(x)$?
3. Find the Fourier Transform of $f(x) = x$ for $|x| \le 1$ and $f(x) = 0$ otherwise.

Course Outcome 5 (CO 5):Compute Laplace transform and apply them to solve ODEs arising in engineering.

1. What is the inverse Laplace Transform of $\frac{3s+2}{(s-1)(s^2+2s+5)}$
2. Find Laplace Transform of (i) $e^{-t}sin^2t$ (ii) $\delta(t-a)$
3. Solve the differential equation $y'' + 4y = f(t), y(0) = 1, y'(0) = 0$ where
$f(t) = \begin{cases} 0 & \text{if } 0 \le t \le 4 \\ 3 & \text{if } t \ge \pi \end{cases}$

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24MA1T02

Course Name: ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS Common to all branches

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Check whether x, lnx are linearly independent or not.
2. Solve $y''' + 9y' = 0$.
3. Find the rational number represented by the repeating decimal 5.373737. . .
4. Examine the convergence of $\sum_{k=1}^{\infty} \frac{1}{k!}$
5. Find the binomial series for $f(x) = (1 + x)^{\frac{1}{3}}$ upto third degree term.
6. Obtain the half range sine series expansion of $f(x) = \pi x - x^2$ in $(0, \pi)$.
7. Find the cosine integral representation of the function $f(x) = \begin{cases} 1 & ; 0 < x < 1 \\ 0 & ; x > 1 \end{cases}$
8. Find the Fourier cosine transform of e^{-x} , $x > 0$.
9. Find the Laplace transform of $sin^2 2t$.
10. Find $L^{-1}\left\{\frac{1}{(s-1)(s-2)}\right\}$.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Solve the initial value problem $y'' + 9y = 0, y(0) = 0.2, y'(0) = -1.5$. 7
    (b) By the method of variation of parameters solve $y'' + 4y = tan2x$. 7

OR

12. (a) By the method of undetermined coefficients solve $y'' + 2y' + 4y = 3e^{-x}$. 7
    (b) Solve $x^2y'' + xy' + 9y = 0, y(1) = 0, y'(1) = 2.5$. 7

13. (a) Test the convergence of (i) $\sum_{k=1}^{\infty} \frac{3k^3-2k^2+4}{k^7-k^3+2}$ (ii) $\sum_{k=1}^{\infty} \frac{k^k}{k!}$. 7
    (b) Check the convergence of the series $1 + \frac{1.3}{3!} + \frac{1.3.5}{5!} + \frac{1.3.5.7}{7!} + \ldots$ 7

OR

14. (a) Determine whether the series $\sum_{k=1}^{\infty} \frac{1}{\sqrt{k}+1}$ is absolutely convergent or conditionally convergent. 7
    (b) Test the convergence of (i)$\sum_{k=1}^{\infty} \frac{k!}{3!(k-1)!3^k}$ (ii) $\sum_{k=1}^{\infty} (\frac{4k-5}{2k+1})^k$ 7

15. (a) Expand into a Fourier series , $f(x) = e^{-x}, 0 < x < 2\pi$. 7
    (b) Obtain the half range Fourier sine series of $f(x) = \begin{cases} x & ,0 < x < \frac{\pi}{2} \\ \pi - x & ,\frac{\pi}{2} < x < \pi \end{cases}$ 7

OR

16. (a) Find the Fourier series expansion of $f(x) = x^2$ in the interval $-\pi < x < \pi$. Hence show that $1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots = \frac{\pi^2}{12}$. 7
    (b) Find the half range cosine series for $f(x) = (x - 1)^2$in $0 \le x \le 1$. 7

17. (a) Find the Fourier transform of $f(x) = \begin{cases} 1 & \text{if } |x| < 1 \\ 0 & \text{otherwise} \end{cases}$ 7
    (b) Find the Fourier sine integral of $f(x) = \begin{cases} sinx & ,0 \le x \le \pi \\ 0 & ,x > \pi \end{cases}$ 7

OR

18. (a) Using Fourier integral representation show that $\int_0^{\infty} \frac{coswx}{1+w^2} dw = \frac{\pi}{2} e^{-x}, x > 0$. 7
    (b) Find the Fourier sine transform of $f(x) = \begin{cases} k & ,0 < x < a \\ 0 & ,x > a \end{cases}$ 7

19. (a) Find the Laplace transform of (i) $tsin2t$ (ii) $e^{-t}sin3tcos2t$ 7
    (b) Using convolution theorem find $L^{-1}\left\{\frac{1}{s(s^2+4)}\right\}$ 7

OR

20. (a) Find $L^{-1}\left\{\frac{4s+5}{(s+2)(s-1)^2}\right\}$ 7
    (b) Use Laplace transform to solve $y'' + 2y' + 2y = 0, y(0) = y'(0) = 1$. 7

B24ES1T03A	COMPUTER AIDED ENGINEERING GRAPHICS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	0	2	4	3	2024

Preamble

This course aims to equip students with the skills for precise technical communication using global standards. Through this course, students learn to proficiently use CAD software and interpret engineering drawings accurately. Emphasis is placed on conveying design intent and specifications effectively. By mastering these skills, students develop a critical eye for detail and enhance their ability to communicate complex engineering concepts visually. Ultimately, the course prepares students to excel in the global engineering landscape by fostering proficiency in graphical communication and CAD expertise.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Draw the projection of points and lines located in different quadrants. (Cognitive Knowledge Level: Analyse)
CO 2	Prepare multi view orthographic projections of objects by visualizing them in different positions. (Cognitive Knowledge Level: Apply)
CO 3	Draw sectional views and develop surfaces of a given object. (Cognitive Knowledge Level: Apply)
CO 4	Familiarize the tools and features of CAD software (Cognitive Knowledge Level: Understand)
CO 5	Prepare pictorial drawings using the principle of isometric projections and convert 3D views to orthographic views using CAD Software (Cognitive Knowledge Level: Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2				1		1		1
CO 2	3	2	2	2				1		1		1
CO 3	3	2	2	2				1		2		1
CO 4	3	1	1	1	2			1		2		1
CO 5	3	2	2	2	2			1		2		1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember			
Understand	40	40	30
Apply	30	30	40
Analyse	30	30	30
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	100	50	2 hours

Continuous Internal Evaluation Pattern

Attendance 20 marks

Continuous Assessment Test (2 numbers) 40 marks

Assignment/Class work 40 marks

Continuous Assessment Test 1 will have 20 marks and will be from Part A. Test 2 will be from Part B and will also carry 20 marks. Regarding Assignments/Class work, 15 marks will be awarded for Part A and the remaining 25 marks should be based on class works/assignments from Part B (minimum 5 exercises).

End Semester Examination Pattern

ESE will have questions only from Part A and with a duration of 2-hours. The exam will be for 50 marks and will have to be drawn on A4 size answer booklets. The question paper shall contain two parts; Part I contains three questions, one question each from the three modules, each carrying 12 marks. Part II contains two questions (from any of the three modules) carrying 14 marks each. The student has to answer all the three questions from Part I and any one question from Part II.

SYLLABUS

PART A

MODULE 1 (11 hours)

Introduction:

Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines:

Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

MODULE 2 (10 hours)

Orthographic projection of Solids:

Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position. Projection of solids with axis inclined to one of the reference planes and both reference planes.

MODULE 3 (10 hours)

Sections of Solids:

Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections.

Development of Surfaces:

Development of surfaces of the Prisms, Pyramids, Cone, Cylinder cut by different section planes.

PART B

MODULE 4 (6 hours)

Introduction to Computer Aided Drawing:

Role of CAD in design and development of new products, Advantages of CAD- Create a new drawing, Set model environment i.e., units, limits etc., Set interface settings e.g., snap, grid, ortho, Create and save an AutoCAD drawing template, Use zooming tools, Drawing commands as line, spline, circle, arc, rectangle, polygon, ellipse, Hatch a closed entity to represent sections, Erase & oops, Copy and Move objects, Rotate, Scale, Stretch Extend & Offset, Mirror and array, Apply Chamfers and Fillets, Edit polylines and spline, decurve, fit, thickness join & explode, Trim, break, explode, Create layers and assign properties as line weights, line types, colour, Modify status: On, Off, Freeze, Thaw, Lock, Unlock, Set layer current, Modify layer attributes, Text and Dimensions, Plotting, Extrusion.

MODULE 5 (8 hours)

Isometric Projection using CAD:

Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Frustum of Pyramid, Frustum of Cone.

Conversion of Pictorial Views using CAD:
Creating two-dimensional drawing from pictorial views.

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.
3. K.N. Anilkumar, Engineering Graphics, Adhyuth Narayan Publishers.
4. P. I. Varghese, Engineering Graphics, Tata McGraw Hill Education.

Reference Books

1. Agrawal, B. and Agrawal, C.M., Engineering Drawing, Tata McGraw Hill Publishers.

2. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
3. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
4. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
	Module 1: Introduction and Orthographic projection of Points and Lines	11
1.1	Relevance of technical drawing in Engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane and Lines inclined to both planes.	4
1.4	Problems on lines using trapezoid method .	2
1.5	Line rotation method of solving, problems on line rotation method.	2
	Module 2: Orthographic projection of Solids	10
2.1	Introduction of different solids, Simple position plan and elevation of solids.	3
2.2	Problems on views of solids inclined to one plane.	2
2.3	Problems on views of solids inclined to both planes.	3
2.4	Practice problems on solids inclined to both planes.	2
	Module 3: Sections of solids and development of surfaces	10
3.1	Introduction to section planes. Principle of locating cutting points and finding true shape.	2

3.2	Problems on sections of different solids and Problems when the true shape is given.	3
3.3	Principle and development of simple solids.	2
3.4	Development of solids and sectioned solids.	3
	Module 4: Introduction to Computer Aided Drawing	6
4.1	Role of CAD in design and development of new products, Advantages of CAD	1
4.2	AutoCAD Fundamentals: Open, (and close) AutoCAD application, Create a new drawing, Set model environment ie units, limits etc, Set interface settings eg snap, grid, ortho, Create and save an AutoCAD drawing template.	1
4.3	Use zooming tools, Drawing commands as line, spline, circle, arc, rectangle, polygon, ellipse, Hatch a closed entity to represent sections, Erase & oops, Copy and Move objects, Rotate, Scale, Stretch Extend & Offset, Mirror and array, Apply Chamfers and Fillets, Edit polylines and spline, decurve, fit, thickness join & explode .	2
4.4	Trim, break, explode, Create layers and assign properties as line weights, line types, colour, Modify status: On, Off, Freeze, Thaw, Lock, Unlock, Set layer current, Modify layer attributes, Text and Dimensions, Plotting, Extrusion. .	2
	Module 5: Isometric Projection using CAD	8
5.1	Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder.	3
5.2	Isometric View and Projections of Frustum of Pyramid, Frustum of Cone..	2
5.3	Creating two-dimensional drawing from pictorial views..	3

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes.

3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO 2):

1. Draw orthographic views of solids and combination solids .
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO 3):

1. Draw views of solids sectioned by a cutting plane.
2. Find location and inclination of cutting plane given true shape of the section.
3. Draw development of lateral surface of solids and also its sectioned views.

Course Outcome 4 (CO 4):

1. Draw the given figure including dimensions using 2D software.

Course Outcome 5 (CO 5):

1. Draw Isometric views/projections of solids/combination of solids using modelling software.
2. Create 2D model using modelling software from the given 3D figure or from real 3D objects.

MODEL QUESTION PAPER

QP CODE: **Pages: 1**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24ES1T03A

Course Name: COMPUTER AIDED ENGINEERING GRAPHICS

Max. Marks: 50 Duration: 2 hours

Instructions: Retain construction lines.Show necessary dimensions.

PART I

Answer all questions. Each question carries 12 marks.

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes.

2. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30^0 to VP. Draw the projections of the solid.

3. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

PART II

Answer any one full question. Each question carries 14 marks.

4. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.

5. A hexagonal prism of base edge 25 mm and height 60 mm is resting on one of its base edges on HP. Draw its projection if the rectangular face carrying that base edge is inclined 35^0 to HP and the base edge at which it is resting is inclined 40^0 to VP.

B24CS1T01	LOGIC SYSTEM DESIGN	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

The objective of the course is to familiarize learners with the basic concepts of Boolean algebra and digital systems. This course covers the design of simple combinational and sequential logic circuits, representation and arithmetic algorithms for Binary, BCD (Binary Coded Decimal) and Floating point numbers which in turn are helpful in understanding organization & design of a computer system and understanding how patterns of ones and zeros can be used to store information on computers, including multimedia data.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Compare various positional number systems and binary codes (Cognitive Knowledge level: Understand)
CO 2	Simplify a given Boolean Function and design a combinational circuit to implement the simplified function using Digital Logic Gates (Cognitive Knowledge level: Apply)
CO 3	Analyze and understand various combinational digital circuits. (Cognitive Knowledge level: Apply)
CO 4	Design of sequential circuits with flip flops.(Cognitive Knowledge level: Apply)
CO 5	Understand the algorithms for binary operation(addition and subtraction) and representation of floating point numbers (Cognitive Knowledge level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	3	2	1	2			1			
CO 2	2	1	3	2	1	2	1				1	
CO 3	2	1	3	2	1	2						
CO 4	2	1	3	2	1	2		1		1		2
CO 5	3	1	3	2	1	2			1			

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	20	20	20
Understand	35	35	35
Apply	45	45	45
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Number systems, Operations & Codes:

Decimal, Binary, Octal and Hexadecimal Number Systems- Number Base Conversions. Addition, Subtraction, Multiplication and Division of binary numbers. Representation of negative numbers- Complements, Subtraction with complements. Addition and subtraction of BCD, Octal and Hexadecimal numbers.

MODULE 2 (9 hours)

Boolean Algebra:

Postulates of Boolean Algebra. Basic theorems and Properties of Boolean Algebra. Boolean Functions - Canonical and Standard forms. Simplification of Boolean Functions- Using Karnaugh- Map Method (up to five variables), Don't care conditions, Product of sums simplification, Tabulation Method. Digital Logic Gates- Implementation of Boolean using basic and universal gates.

MODULE 3 (9 hours)

Combinational Logic Circuits :

Design Procedure & Implementation of combinational logic circuits- Binary adders and subtractors, Binary Parallel adder, Carry look ahead adder, Carry save adder, BCD adder, Code converter, Decoder, Demultiplexer, Encoder, Multiplexer, Parity generator/ Checker.

MODULE 4 (9 hours)

Sequential logic circuits:

Flip-flops- SR, JK, T and D. Triggering of flip-flops- Master slave flip- flops, Edge- triggered flip- flops. Excitation table and characteristic equation. Registers- register with parallel load. Counter design: Asynchronous counters- Binary and BCD counters, timing sequences and state diagrams. Synchronous counters- Binary Up- down counter, BCD counter.

MODULE 5 (11 hours)

Shift registers:

Shift registers – Serial In Serial Out, Serial In Parallel Out, Bidirectional Shift Register with Parallel load. Ring counter. Johnson counter- timing sequences and state diagrams. Basic concepts of PLA.

Arithmetic algorithms:

Algorithms for addition and subtraction of binary numbers in signed magnitude and 2's complement representations. Algorithm for addition and subtraction of BCD numbers. Representation of floating point numbers, Algorithm for addition and subtraction of floating point numbers.

Text Books

1. M. Morris Mano, Digital Logic & Computer Design, 4/e, Pearson Education, 2013 .
2. Thomas L Floyd, Digital Fundamentals, 10/e, Pearson Education, 2009.
3. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007.

Reference Books

1. M. Morris Mano, Michael D Ciletti, Digital Design With An Introduction to the Verilog HDL, 5/e, Pearson Education, 2013.
2. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
	Module 1: Number systems, Operations & Codes:	7
1.1	Number Systems: Decimal, Binary, Octal and Hexadecimal number systems, Number Base Conversions.	1

1.2	Binary Arithmetic: Addition, Subtraction, Multiplication & Division of Binary Numbers.	1
1.3	Addition, Subtraction, Multiplication & Division of Binary Numbers.	
1.4	Representation of Negative Numbers- Complements, subtraction with complements.	1
1.5	BCD Arithmetic: Addition and Subtraction of BCD Numbers.	1
1.6	Octal and Hexadecimal Arithmetic: Addition & Subtraction of Octal and Hexadecimal Numbers.	2
	Module 2: Boolean Algebra:	9
2.1	Introduction to Boolean Algebra: Postulates of Boolean Algebra	1
2.2	Basic theorems and Properties of Boolean Algebra	1
2.3	Boolean Functions: Canonical and Standard Forms	1
2.4	Simplification of Boolean Functions: Karnaugh -Map Method (upto five variables), Don't care conditions.	2
2.5	Products of Sum simplification.	1
2.6	Tabulation method.	1
2.7	Digital Logic Gates: AND, OR, NOT, NAND, NOR, XOR, XNOR, Implementation of Boolean functions using basic and universal gates.	2
	Module 3: Combinational Logic Circuits :	9
3.1	Design Procedure & Implementation of Combinational Circuits.	1
3.2	Binary Adders: Implementation of Half Adder, Full Adder.	1
3.3	Binary Subtractors: Implementation of Half Subtractor, Full Subtractor.	1
3.4	Implementation of Binary Parallel Adder, Carry look ahead Adder, Carry Save Adder, BCD Adder.	2
3.5	Implementation of Various Combinational Circuits: Code Converters, Magnitude Comparator.	1
3.6	Implementation of Decoder, Demultiplexer.	1
3.7	Implementation of Encoder, Multiplexer.	1
3.8	Implementation of Parity Generator/Checker.	1
	Module 4: Sequential logic circuits:	9

4.1	Flip flops: SR, JK, T and D flip- flops.	2
4.2	Triggering of flip-flops- Master slave flip- flop, Edge-triggered flip-flops.	2
4.3	Excitation table and characteristic equations of flip- flops.	1
4.4	Registers- Register with parallel load.	1
4.5	Counter Design: Asynchronous counters- Binary and BCD counters- timing sequences and state diagrams.	1
4.6	Asynchronous counters- Binary and BCD counters- timing sequences and state diagrams.	1
4.7	Synchronous counters- Binary Up- down counter, BCD counter.	1
4.8	Using the Delegation Model.	1
	Module 5: Shift registers and arithmetic algorithms	11
5.1	Shift Registers - Serial In Serial Out, Serial In Parallel Out..	1
5.2	Bidirectional Shift Register with Parallel load.	1
5.3	Shift register counters - Ring Counter, Johnson Counter-timing sequences and state diagrams.	2
5.4	Arithmetic Algorithms: Algorithm for addition and subtraction of binary numbers in Signed magnitude and 2's complement representations.	2
5.5	Algorithm for addition and subtraction of BCD numbers.	2
5.6	Representation of floating point numbers (IEEE Standard representations).	1
5.7	Algorithms for floating point addition and subtraction.	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Perform the following number base conversions:
   (a) $(250.55)_{10}$ to Hexadecimal'
   (b) $(357)_8$ to Decimal'

Course Outcome 2 (CO 2):

1. Given a Boolean function F and don't care conditions D, using Karnaugh map obtain the simplified expression in (i) SOP and (ii) POS:
   (a) F(A, B, C, D) = $A' B' D'$ + A'CD + A'BC
   (b) D(A, B, C, D) = A'B C'D + ACD + A B'D

Course Outcome 3 (CO 3):

1. Design a BCD to Excess-3 Code Convertor.

Course Outcome 4 (CO 4):

1. Design a 4- bit binary ripple counter.

Course Outcome 5 (CO 5):

1. Demonstrate floating-point addition algorithm.

MODEL QUESTION PAPER

QP CODE: **Pages:3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24CS1T01

Course Name: LOGIC SYSTEM DESIGN

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Represent the decimal numbers $(459)_{10}$ and $(859)_{10}$ in hexadecimal and perform addition of these hexadecimal numbers.
2. Find the dual and complement of the boolean function F = AB' + B(A +B').
3. Find the dual and complement of the boolean function F! = A B' + B(A + B').
4. Using K-map, reduce the expression: A! B + A BC + A BC + BC.
5. Design a half subtractor with NAND gates only.
6. Design a combinational circuit that multiplies an input decimal digit by 5 represented in BCD. The output is also in BCD. Show that the outputs can be obtained from the input lines without using any logic gates.
7. Differentiate between ripple counter and synchronous counter.
8. Construct D flip- flop using NAND gates. Also give its truth table.
9. Explain how a shift register is used for serial data transfer?
10. Write short notes on ROM.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Perform the following operations using 2's complement arithmetic 8
    i. $88_{10} + (-37)_{10}$
    ii. $(-20)_{10} + (-12)_{10}$

    (b) Perform the following base conversions: 6
    i. $(101011.11)_2$ to octal
    ii. $(3F9B)_{16}$ to binary
    iii. $(121)_{10}$ to binary
    iv. $(3077)_8$ to binary

OR

12. (a) Find the 12 bit complement representation of the following decimal numbers. 6
    i. -97
    ii. – 224
    iii. - 197.5

    (b) Perform the following operations 8
    i. $(520)_8 + (488)_8$
    ii. $(520)_{16}$ - $(488)_{16}$

13. (a) Prove that 8
    i. AB + A(B + C) + B(B + C) = B + AC
    ii. AB + A(B + C) + B(B + D) = A

    (b) Using K-map, simplify the Boolean function F in sum of products form, using the don't care conditions d:
    F(w, x, y, z) = $w'(x'$y + x' y' + x yz) + x' z'(y + w)
    d(w, x, y, z) = w'x (y'z + y z') + wy 6

OR

14. (a) Simplify the following expressions using Karnaugh- map method. 6
    i. F = Σ(0,2,4,6,9,11,13,15,17,21,25,27,29,31)
    ii. F = Π(0,2,5,7)

    (b) Convert the following to the other canonical form: 8
    i. F(x, y, z, a) = Σ (1,3,7)
    ii. F(x, y, z) = Π(0,3,6,7)
    iii. F(A, B, C, D) = Π(0,1,2,3,4,6,12)

15. (a) Implement Full adder circuit using NAND gate only. 6

    (b) Design a code converter for converting BCD to Excess 3 code 8

OR

16. (a) With a neat diagram explain 4-bit carry look-ahead adder. 6

    (b) Design a Gray to binary code converter using a 4x1 MUX. Draw the circuit diagram and explain 8

17. (a) Design a counter that count the states 0,3,5,6,0... using T flip- flops. 6

    (b) Write the characteristics equation, excitation table of JK, T and D flip flop. 8

OR

18. (a) Explain race around condition and how it can be avoided. 6

    (b) Design a synchronous Binary Up-Down Counter. 8

19. (a) With a neat diagram explain universal shift register. 6

    (b) Explain Johnson Counter with timing diagram. 8

OR

20. (a) Write algorithm for floating point addition and subtraction 6

    (b) Implement the functions Y1 = AB' C' + AB'C + ABC and Y2 = BC + AC using minimum gates Programmable Logic Array 7

<table>
<tr><td rowspan="2">B24CS1T02</td><td rowspan="2">INDUSTRIAL PROGRAMMING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>2</td><td>3</td><td>2024</td></tr>
</table>

Preamble

The objective of the course is to equip the learners to develop multi-module software solutions for real-world computational problems using Python. It encompasses the Python programming environment, syntax, data representations, intermediate level features, GUI programming, Object Oriented Programming and data processing. This course lays the foundation to develop modular software solutions including complex interactive applications, network applications, and data-driven intelligent applications.

Prerequisites

Basic knowledge in Computational Problem Solving, A course in any programming language

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Write, test and debug Python programs (Cognitive Knowledge level: Apply)
CO 2	Develop programs by utilizing the Python programming constructs such as Lists, Tuples, Sets and Dictionaries. (Cognitive Knowledge level: Apply)
CO 3	Develop graphical user interface for solutions using Python libraries. (Cognitive Knowledge level: Apply)
CO 4	Implement Object Oriented programs with exception handling. (Cognitive Knowledge level: Apply)
CO 5	Write programs in Python to process data stored in files by utilizing NumPy, Matplotlib, and Pandas. (Cognitive Knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	1	1	1		1				1
CO 2	2	2	2	1	1	1		1				1
CO 3	2	3	2	1	2	1		1				1
CO 4	2	2	2	1	1	1		1				1
CO 5	2	3	2	1	2	1		1				1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (5 hours)

Programming Environment and Python Basics:

Getting started with Python programming – Interactive shell, IDLE, IPython Notebooks, Detecting and correcting syntax errors, How Python works. The software development process –A case study. Basic coding skills – strings, assignment, and comments, Numeric data types and character sets, Expressions, Using inbuilt functions and modules. Control statements – Iteration with for/while loop, Formatting text for output- A case study. Selection structure (if-else, switch case), Conditional iteration with while - A case study, Testing control statements, Lazy evaluation.

MODULE 2 (8 hours)

Building Python Programs:

Strings and text files – Accessing characters, substrings, Data encryption, Strings and number system, String methods, Text files, A case study on text analysis. Design with Functions – Functions as Abstraction Mechanisms, Problem solving with top-down design, Design with recursive functions, Managing a program's namespace, Higher-Order Functions. Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension. Work with tuples. Sets. Work with dates and times, A case study with lists. Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup. Case Study – Data Structure Selection.

MODULE 3 (6 hours)

Graphics:

Terminal-based programs, Simple Graphics using Turtle, Operations, 2D Shapes, Colors and RGB Systems, A case study. Image Processing – Basic image processing with inbuilt functions. Graphical User Interfaces – Event-driven programming, Coding simple GUI-based programs : Windows, Labels, Displaying images, Input text entry, Popup dialog boxes, Command buttons, A case study.

MODULE 4 (7 hours)

Object Oriented Programming:

Design with classes - Objects and Classes, Methods, Instance variables, Constructor, Accessor and Mutator, Data-Modeling Examples, Structuring classes with inheritance and polymorphism. Abstract classes, Interfaces, Exceptions Handle a single exception, handle multiple exceptions.

MODULE 5 (9 hours)

Data Processing:

Python built-in modules - “os”, “sys”, NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Random numbers. Plotting and visualization-Matplotlib - Basic plot, Ticks, Labels, and Legends. Working with CSV files – Pandas Reading, Manipulating, and Processing Data. Introduction to Micro services using Flask.

Text Books

1. Kenneth A Lambert., Fundamentals of Python: First Programs, 2/e, Cengage Publishing, 2016
2. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O’Reilly Publishers, 2017
3. Flask: Building Python web services, Jack Stouffer, Shalabh Aggarwal, Gareth Dwyer, PACKT Publishing Limited, 2018

Reference Books

4. Zed A Shaw, Learn Python 3 The Hard Way, Addison-Wesley, 2017
5. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Shroff, 2016
6. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
7. Charles Severance, Python for Informatics: Exploring Information,

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	35 Hours
	Module 1: Programming Environment and Python Basics	5
1.1	Getting started with Python programming – Interactive shell, IDLE, iPython Notebooks, Detecting and correcting syntax errors, How Python works.	1
1.2	The software development process – A case study.	1
1.3	Basic coding skills – strings, assignment, and comments, Numeric data types and character sets, Expressions, Using inbuilt functions and modules.	1
1.4	Control statements – Definite Iteration with for loop, Formatting text for output, Selection structure (if-else, switch-case), Conditional iteration with while loop, A case study	1
1.5	Testing the control statements, Lazy evaluation.	1
	Module 2: Building Python Programs	8
2.1	Strings – Accessing characters, substrings, Data encryption, Strings and number system, String methods,	1
2.2	Text files, A case study on text analysis.	1
2.3	Design with Functions – Functions as Abstraction Mechanisms, Problem solving with top-down design,	1
2.4	Design with recursive functions, Managing a program's namespace, Higher- Order Functions.	1
2.5	Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension.	1
2.6	Work with tuples. Sets. Work with dates and times, A case study with lists.	1
2.7	Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup.	1
2.8	Case Study - Data Structure Selection.	1
	Module 3: Graphics	6

3.1	Graphics – Simple Graphics using Turtle, Operations, 2D Shapes, Colors and RGB Systems, A case study.	1
3.2	Image Processing – Basic image processing with inbuilt functions.	1
3.3	Graphical User Interfaces – Event-driven programming	1
3.4	Coding simple GUI-based programs: Windows, Labels, Displaying images,	1
3.5	Coding simple GUI-based programs: Input text entry, Popup dialog boxes, Command buttons	1
3.6	A case study - GUI	1
	Module 4: Object Oriented Programming	7
4.1	Design with classes: Objects and Classes, Methods, Instance Variables	1
4.2	Constructor, Accessors, and Mutators	1
4.3	Structuring classes with Inheritance	1
4.4	Polymorphism	1
4.5	Abstract classes	1
4.6	Interfaces	1
4.7	Exceptions: Handle a single exception, handle multiple exceptions	1
	Module 5: Data Processing	9
5.1	The os and sys modules, NumPy: Basics, Creating arrays, Arithmetic, Slicing	1
5.2	Matrix Operations, Random numbers.	1
5.3	Matplotlib: Basic plot, Ticks, Labels, and Legends	1
5.4	Working with CSV files	1
5.5	Pandas: Reading, Manipulating	1
5.6	Pandas: Processing Data and Visualize.	1
5.7	Introduction to Microservices using Flask	1
5.8	Introduction to Microservices using Flask	1
5.9	Introduction to Microservices using Flask	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What is type conversion? How is it done in Python?

2. Write a note on the Python editors.

3. What is printed when the below code is executed?

```python
mysum = 0
for i in range(5, 11, 2):
    mysum += i
    if mysum == 5:
        break
    mysum += 1
print(mysum)
```

   What would be the output if 'break' is replaced with 'continue' in the above code fragment?

Course Outcome 2 (CO 2):

1. Given is a list of words, wordlist, and a string, name. Write a Python function which takes wordlist and name as input and returns a tuple. The first element of the output tuple is the number of words in the wordlist which have name as a substring in it. The second element of the tuple is a list showing the index at which the name occurs in each of the words of the wordlist and a 0 if it doesn't occur

2. What is the value of L after you run the code below?

```python
L = ["life", "answer", 42, 0]
for thing in L:
    if thing == 0:
        L[thing] = "universe"
    elif thing == 42:
        L[1] = "everything"
```

3. Illustrate how to change a key from a dictionary

Course Outcome 3 (CO 3):

1. A bouncy program is defined as follows – The program computes and displays the total distance travelled by a ball, given three inputs—the initial height from which it is dropped, its bounciness index, and the number of bounces. Given the inputs write a GUI-based program to compute the total distance traveled.

2. Write a Python program to find the quadrant of a point, say (x,y).

3. Write a program to change a color image to black and white.

Course Outcome 4 (CO 4):

1. Write a Python program to implement the addition, subtraction, and multiplication of complex numbers using classes. Use constructors to create objects. The input to the program consist of real and imaginary parts of the complex numbers.
2. Explain inheritance in Python using suitable examples.
3. Illustrate the use of exceptions.

Course Outcome 5 (CO 5):

1. Given a file "auto.csv" of automobile data with the fields index, company, body-style, wheelbase, length, engine-type, num-of-cylinders, horsepower, average-mileage, and price, Write a python code to
   (i) Clean and Update the CSV file
   (ii) Print total cars of all companies
   (iii) Find the average mileage of all companies
   (iv) Find the highest priced car of all companies.
2. Given two matrices A and B, write a program to find the product of A and B.
3. Write a program to plot the histogram of an image.

MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24CS1T02

Course Name: INDUSTRIAL PROGRAMMING

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Write a Python program to reverse a number and also find the sum of digits of the number. Prompt the user for input.
2. Explain the concept of scope and lifetime of variables in Python programming language, with a suitable example.
3. Illustrate format specifiers and escape sequences with examples.
4. Compare tuples, lists, and dictionaries with examples. Describe the following dictionary methods with an example.
5. Describe the following dictionary methods with example:
   i. get( )
   ii. Keys( )
   iii. pop( )
   iv. update( )
   v. values( )
   vi. items( )
6. Differentiate the terminal-based and GUI-based programming in Python.

7. What is polymorphism? Give an example in the context of OOP in Python.
8. How is exception handling accomplished in Python programs?
9. Explain the os and os.path modules in Python with examples. Also discuss walk() and getcwd() methods of the os module.
10. What are the important characteristics of CSV file format?

PART B

Answer any one question from each module. Each question carries 14 marks.

1. (a) Write a Python code to check whether a given year is a leap year or not [A year is a leap year if it's divisible by 4 but not divisible by 100 except for those divisible by 400]. 6

   (b) What are the possible errors in a Python program. Write a Python program to print the value of $22n + n + 5$ for n provided by the user. 8

OR

2. (a) Write a Python program to find the value for $\sin(x)$ up to n terms using the series

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots$$

   where x is in degrees. 6

   (b) Write a Python code to determine whether the given string is a Palindrome or not using slicing. Do not use any string function. 8

3. (a) Write a Python code to create a function called `list_of_frequency` that takes a string and prints the letters in non-increasing order of the frequency of their occurrences. Use dictionaries. 5

   (b) Write a Python program to read a list of numbers & sort the list in ascending order without using any built-in functions. A separate function should be written to sort the list where the name of the list is passed as the parameter. 9

OR

4. (a) Illustrate the following Set methods with an example. 6

   i. `intersection()`
   ii. `union()`
   iii. `issubset()`
   iv. `difference()`
   v. `update()`
   vi. `discard()`

   (b) Write a Python program to check the validity of a password given by the user. The Password should satisfy the following criteria: 8

i. Contains at least one letter between a and z
ii. Contains at least one number between 0 and 9
iii. Contains at least one letter between A and Z
iv. Contains at least one special character from $, #,
v. Minimum length of password: 6

5. (a) Write a program to draw a hexagon using turtle. 5
   (b) Write a note on the image processing function in Python. 9

OR

6. (a) Describe the features of event-driven programming. 4
   (b) Write a GUI-based program that allows the user to convert temperature values between degrees Fahrenheit and degrees Celsius. The interface should have labeled entry fields for these two values. These components should be arranged in a grid where the labels occupy the first row and the corresponding fields occupy the second row. At start-up, the Fahrenheit field should contain 32.0, and the Celsius field should contain 0.0. The third row in the window contains two command buttons, labeled ¿¿¿¿ and ¡¡¡¡. When the user presses the first button, the program should use the data in the Fahrenheit field to compute the Celsius value, which should then be output to the Celsius field. The second button should perform the inverse function. 10

7. (a) How can a class be instantiated in Python? Write a Python program to express the instances as return values to define a class RECTANGLE with parameters height, width, corner_x, and corner_y and member functions to find center, area, and perimeter of an instance. 10
   (b) Explain inheritance in Python. Give examples for each type of inheritance. 4

OR

8. (a) Write a Python class named Circle constructed by a radius and two methods which will compute the area and the perimeter of a given circle. 6
   (b) Write Python program to create a class 'Complex' and implement __add__( ) method to add two complex numbers. Display the result by overloading the + operator. 8

9. (a) Write a Python program to add two matrices and also find the transpose of the resultant matrix. 8
   (b) Given a file "auto.csv" of automobile data with the fields index, company, body-style, wheel-base, length, engine-type, num-of-cylinders, horsepower, average-mileage, and price, write Python codes using Pandas to 6

      i. Clean and Update the CSV file
      ii. Print total cars of all companies
      iii. Find the average mileage of all companies
      iv. Find the highest priced car of all companies.

OR

10. (a) Write Python program to write the data given below to a CSV file. 5

SN	**Name**	**Country**	**Contribution**	**Year**
1	Linus Tovalds	Finland	Linux Kernal	1991
2	Tim Berners Lee	England	World Wide Web	1990
3	Guido Van Rossum	Netherlands	3 Python	1991

(b) Given the sales information of a company as CSV file with the following fields month_number, facecream, facewash, toothpaste, bathingsoap, shampoo, moisturizer, total_units, total_profit. Write Python codes to visualize the data as follows: 9

i. Toothpaste sales data of each month and show it using a scatter plot.

ii. Face cream and face wash product sales data and show it using the bar chart. Calculate total sale data for last year for each product and show it using a Pie chart.

B24CS1T03	OBJECT ORIENTED PROGRAMMING	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Inheritance, Exception handling, Event handling, multithreaded programming, basics of networking with Java and working with window-based graphics. This course helps the learners to develop Desktop GUI Applications, Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

Prerequisites

Basic knowledge in Computational Problem Solving, A course in any programming language

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Utilise datatypes, operators and control statements in Java programs.(Cognitive Knowledge Level: Understand)
CO 2	Write Java programs using the object oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism. (Cognitive Knowledge Level: Apply)
CO 3	Use built in packages and interfaces, Input/ Output Streams and Files in Java to develop programs. Illustrate how robust programs can be written in Java using exception handling mechanism and Implement Java networking programs using sockets. (Cognitive Knowledge Level: Apply)
CO 4	Write application programs in Java using multithreading and database connectivity (Cognitive Knowledge Level: Apply)
CO 5	Write Graphical User Interface based application programs by utilising event handling features and Swing in Java. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	3	3								2
CO 2	1	2	2	2								2
CO 3	1	2	2	1						1		1
CO 4	1	1	2	2								1
CO 5	1	2	2	1								1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (% Marks)	**Test 2 (% Marks)**	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (8 hours)

Introduction:

Approaches to Software Design - Functional Oriented Design, Object Oriented Design. Basic Object-Oriented Concepts, Object Modeling Using Unified Modeling Language (UML)- UML diagrams- Use case model, Class diagram, Interaction diagram.
Introduction to Java- Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM), Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Garbage Collection, Lexical Issues.
Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.
Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence. Control Statements - Selection Statements, Iteration Statements and Jump Statements.

MODULE 2 (10 hours)

Object Oriented Programming in Java:

Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, this Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Final Variables, Inner Classes, Command Line Arguments, Variable Length Arguments.
Inheritance - Super Class, Sub Class, The Keyword super, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, using final with Inheritance
String handling: Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, using valueOf(), Comparison of StringBuffer and String.

MODULE 3 (12 hours)

More Features of Java:

Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.
Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally.

Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Object Streams and Serialization, Working with Files.
Network Programming with Java – Socket Programming in Java, Client Sockets, Server Sockets, Data Transmission through sockets, TCP/IP Programming with Java, Datagram Packet, Datagram Server and Client, A client/Server Example, Sending and receiving objects.

MODULE 4 (8 hours)

Advanced features of Java:

Collections framework - Collections overview, Collections Interfaces- Collection Interface, List Interface. Collections Class – ArrayList class. Accessing a Collection via an Iterator.
Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.
Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model.

MODULE 5 (7 hours)

Graphical User Interface and Database Support of Java:

Swing fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Swing Packages, Event Handling in Swing, Swing Layout Managers, Exploring Swing –JFrame, JLabel, The Swing Buttons, JTextField.
Java DataBase Connectivity (JDBC) - JDBC overview, Creating and Executing Queries – create table, delete, insert, select.

Text Books

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.

2. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11^{th} Edition, Pearson, 2018.

3. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.

Reference Books

1. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008

2. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.

3. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.

4. Sierra K., Head First Java, 2/e, O'Reilly, 2005.

5. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
	Module 1: Introduction	8
1.1	Approaches to Software Design - Functional Oriented Design, Object Oriented Design. Basic Object-Oriented Concepts.	1
1.2	Object Modeling Using Unified Modeling Language (UML)- UML diagrams- Use case model, Class diagram, Interaction diagram.	1
1.3	Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. JVM, Java compiler, Bytecode.	1
1.4	Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues.	1
1.5	Primitive Data types - Integers, Floating Point Types, Characters, Boolean.	1
1.6	JLiterals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.	1
1.7	Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	1
1.8	Control Statements - Selection Statements, Iteration Statements and Jump Statements.	1
	Module 2: Object Oriented Programming in Java	10
2.1	Class Fundamentals, Declaring Objects, Object Reference.	1
2.2	Introduction to Methods, Constructors, this Keyword, Method Overloading, Using Objects as Parameters.	1
2.3	Returning Objects, Recursion, Access Control.	1
2.4	Static Members, Final Variables, Inner Classes, Command Line Arguments, Variable Length Arguments.	1
2.5	Inheritance - Super Class, Sub Class, The Keyword super, protected Members.	1

2.6	Calling Order of Constructors, Method Overriding, the Object class.	1
2.7	Calling Order of Constructors, Method Overriding, the Object class.	1
2.8	String Handling – String Constructors, String Length.	1
2.9	String handling: Special String Operations - Character Extraction, String Comparison, Searching Strings.	1
2.10	Modifying Strings, using valueOf(), Comparison of StringBuffer and String.	1
	Module 3: More Features of Java	12
3.1	Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages.	1
3.2	Interfaces.	1
3.3	Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause.	
3.4	Multiple catch Clauses, Nested try Statements. Throw, throws and finally.	1
3.5	Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class.	1
3.6	Object Streams and Serialization.	1
3.7	Working with Files.	1
3.8	Network Programming with Java – Socket Programming in Java, Client Sockets, Server Sockets.	1
3.9	Data Transmission through sockets, TCP/IP Programming with Java.	1
3.10	Datagram Packet, Datagram Server and Client.	1
3.11	A client/Server Example.	1
3.12	Sending and receiving objects.	1
	Module 4: Advanced features of Java	8
4.1	Collections framework - Collections overview, Collections Interfaces- Collection Interface.	1
4.2	List Interface, Collections Class – ArrayList class.	1
4.3	Accessing a Collection via an Iterator.	1
4.4	Advanced features of Java: Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread.	1

4.5	Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	1
4.6	Event handling - Event Handling Mechanisms, Delegation Event Model.	1
4.7	Event Classes, Sources of Events, Event Listener Interfaces.	1
4.8	Using the Delegation Model.	1
	Module 5: Graphical User Interface and Database Support of Java	7
5.1	Swing fundamentals - Swing Key Features, Model View Controller (MVC).	1
5.2	Swing Controls, Components and Containers.	1
5.3	Swing Packages, Event Handling in Swing.	1
5.4	Swing Layout Managers.	1
5.5	Exploring Swing –JFrame, JLabel, The Swing Buttons, JTextField.	1
5.6	Java DataBase Connectivity (JDBC) - JDBC overview.	1
5.7	Creating and Executing Queries – create table, delete, insert, select.(Basics only, DBMS Course is not a prerequisite)	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. How is platform independence achieved in Java?
2. Discuss the advantages and disadvantages of OOD.
3. Compare and contrast Java Applets and Java Application.

Course Outcome 2 (CO 2):

1. Write a Java program to evaluate a post fix expression containing two operands and a single operator using stack. Stack should be implemented as a separate entity so as to reflect OOP concepts.
2. Demonstrate with example, one method each, from the String class, which performs the below special string operations: Character Extraction, Searching Strings and Modifying Strings.

3. Summarize the need of constructors in Java and list the different types of constructors allowed in Java programs.

Course Outcome 3 (CO 3):

1. Write a program in java to read a paragraph from a text file and print to console.
2. Demonstrate the significance of the keywords 'try', 'catch', 'finally', 'throw' and 'throws' in exception handling of Java with appropriate examples.
3. How do you create and import a package in Java?
4. Explain accept() function in socket programming.

Course Outcome 4 (CO 4):

1. Write a program to demonstrate the start, run, sleep and join methods in Thread class.
2. Write a Java program that creates multiple child threads to print odd and even numbers from 50-100
3. Write a Java program to compare two linked lists. List 1 has the names of 5 colours and list 2 has 4 colours. Print the colours that are not present in both.

Course Outcome 5 (CO 5):

1. Write a GUI based program with separate buttons to add, delete and display student details i.e. name, student ID, current semester and branch of study based on student ID.
2. Using Swing create a JFrame with a JLablel and JButtons. Set the texts of JButtons as "Yes" and "No" respectively. Set the JLabel's text to the text of the Button currently being pressed.Initially the JLabel's text is blank.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24CS1T03

Course Name: OBJECT ORIENTED PROGRAMMING

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Briefly explain the portable, secure and robust features of Java.
2. Describe the concepts of object and class with a suitable Java program.
3. Explain the concept of method overriding with an example.
4. What is the use of the keyword final in Java?
5. Explain the concept of streams.
6. Explain any two applications of Serialization.
7. List any six event listener interfaces.
8. What are Collections in Java? Explain any one Collection interface in Java.
9. Explain any two properties of Swing components in Java.
10. Explain JLabel component. With suitable examples explain any two of its constructors.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Describe in detail any three Object Oriented Programming principles. Illustrate with suitable examples. 9

    (b) What is Java Runtime Environment? What is the role of Java Virtual Machine in it? 5

OR

12. (a) Explain automatic type conversion in Java with an example. What are the two conditions required for it? 6

    (b) Explain in detail the primitive data types in Java. 8

13. (a) Using a suitable Java program explain the difference between private and public members in the context of inheritance. 8

    (b) Is it possible to use the keyword super within a static method? Give justification for your answer. 6

OR

14. (a) Outline the significance of String class in Java and list any of its five built in functions. 5

    (b) Outline the significance of String class in Java and list any of its five built in functions' 9

15. (a) Explain in detail about byte streams and character streams with suitable code samples. 6

    (b) Describe in detail about exception handling, try block and catch clause with the help of a suitable Java program. 8

OR

16. (a) Write a program to establish socket connection between a client and server. Let the client enter two numbers to the server. The server adds the numbers and send back the sum to the client. 8

    (b) Explain throw, throws and finally constructs with the help of a Java program. 6

17. (a) HDescribe in detail the creation of a thread using the Runnable interface and the Thread class with suitable examples. 10

    (b) Explain List Interface. Mention any two exceptions thrown by its methods. 4

OR

18. (a) Explain in detail the Delegation Event model for event handling in Java. 7

    (b) Write a simple program by extending appropriate class to demonstrate the working of threads in java. 7

19. (a) Write a Java program to demonstrate the use of JLabel and JButton by adding them to JFrame. 7

(b) Explain the step-by-step procedure of using Java Database Connectivity in Java programs. 7

OR

20. (a) Explain the class hierarchy of Java Swing components. 7

(b) Write a Java Program to create a student table and to add student details to it using JDBC. 7

B24CS1L01	INDUSTRIAL PROGRAMMING LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The aim of the course is to equip the learners to develop multi-module software solutions for real world computational problems using Python. The students will have a hands-on experience in Python programming environment, syntax, data representations, intermediate level features, GUI programming, Object Oriented Programming and data processing. After the lab session student will be able to design, implement, test, and deploy robust and scalable Python applications for various industrial applications.

Prerequisite

Basic knowledge in Computational Problem Solving

Course Outcomes

After the completion of the course the student will be able to

CO 1	Experiment with concepts of iteration, function, string and list (Cognitive Knowledge level: Apply)
CO 2	Develop python programs which uses tuples, dictionary traversal, dictionary methods, files and operations (Cognitive Knowledge level: Apply)
CO 3	Design turtle graphics and develop graphical user interface for solutions (Cognitive Knowledge level: Apply)
CO 4	Implement Object Oriented programs with exception handling. (Cognitive Knowledge level: Apply)
CO 5	Develop programs in Python to process data stored in files by utilizing NumPy, Matplotlib, and Pandas (Cognitive Knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	1	1	1		1				1
CO 2	2	2	2	1	1	1		1				1
CO 3	2	3	2	1	2	1		1				1
CO 4	2	2	2	1	1	1		1				1
CO 5	2	3	2	1	2	1		1				1

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Viva-Voce/ Test	15 marks
Lab Record	5 marks

SYLLABUS

LIST OF EXPERIMENTS

1	Write a program to find the largest of three numbers.
2	Write a program to print the multiplication table of a number n.
3	Write a program to replace a word by another word in a sentence.
4	Write a program to find Surface area and volume of a cylinder using function.
5	Write a program to confirm the validity of an email id by verifying its format.

6	Write a program to remove duplicates from a list.
7	Write a program to add two matrices.
8	Write a program to read a tuple of numbers and print even tuple and odd tuple.
9	Create a dictionary with a set of book title and corresponding stock. Write a program to update the stock and to add or delete books.
10	A set of numbers are stored in a file. Write a program to print the prime numbers among them.
11	Write a program to count the number of words, sentences, upper case letters, lowercase letters and special symbols in a text stored in file.
12	The Payroll Department keeps a list of employee information for each pay period in a text file. The format of each line of the file is the following: `<last name> <hourly wage> <hours worked>` Write a program that inputs a filename from the user and prints to the terminal a report of the wages paid to the employees for the given period. The report should be in tabular format with the appropriate header. Each line should contain an employee's name, the hours worked, and the wages paid for that period.
13	Write a Python program to find the value for `sin(x)` up to n terms using the series using functions $$\sin(x) = \frac{x}{1!} - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots$$ where x is in degrees.
14	Write a recursive function that expects a pathname as an argument. The pathname can be either the name of a file or the name of a directory. If the pathname refers to a file, its name is displayed, followed by its contents. Otherwise, if the pathname refers to a directory, the function is applied to each name in the directory.
15	Higher order functions: a) Write the code for a mapping that generates a list of the absolute values of the numbers in a list named `numbers`. b) Write the code for a filtering that generates a list of the positive numbers in a list named `numbers`. You should use a lambda to create the auxiliary function. c) Write the code for a reducing that creates a single string from a list of strings named `words`.

16	Turtle graphics: a) Write a menu driven program to draw turtle graphics circle, triangle, square, rectangle, pentagon and hexagon. b) Write a python function to read a shape and display a radial pattern of that shape
17	GUI Programs: a) Temperature Converter: Create a GUI application that allows users to convert temperature between Celsius and Fahrenheit. b) Simple Calculator: Develop a basic calculator application with buttons for arithmetic operations (+, -, *, /) and display for input and output. c) Image Viewer: Create a simple image viewer application that allows users to browse and display images from their computer.
18	Object Oriented Programs: a) Define a student class with attributes such as name, age, and grade. Include methods to calculate the students average grade and display student details. b) Develop a menu-driven program to perform addition, subtraction, and other arithmetic operations on complex numbers. c) Create a menu-driven application for executing arithmetic operations on rational numbers. Employ an exception handling mechanism to manage potential errors. d) Design and implement a blackjack game using Python. The game should allow one player to play against the computerized dealer. The player should be able to hit, stand, double down, and split according to the standard rules of blackjack. Additionally, implement betting functionality where players can place bets before each hand. The game should display the player's hand, the dealer's visible card, and the current balance. Ensure that the game adheres to standard blackjack rules and provides an interactive and enjoyable gaming experience for the player.

19	Data Visualization Using Matplotlib: a) Develop a program to plot a simple line graph using Matplotlib, with data read from a CSV file using Pandas. b) Write a Python script to create a scatter plot of two variables from a CSV file and customize the plot by adding labels, title, and legend using Matplotlib.
20	NumPy: a) Implement a program to generate random data arrays using NumPy and save them to a text file. Then, read the data back from the file and visualize it using Matplotlib. b) Write a Python program to read data from a CSV file using NumPy and perform basic statistical analysis (mean, median, standard deviation, etc.) on the data. c) Implement Matrix multiplication
21	Pandas: a) Create a Python program to read data from an Excel file using Pandas and perform data manipulation operations like filtering, sorting, and grouping. b) Implement a program to merge data from multiple CSV files using Pandas and save the merged data to a new CSV file. Then, visualize the merged data using Matplotlib.

Reference Books

1. Kenneth A Lambert., Fundamentals of Python: First Programs, 2/e, Cengage Publishing, 2016
2. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017
3. Flask: Building Python web services, Jack Stouffer, Shalabh Aggarwal, Gareth Dwyer, PACKT Publishing Limited, 2018
4. Zed A Shaw, Learn Python 3 The Hard Way, Addison-Wesley, 2017
5. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
6. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
7. Charles Severance. Python for Informatics: Exploring Information

B24CS1L02	OBJECT ORIENTED PROGRAMMING LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The aim of the course is to provide hands-on experience to the learners on various object oriented concepts in Java Programming. This course helps the learners to enhance the capability to design and implement various Java applications for real world problems.

Prerequisite

Topics covered under C Programming

Course Outcomes

After the completion of the course the student will be able to

CO 1	Implement the Object Oriented concepts - constructors, inheritance, method overloading and overriding and polymorphism in Java (Cognitive Knowledge Level: Apply)
CO 2	Implement programs in Java which use datatypes, operators, control statements, built in packages and interfaces, Input/Output streams and Files (Cognitive Knowledge Level: Apply)
CO 3	Implement robust application programs in Java using exception handling (Cognitive Knowledge Level: Apply)
CO 4	Implement application programs in Java using multithreading and database connectivity (Cognitive Knowledge Level: Apply)
CO 5	Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2	2	1			1		1		2
CO 2	2	2	2	2	1			1		1		2
CO 3	2	1	2	1	1			1		1		1
CO 4	2	1	2	1	1			1		1		1
CO 5	3	1	3	1	2			1		1		1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Viva-Voce/ Test	15 marks
Lab Record	5 marks

SYLLABUS

LIST OF EXPERIMENTS

1	Write a Java program to check whether a given number is prime or not.
2	Write a Java program to find the second smallest element in an array.
3	Write a Java program that checks whether a given string is a palindrome or not. Ex: MALAYALAM is a palindrome.
4	Write a Java Program to find the frequency of a given character in a string.

5	Write a Java program to multiply two given matrices.
6	Write a Java program which creates a class named 'Employee' having the following members: Name, Age, Phone number, Address, Salary. It also has a method named 'print- Salary( )' which prints the salary of the Employee. Two classes 'Officer' and 'Manager' inherits the 'Employee' class. The 'Officer' and 'Manager' classes have data members 'specialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an officer and a manager by making an object of both of these classes and print the same. (Exercise to understand inheritance)
7	Write a java program to create an abstract class named Shape that contains an empty method named numberOfSides( ). Provide three classes named Rectangle, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method numberOfSides( ) that shows the number of sides in the given geometrical structures. (Exercise to understand polymorphism).
8	Write a Java program using reader/writer class that displays the number of characters, lines and words in a text file.
9	Write a Java program that reads from a file and writes to a file by handling all file related exceptions. (Using FileInputStream and FileOutputStream classes)
10	Write a Java program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use String Tokenizer class of java.util)
11	Write a Java program that shows the usage of try, catch, throws and finally.
12	Write a Java program that implements a multi-threaded program which has three threads. First thread generates a random integer every 1 second. If the value is even, second thread computes the square of the number and prints. If the value is odd the third thread will print the value of cube of the number.
13	Write a Java program that shows thread synchronization.
14	Write a Java program that works as a simple calculator. Arrange Buttons for digits and the + - * % operations properly. Add a text field to display the result. Handle any possible exceptions like divide by zero. Use Java Swing.
15	Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is turned on, and only one light can be on at a time. No light is on when the program starts.
16	Write a Java program to display all records from a table using Java Database Connectivity (JDBC).

Reference Books

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.

2. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11th Edition,

Pearson, 2018.

3. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
4. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
5. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
6. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
7. Sierra K., Head First Java, 2/e, O'Reilly, 2005.
8. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

B24MC1L02	IDEA LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	2	2	P/F	2024

Preamble

This course enables the students to understand the concepts of design, development and documentation tools under various domains in engineering. The various topics covered in this course are concepts of 2D and 3D design, cutting, routing, engraving, milling, slicing, printing and fabrication. Students will be exposed to PCB design and populating. They will learn Microcontroller programming, embedded system design and technical documentation. This course helps students to analyse real-life problems and find solutions using multidisciplinary engineering.

Prerequisite

Higher secondary level Physics and Mathematics

Course Outcomes

After the completion of the course the student will be able to

CO 1	Create 2D and 3D models using appropriate tools. (Cognitive Knowledge Level: Analyse)
CO 2	Design and fabricate circuits using PCB Design and fabrication mechanisms.(Cognitive Knowledge Level: Analyse)
CO 3	Develop project using appropriate Micro controller Programming.(Cognitive Knowledge Level: Apply)
CO 4	Build a product for some applications using design and fabrication technologies.(Cognitive Knowledge Level: create)
CO 5	Create electronic documentation for the system/project using appropriate tools. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	3		2				1	1		
CO 2	1		1		1						1	1
CO 3	2	2	2	2	2	1	1	1	2	2	2	2
CO 4	1	2	3	2	3	2	3	3	3	3	3	3
CO 5						1				3		

Mark Distribution

Total Marks	CIE Marks	ESE Marks (Internal) Micro Project	ESE Duration (Internal) Micro Project Presentation
100	50	50	2 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment	30 marks
Viva-Voce/ Test	10 marks

End Semester Evaluation Pattern:

Micro project Demonstration	20 marks
Micro Project Presentation	20 marks
Micro Project Report	10 marks

Note: The microproject has to be completed by the students as a group of a maximum of four students.

SYLLABUS

LIST OF EXPERIMENTS

Complete at least six experiments and one micro project from the given list.

1	Prepare a 2D and 3D model using any standard tool.
2	Use the 2D model to engrave and cut the acrylic sheet using laser cutter. Assemble the laser-cut parts to fabricate the final model.
3	Use the 2D model for the fabrication of a model by using CNC milling.
4	Use a 3D model to engrave the pattern using CNC milling on the acrylic/wood/plastic block.
5	Use the 3D design for the fabrication of a model by using a 3D printer. Use a slicing software and generate the corresponding G-codes.
6	Write a program to read the input port pins of a micro controller and write the same to the output pins. Use a development board.
7	Write a program to read a sensor (temperature) and display it.
8	Write a program in Arduino IDE for Arduino development board to design a temperature controller. Control the speed of a fan based on the room temperature. Display the temperature on an LCD display.
9	Design a system to display the data send from the embedded system on a GUI in another Embedded system or PC (Wired – UART, I2C, SPI. Wireless – Bluetooth, Wifi)
10	Complete a Microproject. Prepare a technical report using latex for the temperature controller system in the standard template of the university.

Reference Books

1. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing.
2. 3D Printing and Design, Dr. SabrieSoloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
3. The Big Book of Maker Skills: Tools and Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
4. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top Selling Product. Sean Michael Ragan(Author).Weldon Owen;2017.ISBN-13:978-1681881584.
5. Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978- 352137374 .

6. The Art of Electronics. 3^{rd} edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269 .

7. Practical Electronics for Inventors. 4^{th} edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542 .

8. Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 9789352133703.

9. Building Scientific Apparatus. 4^{th} edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586.

10. Programming Arduino: Getting Started with Sketches. 2^{nd} edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633 .

11. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13: 978-1260019193.

12. Pro GIT. 2^{nd} edition. Scott Chacon and Ben Straub. A press. ISBN-13: 9781484200773.

13. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer.

14. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer,2010 .

15. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and Distributors,5^{th} Edition, 2002.

MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.Tech
Artificial Intelligence and Machine Learning

SEMESTER 3

SYLLABUS

SEMESTER 3

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T03C	DISCRETE MATHEMATICS	3-1-0-3	4	4
B	B24CS2T01	DATA STRUCTURES	3-1-0-3	4	4
C	B24CS2T02	COMPUTER ORGANIZATION AND ARCHITECTURE	3-1-0-3	4	4
D	B24CS2T03	COMPUTER NETWORKS	2-1-0-2	3	3
E	B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	3-0-0-3	3	3
G	B24CS2L03	DATA STRUCTURES LAB	0-0-3-3	3	2
H	B24CS2L04	NETWORKING LAB	0-0-3-3	3	2
I	B24MC2T04	UNIVERSAL HUMAN VALUE AND CONSTITUTIONAL RIGHTS	2-0-0-2	2	P/F
J	B24MC2T05	ENERGY CONSERVATION AND ENVIRONMENTAL SUSTAINABILITY	2-0-0-2	2	P/F
M		MINOR	3-1-0-3	4	
		TOTAL		32	22

MINOR

COURSE NO.	COURSES
B24CSM31	PYTHON PROGRAMMING
B24CSM32	MATHEMATICS FOR MACHINE LEARNING
B24CSM33	DATA COMMUNICATION CONCEPTS

B24MA2T03C	DISCRETE MATHEMATICS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

The focus of the course is to build strong mathematical and logical reasoning skills that are essential for tackling more advanced topics in Computer Science. The course helps the learner to apply the theory and applications of elementary Counting Principles, Propositional Logic, Predicate Logic, Lattices, Generating Functions, Recurrence Relations and Algebraic Structures eventually in practical applications

Prerequisites

A solid foundation in higher secondary school Mathematics.

Course Outcomes

After the completion of the course the student will be able to:

CO 1	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 (Cognitive Knowledge Level: Apply)
CO 2	Construct Generating Functions and solve First Order and Second Order Linear Recurrence Relations with Constant Coefficients (Cognitive Knowledge Level: Apply)
CO 3	Examine the validity of predicates in Propositional and Quantified Propositional Logic using truth tables, deductive reasoning and inference theory on Propositional Logic (Cognitive Knowledge Level: Apply
CO 4	Categorize binary relations into various types and illustrate an application of binary relation, Partially Ordered Sets and Lattices, in Computer Science (Cognitive Knowledge Level: Apply)
CO 5	Illustrate the abstract algebraic systems - Semigroups, Monoids, Groups, Homomorphism and Isomorphism of Monoids and Groups(Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2	1								
CO 2	2	2	2	1								
CO 3	2	2	1	1								
CO 4	2	1	1	1		1						
CO 5	2	1	1	1								

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (9 hours)

Counting Techniques:

The Rule of Sum – Extension of Sum Rule. The Rule of Product - Extension of Product Rule. The Binomial Theorem (without proof) Permutations. Combinations. Combination with Repetition. The Pigeonhole Principle. The Principle of Inclusion and Exclusion Theorem (without proof). Derangements.

MODULE 2 (9 hours)

Recurrence Relations and Functions:

Function – domain, range, one to one function, onto function, Image restriction. Generating Function - Definition and Examples, Calculation techniques, Exponential generating function. First-order linear recurrence relations with constant coefficients – homogeneous, non-homogeneous Solution. Second order linear recurrence relations with constant coefficients- homogeneous, non-homogeneous Solution.

MODULE 3 (9 hours)

Mathematical Logic:

Mathematical logic - Basic connectives and truth table, Statements, Logical Connectives, Tautology, Contradiction. Logical Equivalence - The Laws of Logic, The Principle of duality, Substitution Rules. The implication - The Contrapositive, The Converse, The Inverse. Logical Implication - Rules of Inference. The use of Quantifiers - Open Statement, Quantifier. Logically Equivalent – Contrapositive, Converse, Inverse, Logical equivalences and implications for quantified statement, Implications, Negation.

MODULE 4 (9 hours)

Relations:

Cartesian Product - Binary Relation. Properties of Relations- Reachability Relations, Reflexive Relations, Symmetric Relations, Transitive relations, Anti-symmetric Relations, Irreflexive relations Partial Order relations, Equivalence Relations. Partially ordered Set – Hasse Diagram, Maximal-Minimal Element, Greatest element, Least element, Least upper bound (lub), Greatest Lower bound(glb). Equivalence Relations and Partitions - Equivalence Class. Lattice, Sub lattice, Special Lattice, Complete Lattice, Bounded Lattice, Completed Lattice, Distributive Lattice.

MODULE 5 (9 hours)

Algebraic Structures:

Algebraic system-properties- Homomorphism and Isomorphism. Semi group and monoid, sub semi group and sub monoid, Homomorphism and Isomorphism of Semi group and monoids. Group- Elementary properties, subgroup, symmetric group on three symbols, Group Homomorphism, Isomorphism of groups, Cyclic group, Right Coset, Left Coset, Lagrange's Theorem.

Text Books

1. Discrete and Combinatorial Mathematics (An Applied Introduction), Ralph P Grimaldi, B. V Ramana, 8^{th} Ramana, 5th Edition, Pearson.

Reference Books

1. Kenneth H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, MGH, 2011.
2. Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, 2003.
3. Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., New Delhi, 2003.
4. Richard Johnsonbaugh, "Discrete Mathematics", 5/e, Pearson Education Asia, NewDelhi, 2002.
5. Joe L Mott, Abraham Kandel, Theodore P Baker,"Discrete Mathematics for Computer Scientists and Mathematicians", 2/e, Prentice-Hall India, 2009.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Counting Techniques		9 hours
1.1	The Rule of Sum – Extension of Sum Rule	1
1.2	The Rule of Product - Extension of Product Rule	1
1.3	The Binomial Theorem	1
1.4	Permutations	1
1.5	Combinations	1
1.6	Combination with Repetition	1
1.7	The Pigeonhole Principle	1
1.8	The Principle of Inclusion and Exclusion Theorem, Derangements.	2
Module 2: Recurrence Relations and Functions		9 hours
2.1	Function – domain, range, one to one function, onto function, Image restriction.	1
2.2	Generating Function - Definition and Examples, Calculation techniques.	2
2.3	Exponential generating function.	1
2.4	First order linear recurrence relations with constant coefficients – homogeneous.	1
2.5	First order linear recurrence relations with constant coefficients – non-homogeneous.	1
2.6	Second order linear recurrence relations with constant coefficients-homogeneous.	1
2.7	Second order linear recurrence relations with constant coefficients- non-homogeneous.	2
Module 3: Mathematical Logic		9 hours
3.1	Mathematical logic - Basic connectives and truth table.	1

3.2	Statements, Logical Connectives, Tautology, Contradiction.	1
3.3	Logical Equivalence - The Laws of Logic.	1
3.4	The Principle of duality, Substitution Rules, The implication - The Contrapositive, The Converse, The Inverse.	1
3.5	Logical Implication - Rules of Inference.	2
3.6	The use of Quantifiers - Open Statement, Quantifier. Logically Equivalent – Contrapositive, Converse, Inverse.	1
3.7	Logical equivalences and implications for quantified statement, Implications, Negation.	2
Module 4: Relations		9 hours
4.1	Cartesian Product - Binary Relation.	1
4.2	Properties of Relations- Reachability Relations, Reflexive Relations, Symmetric Relations, Transitive relations, Anti-symmetric Relations, Irreflexive relations.	1
4.3	Equivalence Relations.	1
4.4	Partial Order relations.	1
4.5	Partially ordered Set – Hasse Diagram.	1
4.6	Maximal element, Minimal Element, Greatest element, Least element, Least upper bound (lub), Greatest Lower bound(glb).	1
4.7	Equivalence Relations and Partitions - Equivalence Class.	1
4.8	Lattice, Sublattice.	1
4.9	Special Lattice-Complete Lattice, Bounded Lattice, Completed Lattice, Distributive Lattice.	1
Module 5: Algebraic Structures		9 hours
5.1	Algebraic system-properties- Homomorphism and Isomorphism.	1
5.2	Semi group and Monoid.	1
5.3	Sub semi group and Sub monoid, Homomorphism and Isomorphism of Semi group and monoids.	1
5.4	Group- Elementary properties, Subgroup.	1

5.5	Symmetric group on three symbols.	1
5.6	Group Homomorphism, Isomorphism of group.	1
5.7	Cyclic group.	1
5.8	Right Coset, Left Coset, Lagrange's Theorem.	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Solve counting problems by applying the elementary counting techniques- Rule of Sum, Rule of Product, Permutation, Combination, Binomial Theorem, Pigeon-hole Principle and Principle of Inclusion and Exclusion.

1. How many ways are there to place 12 identical marbles of the same colour and size in five distinct jars?
2. Find the number of integers between 1 and 1000 inclusive, which are not divisible by 5, 6 or 8.
3. How many cards must be selected from a deck of 52 cards to guarantee that at least three cards of the same suit are chosen.

Course Outcome 2 (CO 2): Explain Generating Functions and solve First Order and Second Order Linear Recurrence Relations with Constant Coefficients.

1. Solve $a_{n+2} - 2a_{n+1} + a_n = 2^n$.
2. A person invests Rs.100000 at 12% interest compounded annually. How long will it take to double the investment.
3. Find the generating function for the sequence $1, 3, 3^2, 3^3, \ldots$.

Course Outcome 3 (CO 3): Check the validity of predicates in Propositional and Quantified Propositional Logic using truth tables, deductive reasoning and inference theory on Propositional Logic.

1. Negate the statement "Raj is doing his homework and Karen is practicing his piano lessons".

2. Check whether the following arguments is valid. "If today is Tuesday then I have a test in Mathematics or Economics. If my Economics professor is sick then I will not have a test in Economics. Today is Tuesday and my Economics Professor is sick. Therefore, I have a test in Mathematics."

3. Determine the truth value of the given statement where the domain consist of all real numbers.
$$\forall x \exists y (x < y)$$

Course Outcome 4 (CO 4): Classify binary relations into various types and illustrate an application of binary relation, Partially Ordered Sets and Lattices, in Computer Science.

1. If A ={1, 2, 3, 4}, give an example of a relation R that is reflexive and symmetric but not transitive.

2. Let Z be the set of integers. R is a relation called "Congruence Modulo 3" defined by $R = \{(x, y)/x \in Z, y \in Z, x - y$ is divisible by 5 $\}$. Show that R is an equivalence relation.

3. Is $(D_{24}, |)$ a Bounded Lattice?

Course Outcome 5 (CO 5): Illustrate the abstract algebraic systems - Semigroups, Monoids, Groups, Homomorphism and Isomorphism of Monoids and Groups.

1. Give an example of a monoid which is not a group.

2. Show that every cyclic group is Abelian. Is the converse true?

3. Let H and K be subgroups of a group G, where e is the identity of G. Prove that if $|H| = 10$ and $|K| = 21$, then $H \cap K = \{e\}$.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24MA2T03C

Course Name: DISCRETE MATHEMATICS
Common to CSE, CSE(DS), AIML

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Sixteen people are to be seated at two round tables, one of which seats ten people while the other seats 6. How many different seating arrangements are possible?
2. In how many ways can we distribute 8 identical white marbles in 4 distinct containers, so that no jar is left empty?
3. Suppose that the number of bacteria in a colony triples every hour. If 100 bacteria were used to begin the colony, how many bacteria will be there in the colony in 10 hours?
4. Solve the recurrence relation $a_n = 7a_{n-1}$, $n > 0, a_2 = 98$.
5. Write the negation of the following statement. "If I drive, then I will not walk".
6. Show that $(\neg p \vee \neg q) \rightarrow [p \wedge q \wedge r]$ and $p \wedge q$ are logically equivalent.
7. Let $A = \{1, 2, 3, 4, 5\}$ and $B = \{a, b, c, d\}$. How many elements are there in $P(\mathrm{A}{\times}\mathrm{B})$, the power set of $A \times B$.
8. Define Complete Lattice. Give an example.
9. Is the set of integers Z, a semigroup under subtraction? Justify your answer.

10. Let $(A, \cdot)$ be a group. Show that $(ab)^{-1} = b^{-1}a^{-1}$.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) A certain ice cream store has 31 flavours of ice cream available. In how many ways can we order a dozen ice cream cones if, (7)
    i. We do not want the same flavour more than once.
    ii. A flavour may be ordered as many as 12 times.
    iii. A flavour may be ordered no more than 11 times.

    (b) Determine the number of six-digit integers (no leading zeros) in which (7)
    i. No digit may be repeated.
    ii. Digits may be repeated.
    iii. Digits may be repeated and the six-digit integer is even.
    iv. No digit may be repeated and the six digit integer is divisible by 5.

OR

12. (a) In the expansion of $(x + 2y + 3z)^{12}$, determine the coefficient of (7)
    i. x^6y^6
    ii. $x^5y^3z^4$
    iii. x^4y^7z

    (b) In how many ways can the 26 letters of the alphabet be permuted so that none of the patterns car, dog, pun, or byte occurs? (7)

13. (a) Solve the recurrence relation $a_{n+2} - 4a_{n+1} + 3a_n = -200$, $n \geq 0$, $a_0 = 3000$, $a_1 = 3300$. (7)

    (b) In how many ways can a police officer distribute 24 rifle shells to four police officers so that each officer gets at least three shells but not more than eight. (7)

OR

14. (a) Solve the recurrence relation $a_{n+2} + a_n = 0$, $n \geq 0$, $a_0 = 0, a_1 = 3$. (7)

    (b) Determine the coefficient of x^{15} in the expansion of $(x^2 + x^3 + x^4 + ...)^4$. (7)

15. (a) Prove the validity of the following argument:
    "If it does not rain or if there is no traffic dislocation, then the sports day will be held and cultural programmes will go on"; "If the sports day is held, the trophy will be awarded" and "the trophy was not awarded" therefore, "It rained". (7)

    (b) Write the symbolic form of the open statement 'If x is even, then x is not divisible by 5'. Also write its converse, inverse and contrapositive both in symbolic form and in words. (7)

OR

16. (a) Write the dual of the statement $(\neg p \wedge \neg q) \vee (T_0 \wedge p) \vee p$ and use laws of logic to show that it is equivalent to $p \wedge \neg q$. (7)

    (b) Determine the truth value of each of the following statements if the universe comprises all non zero integers. (7)

    i. $\exists x \exists y (xy = 2)$
    ii. $\exists x \forall y (xy = 2)$
    iii. $\exists x \exists y [(4x + 2y = 3) \wedge (x - y) = 1]$

17. (a) Let $A = \{a, b, c\}$ and $Q(A)$, is the set of all proper subsets of A. The relation $\leq$ be the subset relation defined on $Q(A)$. Draw the Hasse diagram of $(Q(A), \leq)$. (7)

    (b) Let R be a relation defined on Z by if aRb if 4 divides $a - b$ Then find all equivalence classes. (7)

OR

18. (a) Let $A = \{1, 2, 3, 4, 6, 8, 12, 24\}$ and R be a relation on A defined by aRb if a divides b. Is R a partial order relation? (7)

    (b) For the partially ordered set $(\{3, 5, 9, 15, 24, 45\}, |)$. Find the (7)

    i. Minimal element
    ii. Greatest element
    iii. All upper bounds of $\{3, 5\}$

19. (a) Show that any group G is abelian if and only if $(ab)^2 = a^2b^2$ for all $a, b \in G$. (7)

    (b) Define semigroup homomorphism. Determine which of the following functions are homomorphism from $(Z^+, +)$ to $(Z^+, \cdot)$.
    (i) $f(n) = n$ (ii) $f(n) = 3^n$ (7)

OR

20. (a) If $A = \{1, 2, 3\}$ list all permutations on A and prove that it is a group. (7)

    (b) State and prove Lagrange's theorem. (7)

B24CS2T01	DATA STRUCTURES	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course facilitates the learner to understand various data structures, their organization, and operations. The course introduces data structures such as stacks, queues, linked lists, binary trees, heaps, and graphs. The learner will be able to assess the most appropriate data structures and associated algorithms for tackling real world problems.

Prerequisites

Problem Solving and Programming Techniques(A) (B24ES1T01A)

Course Outcomes

After the completion of the course, the student will be able to:

CO 1	Develop algorithms to solve problems and evaluate their performance based of time/space complexities expressed using asymptotic notations. (Cognitive Knowledge Level: Apply)
CO 2	Solve problems using simple data structures like arrays and queues for applications involving arithmetic expressions, sparse matrices, polynomials, searching etc. (Cognitive Knowledge Level: Apply)
CO 3	Construct solutions using linked lists for dynamic memory allocation and management. (Cognitive Knowledge Level: Apply)
CO 4	Use suitable non-linear data structures like trees and graphs to represent, store and manipulate hierarchical data efficiently. (Cognitive Knowledge Level: Apply)
CO 5	Make use of various sorting and hashing techniques to increase search efficiency and fast data retrieval. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	2								1
CO 2	3	3	3	2								1
CO 3	3	3	3	3								1
CO 4	3	3	3	3								1
CO 5	3	3	3	2								1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (5 hours)

Basic Concepts of Data Structures:

System Life Cycle, Algorithms, Performance Analysis, Space Complexity, Time Complexity, Asymptotic Notation, Complexity Calculation of Simple Algorithms.

MODULE 2 (10 hours)

Arrays and Searching:

Polynomial representation using Arrays, Sparse matrix, Stacks, Queues- Circular Queues, Priority Queues, Double Ended Queues, Evaluation of Expressions, Linear Search and Binary Search.

MODULE 3 (12 hours)

Linked List and Memory Management:

Self Referential Structures, Dynamic Memory Allocation, Singly Linked List- Operations on Linked List, Doubly Linked List, Circular Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List, Memory allocation and de-allocation, First-fit, Best-fit and Worst-fit allocation schemes.

MODULE 4 (8 hours)

Trees and Graphs:

Trees, Binary Trees- Tree Operations, Binary Tree Representation, Tree Traversals, Binary Search Trees- Binary Search Tree Operations. Graphs, Representation of Graphs, Depth First Search and Breadth First Search on Graphs, Applications of Graphs.

MODULE 5 (10 hours)

Sorting and Hashing:

Sorting Techniques – Selection Sort, Insertion Sort, Quick Sort, Merge Sort, and Heap Sort. Hashing- Hashing Techniques, Collision Resolution, Overflow handling, Hashing functions – Mid square, Division, Folding, Digit Analysis.

Text Books

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Universities Press, Fundamentals of Data Structures in C.

Reference Books

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Fourth Edition, MIT Press.
2. Samanta D., Classic Data Structures, Prentice Hall India.
3. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, 2/e, Cengage Learning.
4. Aho A. V., J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms, Pearson Publication.
5. Tremblay J. P. and P. G. Sorenson, Introduction to Data Structures with Applications, Tata McGraw Hill.
6. Wirth N., Algorithms + Data Structures = Programs, Prentice Hall.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Basic Concepts of Data Structures		5 hours
1.1	System Life Cycle,	1
1.2	Algorithms , Performance Analysis	1
1.3	Space Complexity, Time Complexity	1
1.4	Asymptotic Notation (Big O Notation)	1
1.5	Complexity Calculation of Simple Algorithms	1
Module 2: Arrays and Searching		10 hours
2.1	Polynomial representation using Arrays	1
2.2	Sparse matrix (Lecture 1)	1

2.3	Sparse matrix (Lecture 2)	1
2.4	Stacks	1
2.5	Queues, Circular Queues	1
2.6	Priority Queues,	1
2.7	Double Ended Queues,	1
2.8	Conversion and Evaluation of Expressions (Lecture 1)	1
2.9	Conversion and Evaluation of Expressions (Lecture 2)	1
2.10	Linear Search and Binary Search	1
Module 3: Linked List and Memory Management		12 hours
3.1	Self Referential Structures	1
3.2	Dynamic Memory Allocation	1
3.3	Singly Linked List-Operations on Linked List,	1
3.4	Doubly Linked List	1
3.5	Circular Linked List	1
3.6	Stacks Using Linked List	1
3.7	Queues Using Linked List	1
3.8	Polynomial representation using Linked List(Lecture 1)	1
3.9	Polynomial representation using Linked List(Lecture 2)	1
3.10	Memory de-allocation	1
3.11	Memory allocation-First-fit	1
3.12	Best-fit and Worst-fit allocation schemes	1
Module 4: Trees and Graphs		8 hours
4.1	Trees, Binary Trees	1
4.2	Tree Operations, Binary Tree Representation,	1
4.3	Tree Traversals	1
4.4	Binary Search Trees	1
4.5	Binary Search Tree Operations	1
4.6	Graphs, Representation of Graphs	1

4.7	Depth First Search and Breadth First Search on Graphs	1
4.8	Applications of Graphs	1
Module 5: Sorting and Hashing		10 hours
5.1	Sorting Techniques – Selection Sort	1
5.2	Insertion Sort	1
5.3	Quick Sort	1
5.4	Merge Sort	1
5.5	Heap Sort	1
5.6	Hashing- Hashing Techniques	1
5.7	Collision Resolution	1
5.8	Overflow handling	1
5.9	Hashing functions – Mid square and Division methods	1
5.10	Folding and Digit Analysis methods	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Write an algorithm for matrix multiplication and calculate its time complexity.
2. Explain the importance of time complexity in data structure. Derive the Big O notation for the function $f(n) = 4n^3 + 5n^2 + 7n + 3$.

Course Outcome 2 (CO 2):

1. How a linked list can be used to represent the polynomial $5x^4y^6 + 24x^3y^4 - 17x^2y^3 + 15xy^2 + 45$.Write an algorithm to add two Bivariate polynomials represented using linked list.
2. Write an algorithm to add two polynomials (single variable polynomials) represented using array.

Course Outcome 3 (CO 3):

1. Design a memory allocation system using a doubly linked list where each node represents a memory block (size in KB). Implement the following operations:
   - (a) Allocate memory (insert a node)
   - (b) Free memory (delete a node)
   - (c) Display the available memory blocks

   Simulate a memory allocation scenario where memory blocks (100KB, 200KB, 50KB, 300KB, 150KB) are allocated and then deallocated in a dynamic manner.

2. Consider six memory partitions of size 200 KB, 400 KB, 600 KB, 500 KB, 300 KB and 250 KB. These partitions need to be allocated to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order. Perform the allocation of processes using-
   - (a) First Fit Algorithm
   - (b) Best Fit Algorithm
   - (c) Worst Fit Algorithm

Course Outcome 4 (CO 4):

1. Create a Binary Search Tree with node representing the following sequence 14, 15, 4, 18, 9, 16, 20, 17, 3, 7, 5, 2 and perform inorder, preorder and postorder traversals on the above tree and print the output.

2. Give an algorithm to perform the following operations in a single linked list.
   - (a) Count the number of nodes in a single linked list.
   - (b) Find the number of times a data item called ITEM occurs in the list.

Course Outcome 5 (CO 5):

1. The size of a hash table is 7. The index of the hash table varies from 0 to 6. Consider the keys 89, 18, 49, 58, 25 in the order. Show how the keys are stored in the hash table using Linear probing.

2. What is MAX HEAP? Write an algorithm to perform Heap sort for a set of values 16, 14, 10, 8, 7, 9, 3, 2, 4, 1.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24CS2T01

Course Name: DATA STRUCTURES

Max. Marks: 100 Duration: 3 hours

PART A

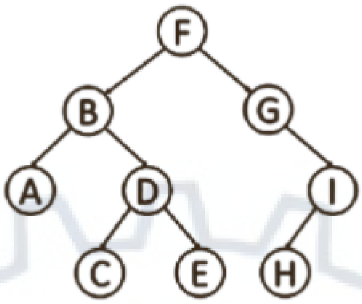
Answer all questions. Each question carries 3 marks.

1. Explain the best case, worst case, average case of linear search algorithm.
2. What is frequency count? Calculate the frequency count of the statement x = x+1; in the following code segment.

```
for (i = 0; i < n; i++)
for (j = 1; j < n; j*=2)
x = x + 1;
```

3. What are the applications of stack?
4. Differentiate between simple queue with circular queue.
5. Write an algorithm to insert an element at the end of doubly linked list. Illustrate with the help of an example.
6. What do you mean by self-referential structure? Give one example.
7. Differentiate between complete binary tree and full binary tree with suitable example.

8. Write the output of inorder, preorder, and postorder traversals on the following tree.



9. Illustrate insertion sort algorithm.

10. What do you mean by Double Hashing? Explain with an example.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Explain any three asymptotic notations used to express the complexity of algorithm with the help of suitable examples. (9)

    (b) Derive Big-O notation for the function f(n) = n^3+2n^2+5. (5)

OR

12. (a) Write an algorithm to find the sum of n numbers and calculate its time complexity. (7)

    (b) Explain various phases in system life cycle. (7)

13. (a) Write the algorithm to add two polynomials represented by arrays and illustrate with an example. (9)

    (b) Write an algorithm to reverse a string using a stack. (5)

OR

14. (a) What do you mean by the data structure Priority Queue? Write algorithms to insert an element into a priority queue. (5)

    (b) Write an algorithm to convert an infix expression into its equivalent postfix expression. Convert the expression ((A/(B-D+E))*(F-G)*H) to postfix form. Show each step in the conversion, including the stack contents. (9)

15. (a) What do you mean by a circular linked list? Write an algorithm to perform insert and delete operations on a circular linked list. (7)

(b) Given five memory partitions of 400Kb, 600Kb, 350Kb, 200Kb, 800Kb (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of 520 Kb, 617 Kb, 200 Kb, and 750 Kb (in order)? (7)

OR

16. (a) Write an algorithm to insert an element at the beginning, end, and intermediate position of a doubly linked list. (7)

    (b) Write an algorithm to append one linked list to another. Explain with an example. (7)

17. (a) Write and discuss algorithm to insert an element to Binary search tree. Show the structure of the binary search tree after adding each of the following values in that order: 2, 5, 1, 7, 10, 9, 11, 6. (7)

    (b) Write and illustrate non-recursive pre-order tree traversal algorithm. (7)

OR

18. (a) Write and illustrate Depth First Search algorithm. (7)

    (b) Explain various graph representations with example. (7)

19. (a) Write and illustrate Merge sort algorithm with a suitable example. (9)

    (b) Write selection sort algorithm with the help of an example. (5)

OR

20. (a) Hash the following keys using open chaining method and closed linear probing method. Size of the table is 11, and the Hash function H(K) = K mod 11. Keys =17, 22, 34, 23, 19, 66. (6)

    (b) Explain any four hash functions with examples. (8)

B24CS2T02	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

The course is prepared with the view of enabling the learners capable of understanding the fundamental architecture of a digital computer. Study of Computer Organization and Architecture is essential to understand the hardware behind the code and its execution at physical level by interacting with existing memory and I/O structure. It helps the learners to understand the fundamentals about computer system design so that they can extend the features of computer organization to detect and solve problems occurring in computer architecture.

Prerequisites

Logic System Design (B24CS1T01)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Comprehend the role of the basic components within a system and describe their importance in the overall functionality and performance of the system (Cognitive Knowledge: Apply)
CO 2	Examine the implementation aspects of arithmetic algorithms for floating-point numbers and provide an overview of pipeline processors, addressing key design issues that impact performance and efficiency. (Cognitive Knowledge Level:Apply)
CO 3	Explore different data transferring schemes, such as direct memory access (DMA), interrupt-driven I/O, and programmed I/O, within a system. Additionally, examine the principles of ALU design, focusing on the execution of arithmetic and logic operations within the processor (Cognitive Knowledge Level: Apply)
CO 4	Illustrate the principles of processor organization by designing various components, such as the Accumulator, status registers, and shifters and developing the control logic to efficiently solve a given arithmetic problem.(Cognitive Knowledge Level: Apply)
CO 5	Apply memory system principles, including RAM, ROM, and cache memory, to optimize performance through placement, replacement ,and update policies. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3									1
CO 2	3	3	3	2	1							1
CO 3	2	2	2	1	1							1
CO 4	3	2	3									1
CO 5	3	2	2		1							1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance — 10 marks

Continuous Assessment Test (2 numbers) — 25 marks

Assignment/Quiz/Course Project — 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (9 hours)

Fundamentals of Computer Organization:

Basic Structure of Computers: Functional Units, Basic Operational Concepts - Complete Instruction Execution, Bus Structures- single bus organization and multiple bus organization, Memory System Basics: Memory Locations and Addresses, Memory Operations, Endianness, Instruction types and Classification, Addressing Modes based on RISC architecture.

MODULE 2 (10 hours)

Floating-Point Computation and Pipelined Processor Architecture:

Floating-Point Numbers and Operations- addition, subtraction, multiplication and division Operations on Floating-Point Numbers, Implementing Floating-Point Operations. Pipelined Processor: Pipelined Datapath, Pipelined Control, Hazards and Solutions: Data, Control and structural Hazards,hazards detection and resolution.

MODULE 3 (7 hours)

I/O Systems and ALU Design:

I/O Fundamentals: I/O Modules, I/O Processing Methods: Programmed I/O, Interrupt-Driven I/O, Direct Memory Access (DMA)-DMA controller, bus arbitration, Design of ALU (Arithmetic and Logic Unit)- Arithmetic Unit Design, Logic Unit Design, ALU design.

MODULE 4 (11 hours)

Processor Organization and Control Unit Design:

Accumulator register design, Shifter Design, status register, processor organization. Control logic design Design: hardwired control design(One Flip-Flop State), software control design (Micro programmed Control), microprogram sequencer-horizontal and vertical micro instruction.

MODULE 5 (8 hours)

Memory Architecture and Cache Optimization Techniques:

Introduction to Memory Systems: Memory Interleaving Techniques, Memory Organization, Semiconductor Memory RAM, ROM, and Types of cache memory: Basic Concepts, Cache Mapping Techniques, Cache Placement, Replacement and Update Policies.

Text Books

1. Computer Organization and Embedded Systems – V. Carl Hamacher, Zvonko G. Vranesic, Safwat G. Zaky, Naraig Manjikian, 6^{th} Edition.
2. Computer Organization and Architecture: Designing for Performance – William Stallings, 10^{th} Edition.
3. Computer System Architecture – M. Morris Mano, 3^{rd} Edition.
4. Digital Design and Computer Architecture – David Money Harris, Sarah L. Harris, 2^{nd} Edition.

Reference Books

1. Computer Architecture: A Quantitative Approach – John L. Hennessy, David A. Patterson, 6^{th} Edition.
2. Structured Computer Organization – Andrew S. Tanenbaum, 6^{th} Edition.
3. Fundamentals of Computer Organization and Architecture – Mostafa Abd-El-Barr, Hesham El-Rewini, 2^{nd} Edition.
4. Modern Processor Design: Fundamentals of Superscalar Processors – John P. Shen, Mikko H. Lipasti, 1^{st} Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Fundamentals of Computer Organization		9 hours
1.1	Basic Structure of Computers: Functional Units	1

1.2	Basic Operational Concepts - Complete Instruction Execution	1
1.3	Bus Structures - Single Bus Organization	1
1.4	Bus Structures - Multiple Bus Organization	1
1.5	Memory System Basics: Memory Locations and Addresses	1
1.6	Memory Operations - Read and Write	1
1.7	Endianness: Big Endian vs. Little Endian	1
1.8	Instruction Types and Classification	1
1.9	Addressing Modes based on RISC Architecture	1
Module 2: Floating-Point Computation and Pipelined Processor Architecture		10 hours
2.1	Floating-Point Numbers and Operations:Implementing Floating-Point numbers	1
2.2	Addition and Subtraction	2
2.3	Multiplication Operations on Floating-Point Numbers	1
2.4	Division Operations on Floating-Point Numbers	1
2.5	Pipelined Processor	1
2.6	Pipelined Datapath	1
2.7	Pipelined Control	1
2.8	Data, Control and Structural Hazards	1
2.9	Hazards detection and resolution	1
Module 3: I/O Systems and ALU Design		7 hours
3.1	I/O Fundamentals: I/O Modules, I/O Processing Method	1
3.2	Programmed I/O, Interrupt-Driven I/O	1
3.3	Interrupt-Driven I/O	1
3.4	Direct Memory Access (DMA)	1
3.5	DMA controller and bus arbitration	1
3.6	Design of ALU (Arithmetic and Logic Unit)Arithmetic Unit Design	1
3.7	Logic Unit Design, ALU design	1

Module 4: Processor Organization and Control Unit Design		11 hours
4.1	Accumulator register design	1
4.2	Shifter Design	1
4.3	Status register	1
4.4	processor organization	1
4.5	Control logic design Design	1
4.6	Hardwired control design(one filp fliop per state)	1
4.7	Hardwired control design(one filp fliop per state)	1
4.8	Software control logic design(micro program control)	1
4.9	Software control logic design (micro program control)	1
4.10	Microprogram sequencer	1
4.11	Horizontal and Vertical micro instruction	1
Module 5: Memory Architecture and Cache Optimization Techniques		9 hours
5.1	Memory interleaving	1
5.2	Memory organization	1
5.3	Semiconductor RAM memories	1
5.4	ROM and types	1
5.5	Cache Memory: Basic Concepts	1
5.6	Cache Mapping Techniques	2
5.7	Cache Replacement Policies	1
5.8	Memory update Policies	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Identify the addressing modes that can be used for representing the following higher level language constructs in machine level. Illustrate each addressing mode using an example.

   (a) Arrays

(b) Pointers
(c) Constants
(d) Variables

2. Illustrate the single bus organization of processor unit with the help of suitable diagrams. Explain, listing the control signals, how the following operations are handled in this organization.
   (a) Move (R6), R2
   (b) Add (R4),(R3)

Course Outcome 2 (CO 2):

1. Identify the various hazard that might occur during the execution of the following instruction i,j,k in a pipeline structure which consists of five stages of instruction, fetch, decode, operation fetch, execute and write?

```
SUB R2, R1, R3
OR R3, R2, [R5]
JUMP LOOP
LOOP: SUB R2, R1, R3
SUB R2, R1, R3
JCLOC
```

2. A computer system using **IEEE 754 single-precision floating-point representation** performs the addition operations on : $3.5 \times 10^5 + 7.5 \times 10^{-4}$.

Course Outcome 3 (CO 3):

1. Design an arithmetic circuit with one selection variable S and two data inputs A and B.When S=0,the circuit performs the addition operation F=A+B,when S=1 the circuit perform increment operation F=A+1.
2. Describe the different I/O processing methods and their impact on system performance.

Course Outcome 4 (CO 4):

1. Design an accumulator with control variables P_1 to P_5, which perform the following arithmetic and logic operations:
   (a) $P_3 : A \leftarrow A \wedge B$ (Bitwise XOR)
   (b) $P_4 : A \leftarrow A \oplus B$ (Bitwise AND)
   (c) $P_5 : A \leftarrow \text{Shl}(A)$ (Logical Shift Right)
2. Compare one flip-flop state control and microprogrammed control in processor design.

Course Outcome 5 (CO 5):

1. How do multi-level caches improve system performance? Provide examples of real-world implementations.
2. Compare Asynchronous DRAMs and Synchronous DRAMs.

MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24CS2T02

Course Name: Computer Organization and Architecture

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Auto increment mode is useful for accessing data items in successive memory locations. Justify the statement.

2. Consider a system with 32bit processor, the program reads the word "BEAUTIFUL", and store it in successive memory locations starting from location 1000.Show the contents of the second and third word in the memory locations when the word is stored in the following format.

   (a) Big-endian format

   (b) Little-endian format

   The ASCII values are as follows:

   - B = 0x42
   - E = 0x45
   - A = 0x41
   - U = 0x55
   - T = 0x54
   - I = 0x49

- F = 0x46
- U = 0x55
- L = 0x4C

3. What is IEEE 754 floating-point representation?
4. How does pipelining improves performance?
5. Differentiate between programmed I/O and interrupt-driven I/O.
6. Consider the designing of Arithmetic circuit. The arithmetic operations can be performed by keeping A as such and making changes to the B value. Design a circuit to accomplish this with the help of a neat diagram.
7. What is the function of a status register in a processor?
8. Differentiate between hardwired and microprogrammed control units.
9. What is the purpose of cache memory in a computer system?
10. Differentiate between direct-mapped and associative cache memory.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Identify the addressing modes that can be used for representing the following higher level language constructs in machine level. Illustrate each addressing mode using an example. (7)
    i. Arrays
    ii. Pointers
    iii. Constants
    iv. Variables

    (b) Illustrate the single bus organization of processor unit with the help of suitable diagrams. Explain, listing the control signals, how the following operations are handled in this organization. (7)
    i. Transfer contents of register R5 to R1
    ii. Move (R6), R2

OR

12. (a) Explain memory addressing in a computer. How does addressing affect system performance? (7)

    (b) Discuss the various addressing modes used in RISC architecture with suitable examples. (7)

13. (a) Explain the steps involved in floating-point addition and subtraction. How are rounding errors handled? (7)

(b) Identify the various hazard that might occur during the execution of the following instruction i,j,k in a pipeline structure which consist of five stages of instruction, fetch, decode, operation fetch, execute and write? (7)

```
SUB R2, R1, R3
OR R3, R2, [R5]
JUMP LOOP
LOOP: SUB R2, R1, R3
SUB R2, R1, R3
JCLOC
```

OR

14. (a) A computer system using **IEEE 754 single-precision floating-point representation** performs the following operations: (7)

A. Addition: $1.5 \times 10^3 + 2.5 \times 10^{-2}$
B. Multiplication: $3.75 \times 10^4 \times 2.0 \times 10^{-3}$

i. Identify any potential precision loss or rounding errors in the operations.
ii. Explain how the system handles normalization during these calculations.

(b) Analyze how performance is measured in pipelined processors. Use an example to illustrate your answer. (7)

15. (a) Explain the working of direct memory access (DMA) and its advantages over traditional I/O methods. (7)

(b) Design an arithmetic circuit with one selection variable S and two data inputs A and B.When S=0,the circuit performs the addition operation F=A+B, when S=1 the circuit perform increment operation F=A+1. (7)

OR

16. (a) Describe the different I/O processing methods and their impact on system performance. (7)

(b) Explain how ALU operations are performed using logic gates and discuss the role of status registers in arithmetic computations. (7)

17. (a) Design an accumulator with control variables P_1 to P_5, which perform the following arithmetic and logic operations: (7)

i. $P_1 : A \leftarrow A + B$ (Addition)
ii. $P_2 : A \leftarrow A'$ (One's Complement)
iii. $P_3 : A \leftarrow A \wedge B$ (Bitwise AND)
iv. $P_4 : A \leftarrow A \oplus B$ (Bitwise XOR)
v. $P_5 : A \leftarrow \text{Shl}(A)$ (Logical Shift Left)

(b) Explain the working of a control unit. How does it influence instruction execution? (7)

OR

18. (a) Design a 4-bit combinational logic shifter which will perform the operations given below with two control variable H1 and H0? (7)

    i. ashr

    ii. Clear

    iii. Load all bits with 1.

    (b) Compare one flip-flop state control and microprogrammed control in processor design. (7)

19. (a) Compare Asynchronous DRAMs and Synchronous DRAMs. (7)

    (b) Describe different cache mapping techniques and compare their effectiveness. (7)

OR

20. (a) What is a DRAM? Compare the two types of DRAMs, highlighting their differences (7)

    (b) How do multi-level caches improve system performance? Provide examples of real-world implementations. (7)

B24CS2T03	COMPUTER NETWORKS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

This course introduces students to a clear understanding of how computer networks from local area networks to the massive and global Internet are built, how they allow computers to share information and communicate with one another. This course explores the physical aspects of computer networks, the layers of the OSI Reference Model, and inter-networking. It enables learners to compare and analyze existing network technologies, helping them select the most suitable network design for a given system.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand the fundamental concepts, types, and applications of computer networks, including network hardware, software, and layered architecture models.(Cognitive Knowledge Level: Understand)
CO 2	Analyze data link layer functionalities, error detection and correction techniques, and medium access control protocols for efficient data transmission.(Cognitive Knowledge Level: Apply)
CO 3	Demonstrate an understanding of network layer operations, including addressing, routing algorithms, and congestion control mechanisms. (Cognitive Knowledge Level: Apply)
CO 4	Examine transport layer services, protocols, flow control, congestion control, and NAT mechanisms.(Cognitive Knowledge Level: Apply)
CO 5	Evaluate application layer protocols, security challenges, and cryptographic techniques to enhance network security and performance.(Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	1	1							2
CO 2	3	3	2	2	2							2
CO 3	3	3	3	3	2							2
CO 4	3	3	3	3	3	1						2
CO 5	2	3	2	3	3	2	1	3				3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Introduction & Physical Layer

Introduction to Computer Networks, Network Hardware and Software, OSI Model: Overview and Functions of Each Layer, TCP/IP Model: Comparison with OSI Model, Physical Layer: Transmission Modes, Signal Encoding Techniques.

MODULE 2 (8 hours)

Data Link Layer

Data Link Layer: Functions and Services, Error Detection and Correction: CRC, Checksum, Flow Control Mechanisms: Stop-and-Wait, Sliding Window Protocols, Medium Access Control (MAC) Protocols:ALOHA, CSMA/CD, CSMA/CA, IEEE 802.3 Ethernet (Wired LAN) and IEEE 802.11 (Wireless LAN).
Case Study: Wireshark Analysis of Ethernet & Wireless LAN.

MODULE 3 (8 hours)

Network Layer

Network Layer Services and Functions, IPv4 Addressing and Subnetting, IPv6 Addressing and Transition Strategies, Routing Algorithms: Shortest Path, Distance Vector, Link State Routing Protocols: RIP, OSPF, BGP, Congestion Control Techniques - Leaky Bucket, Token Bucket, Quality of Service (QoS) Techniques for Network Performance.

MODULE 4 (8 hours)

Transport Layer

Transport Layer Services & Protocols, User Datagram Protocol (UDP) – Features and Applications, Transmission Control Protocol (TCP) – Features, Segment Structure, TCP Connection Establishment and Flow Control TCP Congestion Control Mechanisms - Slow Start, AIMD, Fast Retransmit.
Case Study: Analyzing TCP and UDP Packets using Wireshark.

MODULE 5 (5 hours)

Application Layer and Network Security

Overview of Application Layer Protocols, Domain Name System (DNS) and its Role in the Internet, File Transfer Protocol (FTP) and Simple Mail Transfer Protocol (SMTP), Hypertext Transfer Protocol (HTTP) and World Wide Web (WWW).
Case Study: Cybersecurity Attacks and Network Defense Strategies

Text Books

1. Behrouz A Forouzan, Data Communication and Networking, 4/e, Tata McGraw Hill
2. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI (Prentice Hall India).

Reference Books

1. Larry L Peterson and Bruce S Dave, Computer Networks – A Systems Approach, 5/e, Morgan Kaufmann
2. Fred Halsall, Computer Networking and the Internet, 5/e.
3. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
4. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
5. W. Richard Stevens. TCP/IP Illustrated Volume 1, Addison-Wesley, 2005.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	36 Hours
Module 1: Introduction & Physical Layer		7 hours
1.1	Introduction to Computer Networks: Uses, Types, and Applications	1
1.2	Network Hardware and Software: LAN, WAN, MAN, Internet, Protocols	1
1.3	OSI Model: Overview and Functions of Each Layer	1

1.4	TCP/IP Model: Comparison with OSI Model	1
1.5	Physical Layer: Transmission Modes, Signal Encoding Techniques	1
1.6	Transmission Media: Guided (Twisted Pair, Coaxial, Fiber Optic)	1
1.7	Transmission Media Unguided (Radio, Infrared, Microwave)	1
Module 2: Data Link Layer		8 hours
2.1	Data Link Layer: Functions and Services	1
2.2	Error Detection & Correction: CRC, Checksum, Hamming Code	1
2.3	Flow Control Mechanisms: Stop-and-Wait, Sliding Window Protocols	1
2.4	Medium Access Control (MAC) Protocols: ALOHA, CSMA/CD	1
2.5	Medium Access Control (MAC) Protocols: CSMA/CA	1
2.6	IEEE 802.3 Ethernet (Wired LAN)	1
2.7	IEEE 802.11 (Wireless LAN)	1
Case Study: Wireshark Analysis of Ethernet & Wireless LAN (1 hour)		
Module 3: Network Layer		8 hours
3.1	Network Layer Services & Functions	1
3.2	IPv4 Addressing and Subnetting	1
3.3	IPv6 Addressing and Transition Strategies	1
3.4	Routing Algorithms: Shortest Path, Distance Vector	1
3.5	Routing Algorithms: Link state Routing	1
3.6	Routing Protocols: RIP, OSPF, BGP	1
3.7	Congestion Control Techniques (Leaky Bucket, Token Bucket)	1
3.8	Quality of Service (QoS) Techniques for Network Performance	1
Module 4: Transport Layer		8 hours
4.1	Transport Layer Services & Protocols	1

4.2	User Datagram Protocol (UDP) – Features and Applications	1
4.3	Transmission Control Protocol (TCP) – Features, Segment Structure	1
4.4	TCP Connection Establishment	1
4.5	Flow Control	1
4.6	TCP Congestion Control Mechanisms (Slow Start, AIMD, Fast Retransmit)	1
4.7	TCP Congestion Control Mechanisms Continued.	1
Case Study: Analyzing TCP and UDP Packets using Wireshark (1 hour)		
Module 5: Application Layer and Network Security		5 hours
5.1	Overview of Application Layer Protocols	1
5.2	Domain Name System (DNS) and its Role in the Internet	1
5.3	File Transfer Protocol (FTP) and Simple Mail Transfer Protocol (SMTP)	1
5.4	Hypertext Transfer Protocol (HTTP) and World Wide Web (WWW)	1
Case Study: Cybersecurity Attacks and Network Defense Strategies(1 hour)		

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Compare TCP/IP and OSI reference model.
2. The purpose of physical layer is to transport a raw bit stream from one machine to another. Justify.

Course Outcome 2 (CO 2):

1. Ethernet frames must be at least 64 bytes long to ensure that the transmitter is still going in the event of a collision at the far end of the cable. Fast Ethernet has the same 64-byte minimum frame size but can get the bits out ten times faster. How is it possible to maintain the same minimum frame size?

2. What do you mean by bit stuffing?

Course Outcome 3 (CO 3):

1. Discuss the differences between IPV4 and IPV6.
2. Explain the different types of routing algorithms.

Course Outcome 4 (CO 4):

1. Discuss the differences between TCP and UDP.
2. Enumerate the different congestion control mechanisms in TCP.

Course Outcome 5 (CO 5):

1. Discuss the architecture of WWW.
2. Explain the different types of FTP Commands and replies.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24CS2T03

Course Name: COMPUTER NETWORKS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What does "negotiation" mean when discussing network protocols in a layered architecture? Give an example.
2. Define simplex, half-duplex, and full-duplex transmission modes. Give one example for each.
3. Data link protocols almost always put the CRC in a trailer rather than in a header. Why?
4. An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. What is the binary value after encoding?
5. Illustrate the Count to Infinity problem in routing.
6. Discuss the IPV6 frame format.
7. Explain the TCP Segment Header.
8. Why is Transport layer called true End to End layer? Why is flow control and error control used in Transport layer in addition to data link layer ?
9. Discuss the ports used in FTP?

10. What is SMTP.Explain its features.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Discuss the ISO-OSI model with the help of a neat diagram. (14)

OR

12. (a) Explain the different signal encoding techniques in the physical layer. (8)
    (b) Compare the TCP/IP layer with the ISO-OSI layer in the physical layer. (6)

13. (a) Discuss the GoBackN and selective repeat sliding window protocols. (8)
    (b) Differentiate IEEE 802.3 with IEEE 802.11. (6)

OR

14. (a) Differentiate the different Medium Access Control(MAC) protocols. (14)

15. (a) Explain the different types of routing algorithms. (14)

OR

16. (a) What are the techniques for ensuring good QoS? (8)
    (b) Explain the Leaky Bucket Algorithm. (6)

17. (a) A company is granted the site address 181.56.0.0 (class B). The company needs 1000 subnets. Find the number of possible subnets and the hosts that can be connected to each subnet. (8)
    (b) What are the TCP Congestion control mechanisms. (6)

OR

18. (a) What are the differences between TCP and UDP. (8)
    (b) Describe the structure of UDP Header. (6)

19. (a) Discuss DNS and its role in Internet? (8)
    (b) Explain the different types of FTP Queries and Replies? (6)

OR

20. (a) Discuss the features of SMTP? (8)
    (b) Explain the features of WWW? (6)

B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	0	0	3	3	2024

Preamble

This course will aid and equip the students to comprehend the various concepts in Business Economics and Finance. They will gain an understanding of price, demand, production, costs and revenue. They will also learn about the functioning of various markets and fathom the problems affecting the world of business. They will be introduced to national income accounting and to the financial tools used in personal finance. The students will also gain an insight into business financing and the functioning of the stock market.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand the fundamental concepts and theories of demand, supply, and production to various related economic issues. (Cognitive Knowledge Level: Understand)
CO 2	Understand the concepts relating to costs and revenue to the functioning of firms in different market situations and solve simple business problems using break even analysis. (Cognitive Knowledge Level: Understand)
CO 3	Apply the basic macroeconomic principles to economic concepts influencing the economy as a whole like national income accounting, monetary and fiscal policy, balance of payments and international trade. (Cognitive Knowledge Level: Apply)
CO 4	Make use of the possibilities of financial management to acquire knowledge in the functioning of the Indian financial system and evaluate decisions regarding personal finance. (Cognitive Knowledge Level: Apply)
CO 5	Develop decision making capability by acquiring knowledge in stock markets, mutual funds, business financing and international financing. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1					1	1
CO 2	1	1	1	1	1	1					1	1
CO 3	1	1	1	1	1	1	1				2	1
CO 4	1	1	1	1	1	2		1	1		2	2
CO 5	1	1	1	1	2	2		1	1		2	2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	50	30	30
Understand	50	40	40
Apply		30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (8 hours)

Fundamentals of Business Economics

Introduction – Demand and its determinants – Law of demand – Elasticity of demand: Price, Income and Cross - Measurement of elasticity and its applications (Numerical problems) – Supply and its determinants – Determination of Equilibrium Price – Changes in demand and supply and its effects Utility – Law of diminishing marginal utility - Consumer surplus - Producer surplus. Production concepts: Production function - Cobb Douglas function (Numerical problems) - Average product - Marginal product - Law of variable proportions – Law of Returns to Scale.

MODULE 2 (7 hours)

Cost, Revenue and Markets

Concepts of cost: Opportunity cost - Explicit and implicit cost – Private and social cost- Short run cost curves – Fixed, variable, total, average and marginal cost curves - Long run cost curves.
Concepts of revenue: Average and marginal revenue - Shutdown point - Break Even analysis (Numerical problems).
Markets: Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly - Cartel and Collusion (Features and equilibrium of a firm) - Product pricing: Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming – Administered pricing.

MODULE 3 (7 hours)

National Income, Inflation and International Trade

Circular flow of income - Multi-sector model - National income concepts: GNP, GDP, NNP, NI, PI, DPI, PCI - Methods of measuring national income – Difficulties (Numerical problems).
Inflation –Types - Causes and effects – Measures to control inflation - Monetary and fiscal policies – Deflation.
International Trade - Balance of payments – Components – Deficit - Devaluation – Tariff and non-tariff barriers.

MODULE 4 (7 hours)

Fundamentals of Financial Management

Introduction - Reserve Bank of India – Functions - Credit control techniques: Quantitative and qualitative techniques - Working capital management - Factors affecting working capital - Management of cash and marketable securities - Receivables management - Balance Sheet - Profit and Loss Account.
Personal Finance: Personal budget – Tracking income and expenses - 50-30-20 budgeting rule – Emergency fund – Debit vs Credit instruments – Diversification of Investments –Shares vs Bonds - Power of Compounding – Financial independence – Types of Insurance - Digital technology in Finance.

MODULE 5 (7 hours)

Business Financing

Introduction: The Stock Market: Functions, Problems faced by the stock market in India – Demat account and trading account – Market indices: Sensex and Nifty - Derivatives: Forwards, Futures, Options, Swaps - Mutual Funds – Types.
Sources of business financing: Equity capital - Preference capital - Debenture capital - Term loans - Retained earnings - Money market – Instruments - International Financing - FDI, FII.

Text Books

1. Dominic Salvatore “Principles of Microeconomics”, Oxford University Press, 2009.
2. Gregory N Mankiw, “Principles of Macro Economics”, Cengage Leaning India, 2022.
3. Prasanna Chandra, “Financial Management”, McGraw Hill, 2022.

Reference Books

1. Paul A Samuelson, “Economics”, McGraw Hill, 2019.
2. A. Koutsoyiannis, “Modern microeconomics”, Palgrave McMillan, 1979.
3. Geetika Piyali Ghosh and Chodhury “Managerial Economics”, McGraw Hill, 2017.
4. M Y Khan & P K Jain, “Financial Management”, McGraw Hill, 2018.
5. Ruddar Datt, “Indian Economy”, S.Chand and Company Ltd, 2018.
6. Dwivedi D N, “Macro Economics”, McGraw Hill, 2018.
7. Gregory N Mankiw, “Principles of Micro Economics”, Cengage Leaning India, 2020.
8. James C Van Horne, “Financial Management and Policy”, Pearson Education, 20.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	36 Hours
Module 1: Fundamentals of Business Economics		8 hours
1.1	Introduction - Demand and its determinants – Law of demand – Elasticity of demand – Measurement of elasticity and its applications (Numerical problems).	2
1.2	Supply and its determinants – Determination of equilibrium price – Changes in demand and supply and its effects.	2
1.3	Law of diminishing marginal utility - Consumer surplus - producer surplus	2
1.4	Production concepts: Production function - Cobb Douglas function (Numerical problems) - Average product - Marginal product - Law of variable proportions - Law of Returns to Scale.	2
**Activity 1: OPEC decides to reduce its output of oil. Using demand and supply curves bring out the effect of this on the price of oil in the world market.* *Activity 2: Derive the determination of the equilibrium price of a super luxury and an economy car.*		
Module 2: Cost, Revenue and Markets		7 hours
2.1	Concepts of cost - Opportunity cost - Explicit and implicit cost – Private and social cost- Short run cost curves – Fixed, variable, total, average and marginal cost curves - Long run cost curves.	2
2.2	Concepts of revenue – Average and marginal revenue - Shutdown point – Break Even analysis (Numerical problems).	2
2.3	Markets: Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly - Cartel and Collusion (Features and equilibrium of a firm).	2
2.4	Product pricing: Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming – Administered pricing.	1
Activity 1: Determination of equilibrium price and output in oligopoly companies in India. *Activity 2: Pricing strategy followed by Apple in regard to their mobiles.*		

Module 3: National Income, Inflation and International Trade		7 hours
3.1	Circular flow of income - Multi-sector model - National income concepts – GNP, GDP, NNP, NI, PI, DPI, PCI - Methods of measuring national income – Difficulties (Numerical problems).	2
3.2	Inflation –Types - Causes and effects – Measures to control inflation - Monetary and fiscal policies – Deflation.	2
3.3	International Trade - Balance of payments – Components – Deficit.	2
3.4	Devaluation — Tariff and non-tariff barriers.	1
Activity 1: Compare the present BoP position of India and China. *Activity 2: Impact of tariff wars in today's global scenario.*		
Module 4: Financial Management		7 hours
4.1	Introduction - Reserve Bank of India – Functions - Credit control techniques: Quantitative and qualitative techniques.	2
4.2	Working capital management - Factors affecting working capital.	1
4.3	Management of cash and marketable securities - Receivables management. Balance Sheet - Profit and Loss Account.	2
4.4	Personal Finance: Budget – Tracking income and expenses - 50-30-20 budgeting rule – Emergency fund – Debit vs Credit Cards – Diversification of Investments – Shares vs Bonds - Power of Compounding – Financial independence – Insurance – Types of Insurance - Digital technology in Finance.	2
Activity 1: Investigate the historical returns offered by different asset classes. *Activity 2: Steps needed to circumnavigate financial challenges like student loans, buying a car, purchasing a home vs renting etc.*		
Module 5: Business Financing		7 hours
5.1	Introduction - The Stock Market – Functions, Problems faced by the stock market in India – Demat account and trading account – Market indices: Sensex and Nifty.	3
5.2	Derivatives: Forwards, Futures, Options, Swaps - Mutual Funds – Types.	1

5.3	Sources of business financing: Equity capital - Preference capital - Debenture capital - Term loans - Retained earnings.	2
5.4	International Financing - FDI, FII.	1
Activity 1: Research and present the stock performance of a company. *Activity 2: Investigate the impact of foreign direct investment into India taking the examples of multinational companies.*		

* Activities are a desirable part of the course.

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. State the Law of demand.
2. With the help of a figure, elucidate the concept of consumer surplus.
3. Define utility. State the Law of diminishing marginal utility.

Course Outcome 2 (CO 2):

1. Distinguish between explicit and implicit cost.
2. Bring out the relationship between average and marginal revenue.
3. How does a firm under monopoly attain equilibrium?

Course Outcome 3 (CO 3):

1. With the help of a figure, examine the circular flow of income in a multi sector economy.
2. State the government measures to control inflation.
3. What are non-tariff barriers? Give two examples.

Course Outcome 4 (CO 4):

1. Mention any four functions of the RBI.
2. Elucidate the concept of working capital management. State the main factors influencing it.

3. Clarify the significance of an emergency fund? Mention its advantages.

Course Outcome 5 (CO 5):

1. Elucidate the main problems faced by the stock market in India.
2. Clarify the significance of mutual funds? Mention the main types of mutual funds.
3. Distinguish between FDI and FII.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24HU2T01

Course Name: BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. With the help of a figure, elucidate the concept of consumer surplus.
2. A tea company sold 40000 kg of tea when the price of coffee was Rs.50 per kg. Later they were able to sell 45000 kg when the price of coffee increased to Rs.70 per kg. Calculate the cross elasticity of demand for tea.
3. Distinguish between explicit and implicit cost.
4. List the features of a firm under perfect competition.
5. Define cost plus pricing. Mention its advantage.
6. Write a note on non-tariff barriers. Give two examples.
7. Define Cash Reserve Ratio.
8. Write a note on the significance of receivables management.
9. Distinguish between demat account and trading account.
10. What is FDI? Mention two of its merits.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) State the Law of Demand. Also mention the assumptions and exceptions of the law. (7)

    (b) What is the Cobb- Douglas production function? Mention its feature. If the production function of a firm is $Q = 30L^{1/2}K^{1/2}$, find out the average and marginal product of labour from the function, if 225 units of labour is combined with 196 units of capital. (7)

OR

12. (a) State the Law of diminishing marginal utility. Also mention the assumptions and importance of the law . (7)

    (b) Define Income elasticity. When the income of a consumer was Rs. 50000 per month, the quantity demanded of a good was 100 units. When his income increased to Rs.80000, his demand increased to 110 units. Is the good a normal or an inferior one? Give reason. (7)

13. (a) State the features of a firm under monopolistic competition. With the help of a figure, explain the determination of equilibrium price and output under monopolistic competition. (7)

    (b) A firm sells its product at Rs.400 per unit. To produce a unit, it needs raw materials for Rs. 150, labour for Rs.70 and incurs other variable expenses for Rs. 40.The firms fixed expenses are Rs.15,00,000. Find the breakeven quantity of the firm. (7)

OR

14. (a) State the features of a firm under perfect competition. With the help of a figure, explain the determination of equilibrium price and output under perfect competition. (7)

    (b) The value of the total sales of a company is Rs. 100000. Its fixed cost is Rs. 20000, while its variable cost is Rs.50000. Calculate

    i. the P/V ratio
    ii. breakeven point
    iii. Margin of safety at this level of sales
    iv. If it sells each unit for Rs.20, how many units should the company sell to break even?
    v. Find the sales required to earn a profit of Rs.20000. (7)

15. (a) With the help of a figure, examine the circular flow of income in a multi sector economy. (7)

    (b) From the following data,

    (a) Gross National Product = Rs 14700 crores
    (b) GST = Rs 1100 crores

(c) Undisbursed Profit = Rs 2000 crores
(d) Corporate Income Tax = Rs 1000 crores
(e) Depreciation = Rs 1500 crores
(f) Net Factor Income from abroad = Rs 5200 crores
(g) Income Tax = Rs 500 crores
(h) Subsidies = Rs 400 crores
(i) Social Security Contribution = Rs 300 crores

Calculate

i. GDP
ii. NI
iii. PI (7)

OR

16. (a) Elucidate the economic problem of inflation. What are its main types? State the government measures to control inflation. (7)

(b) In an economy, the total expenditure of the people on various goods and services is Rs 2000 crores. The government spending is Rs 500 crores while the total investment is Rs 300 crores. Exports are Rs 200 crores and imports are Rs. 100 crores. The depreciation is Rs 80 crores. Find the value of GNP. (7)

17. (a) Discuss the functions of the RBI. What are the main quantitative techniques used by the RBI? (7)

(b) State the meaning of balance sheet in accounting. Draw a format of the balance sheet showing the different entries. (7)

OR

18. (a) Write a note on the management of cash and marketable securities. (7)

(b) State the significance of profit and loss account. Illustrate a format of the profit and loss account. (7)

19. (a) Elaborate the main functions performed by the stock market in an economy. (7)

(b) Elucidate the various sources of business financing available to companies. (7)

OR

20. (a) Elaborate the meaning of mutual funds. Discuss the different types of mutual funds. (7)

(b) Distinguish between FDI and FII. (7)

<table>
<tr><td rowspan="2">B24CS2L03</td><td rowspan="2">DATA STRUCTURES LAB</td><td>L</td><td>T</td><td>P</td><td>S</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>2</td><td>2024</td></tr>
</table>

Preamble

The aim of the Course is to give hands-on experience for Learners on creating and using different Data Structures. Data Structures are used to process data and arrange data in different formats for many applications. The most commonly performed operations on data structures are traversing, searching, inserting, deleting and few special operations like merging and sorting.

Prerequisites

Problem Solving and Programming Techniques(A)(B24ES1T01A)

Course Outcomes

After the completion of the course the student will be able to

CO 1	Develop time/space efficient program using arrays/queues/circular queues/priority queues for sorting, searching, arithmetic expression evaluation, polynomial operations, sparse matrices, etc. (Cognitive Knowledge Level: Apply)
CO 2	Implement algorithms and develop programs using linked lists for various user applications. (Cognitive Knowledge Level: Apply)
CO 3	Develop and execute time/space efficient programs using trees and graphs for various applications. (Cognitive Knowledge Level: Apply)
CO 4	Identify and develop the suitable sorting algorithms to sort a given set of records. (Cognitive Knowledge Level: Apply)
CO 5	Experiment with hash tables and apply various collision resolution techniques to solve problems that require fast lookups, insertions and deletions. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	3	2				1		1		2
CO 2	2	3	3	2				1		1		2
CO 3	2	3	3	2				1		1		2
CO 4	2	3	3	2				1		1		2
CO 5	2	3	3	2				1		1		2

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Viva-Voce/ Test	15 marks
Lab Record	5 marks

SYLLABUS

LIST OF EXPERIMENTS

1	Find the sum of two sparse polynomials using arrays.
2	Find the transpose of a sparse matrix and sum of two sparse matrices. *
3	Convert infix expression to postfix (or prefix) and then evaluate using stack.*
4	Implement Stack, Queue, DEQUEUE, and Circular Queue using arrays.*
5	Implement backward and forward navigation of visited web pages in a web browser (i.e. back and forward buttons) using doubly linked list operations.

6	Implement addition and multiplication of polynomials using singly linked lists.
7	Create a binary tree for a given simple arithmetic expression and find the prefix/postfix equivalent.*
8	Implement a dictionary of word-meaning pairs using binary search trees.*
9	Implement the find and replace feature in a text editor.
10	Implementation of searching Algorithms: Linear Search, Binary Search*
11	Implement Insertion Sort, Quick Sort, Heap Sort and Merge Sort and compare the number of steps involved.*
12	Representation of graphs and computing various parameters (in degree, out degree etc.) - adjacency list, adjacency matrix.
13	The General post office wishes to give preferential treatment to its customers. They have identified the customer categories as Defence personnel, Differently abled, Senior citizen, Ordinary. The customers are to be given preference in the decreasing order - Differently abled, Senior citizen, Defence personnel, Normal person. Generate the possible sequence of completion.
14	Implement a spell checker using a hash table to store a dictionary of words for fast lookup. Implement functions to check if a word is valid and to suggest corrections for misspelled words.*
15	The CSE department is organizing a tech fest with so many exciting events. By participating in an event, you can claim for activity points. Each event i gives you A[i] activity points where A is an array. If you are not allowed to participate in more than k events, calculate the max number of points that you can earn?
16	Merge K sorted lists into a single sorted list using a heap. Use a min-heap to keep track of the smallest element from each list. Repeatedly extract the smallest element and insert the next element from the corresponding list into the heap until all lists are merged.
17	Implement a stack using linked list with the operations: a) Push elements to the queue. b) Pop elements from the queue. c) Display the queue after each operation.
18	Implement a Queue using linked list with the operations: a) Insert an elements to the queue. b) Delete an elements from the queue. c) Display the queue after each operation.

19	Write a program to reverse the content of queue using stack expression.
20	Write a program for addition of polynomials containing two variables using linked list.
21	The details of students(number, name, total-mark) are to be stored in a linked list. Write functions for the following operations: a) Insert b) Delete c) Search d) Sort on the basis of number e) Display the resultant list after every operation
22	Create a Doubly Linked List from a string taking each character from the string. Check if the given string is palindrome in an efficient method.
23	Create a binary tree with the following operations a) Insert a new node b) Inorder traversal. c) Preorder traversal. d) Postorder traversal. e) Delete a node.
24	Write a program to create a binary search tree and find the number of leaf nodes
25	Create a binary search tree with the following operations: a) Insert a new node b) Inorder traversal c) Preorder traversal d) Postorder traversal e) Delete a node
26	Write a program to sort a set of numbers using a binary tree.

27	Represent any given graph and * a) Perform a depth first search b) Perform a breadth first search
28	Create a text file containing the name, height, weight of the students in a class. Perform Quick sort and Merge sort on this data and store the resultant data in two separate files. Also write the time taken by the two sorting methods into the respective files. Eg. Sony Mathew 5.5 60 Arun Sajeev 5.7 58 Rajesh Kumar 6.1 70
29	Write a program to sort a set of numbers using Heap sort and find a particular number from the sorted set using Binary Search.
30	Implement a Hash table using Chaining method. Let the size of hash table be 10 so that the index varies from 0 to 9.
31	Implement a Hash table that uses Linear Probing for collision resolution.

* Mandatory

B24CS2L04	NETWORKING LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The course enables the learners to get hands-on experience in network programming using file transfer techniques and network monitoring tools. It covers implementation of network protocols and algorithms, configuration of network services and familiarization of network simulators. This helps the learners to develop, implement protocols and evaluate its performance for real world networks.

Prerequisites

Problem Solving and Programming Techniques(A)(B24ES1T01A), Object Oriented Programming(B24CS1T03)

Course Outcomes

After the completion of the course the student will be able to

CO 1	Demonstrate fundamental network programming concepts. (Cognitive Knowledge Level: Apply)
CO 2	Apply file transfer techniques and multi-threading to develop efficient and concurrent network applications.(Cognitive Knowledge Level: Apply)
CO 3	Analyze network traffic and packet flow.(Cognitive Knowledge Level: Apply)
CO 4	Implement and compare various network protocols, including MAC protocols, routing algorithms, and congestion control mechanisms.(Cognitive Knowledge Level: Apply)
CO 5	Analyze network security measures by designing an Intrusion Detection System. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	1					1	1	1
CO 2	3	3	3	2	1					1	1	1
CO 3	3	2	3	3	1					1	1	1
CO 4	3	3	3	3	1					1	1	1
CO 5	3	2	1	2	1					1	1	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Viva-Voce/ Test	15 marks
Lab Record	5 marks

SYLLABUS

LIST OF EXPERIMENTS

1	(a) Create three programs, two of which are clients to a single server. Client1 will send a character to the server process. The server will decrement the letter to the next letter in the alphabet and send the result to the client2. Client2 prints the letter it receives, and then all the processes terminate. (b) Write a socket program to enable client1 to send a float value to the server. The server process should increase the value of the number it receives by a power of 1.5. The server should print both the value it receives and the value that it sends. Client2 should print the value it receives from the server. (c) Send a C structure that includes data of type character, integer, and float from client1 to the server. The server should change the values so client2 receives a structure with entirely different data. Data should not be converted to any other data type before transmission.*
2	Implement the following using TCP socket: When the server receives a message from a client, it simply converts the message by using following rule: "If a character is a letter or a digit, it will be replaced with the next character in the character set, except that Z will be replaced by A, z by a and 9 by 0. Thus, i becomes j, C becomes D, p becomes q, and so on. Any character other than a letter or a digit will be replaced by a period(.)" and send it back to the client. This sending and receiving message should be repeated until the client and server send a BYEBYE message.*
3	Implement a chat server that allows multiple clients to send and receive messages in real-time using TCP. The server should broadcast messages to all connected clients.
4	Develop a multi-threaded TCP server where each client receives a unique thread to handle requests. Clients should send a number, and the server should return its factorial. Modify the server to handle both TCP and UDP-based requests concurrently.
5	Use Wireshark to capture packets transferred while loading a web page and identify the transport layer protocol used. Analyze the captured packets to extract HTTP request methods and response status codes.*

6	Implement a basic slotted ALOHA protocol where multiple clients try to send packets, and collisions are detected. Extend the program to implement CSMA/CD and simulate collision detection and retransmission.
7	Create three topologies with five nodes and generate FTP traffic for 60 seconds. Generate CBR traffic for a network of 5 nodes and simulate for 150 seconds. Also, create its trace file. Plot TCP throughput using X-graph by varying the number of nodes.
8	Simulate the network for 200 sec and plot the graph of the following: i) TCP throughput vs. simulation time (for every 50secs). ii) TCP packet delays vs. simulation time (for every 50sec). iii) Packet loss vs. simulation time (for every 50sec).*
9	Simulate the Distance Vector Routing with randomly deployed 50 stations. Check for the Count–to–Infinity problem. If it does not exist, then impose the problem and implement any two solutions to resolve the Count-to-Infinity problem in the routing protocol. Simulate 100secs. Measure and plot the network performance in terms of PDR, PLR, routing overhead, and route reconstruction rate for every 10sec interval.*
10	Simulate the link state routing protocol to maintain routing tables as the traffic and topology of the network changes.*
11	a. Simulate the Stop-and-Wait protocol where the sender transmits one packet at a time and waits for an acknowledgment before sending the next packet. Introduce a 5% probability of packet loss and implement retransmission for lost packets. Measure and plot Throughput vs. Simulation Time and Packet Delay vs. Simulation Time for 100 packets. b. Simulate the Go-Back-N protocol with a window size of 4. Implement retransmission of all unacknowledged packets upon detection of a lost packet. Compare the protocol's Throughput and Retransmission Overhead with Stop-and-Wait. c. Simulate the Selective Repeat protocol with a window size of 4, where only lost packets are retransmitted. Introduce a 10% probability of packet loss and measure Packet Delivery Ratio (PDR) vs. Simulation Time. Compare Selective Repeat's performance with Go-Back-N regarding efficiency and delay.*
12	Analyze network performance using Ping and Traceroute commands to measure latency, packet loss, and routing paths. Record and analyze: RTT vs. Packet Loss, RTT vs. Network Delay.*

13	Compare TCP Tahoe and TCP Reno under different traffic conditions using Token Bucket and Leaky Bucket congestion control mechanisms. Simulation Setup Network: 50 nodes, Traffic Levels: Low (5%), Medium (15%), High (25%) Simulation Time: 50 sec (Intervals: 10, 20, 30, 40, 50 sec). Regulate packet transmission based on token availability. Transmit packets at a constant rate, handling bursty traffic. Plot graphs on PDR vs. Simulation Time, Control Overhead vs. Simulation Time, Congestion Rate vs. Simulation Time.*
14	Configure Snort as an Intrusion Detection System (IDS) to monitor network traffic. Capture live packets, detect unauthorized SSH login attempts, and observe alerts. Simulate a DoS attack using excessive ping requests and analyze Snort logs. Perform a port scan using Nmap, detect it and interpret the generated alerts.*

* Mandatory

Reference Books

1. W. Richard Stevens, Bill Fenner, Andy Rudoff, UNIX Network Programming: Volume 1, The Sockets Networking API, 3rd Edition, Pearson, 2015.

2. Lisa Bock, Learn Wireshark: Confidently navigate the Wireshark interface and solve real-world networking problems, Packt Publishing, 2019.

3. Teerawat Issariyakul, Ekram Hossain, Introduction to Network Simulator NS2, 2nd Edition, Springer, 2019.

B24MC2T04	UNIVERSAL HUMAN VALUE AND CONSTITUTIONAL RIGHTS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	0	0	2	P/F	2024

Preamble

This course explores various dimensions of human existence, beginning with self-awareness and an understanding of essential needs such as prosperity, happiness, inner peace, and harmonious relationships. It also introduces the preamble and key features of the Indian Constitution, along with the Directive Principles of State Policy, highlighting their importance in shaping governance and promoting social welfare. By the end of the course, students will be better equipped to act responsibly, address challenges with sustainable solutions, and foster positive human relationships grounded in an understanding of human nature.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand the importance of value education for holistic development and to fulfill human aspirations. (Cognitive Knowledge Level: Understand)
CO 2	Develop more awareness of themselves, and their surroundings(family, society, nature)to build harmonious and respectful relationships.(Cognitive Knowledge Level : Apply)
CO 3	Understand and appreciate the preamble and other features in the Indian Constitution to promote responsible citizenship. (Cognitive Knowledge Level: Understand)
CO 4	Understand the fundamental rights and duties enshrined in the Indian Constitution and the Directive Principles of State Policy and their role in shaping governance and social welfare. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	1	2	1	1	1	2
CO 2						2	2	2	2	2	1	2
CO 3						2	2	2		2		2
CO 4						2	2	2		2		2

Assessment Pattern

Bloom's Category	Continuous Assessment	End Semester Examination (% Marks)
	Test 1 (%Marks)	
Remember	30	30
Understand	60	60
Apply	10	10
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test	
(One test, conducted for 50 marks and reduced to 25)	25 marks
Assignment/Quiz/Course Project/Seminar	15 marks

End Semester Examination Pattern

There will be two parts, Part A and Part B. Part A contains 4 questions carrying 3 marks from each module. Part B contains 2 questions from each module out of which one is to be answered. In Part B, each question of first two modules carries 9 marks and each question of last two modules carries 10 marks.

SYLLABUS

MODULE 1 (6 hours)

Introduction to Values

The Need of Value Education-Guidelines for Value Education, Self-exploration as the Process for Value Education- Two parts, Important implications of Self Exploration, Continuous Happiness and Prosperity - A Look at Basic Human Aspirations-Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)-Method to fulfill the Basic Human Aspirations.

MODULE 2 (5 hours)

Harmony in the Human Being, Family and Society

Understanding Human being as the Co-existence of the Self and the Body- Distinguishing between the Needs of the Self and the Body- Harmony of the Self with the Body- Harmony in the Family – the Basic Unit of Human Interaction- Understanding Harmony in the Society.

MODULE 3 (5 hours)

Introduction to Constitution of India

Definition and Historical Background of the Constitution-Salient Features of the Constitution- Preamble of the Constitution- Union and Its Territory- Meaning and Types of Citizenship- Termination of Citizenship.

MODULE 4 (8 hours)

State Policies and Fundamental Rights

Definition of the State- Fundamental Rights- General Nature and Classification- Right to Equality and Right to Freedom- Right Against Exploitation- Right to Freedom of Religion- Cultural and Educational Rights- Right to Constitutional Remedies- Protection Against Conviction for Offences- Right to Information (RTI) and Its Applications- Directive Principles of State Policy- Classification of Directives- Fundamental Duties.

Text Books

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2023.

2. The Teacher's Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New

Delhi, 2023.

3. D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 26/e, 2022.
4. P M Bhakshi, The constitution of India, Universal Law, 19/e, 2023.

Reference Books

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi,2006.
3. Ministry of Law and Justice, The constitution of India, Govt of India, New Delhi,2019.
4. J N Pandey, The constitutional Law of India, Central Law Agency, Allahabad, 51e,2019.
5. M V Pylee, Indias Constitution, S Chand and Company, New Delhi,16e, 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	24 Hours
Module 1: Introduction to Values		6 hours
1.1	The Need of Value Education-Guidelines for Value Education	1
1.2	Self-exploration as the Process for Value Education-Two Parts	1
1.3	Important implications of Self Exploration	1
1.4	Continuous Happiness and Prosperity -A Look at Basic Human Aspirations	1
1.5	Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)	1
1.6	Method to fulfill the Basic Human Aspirations	1

Module 2: Harmony in the Human Being, Family and Society		5 hours
2.1	Understanding Human being as the Co-existence of the Self and the Body	1
2.2	Distinguishing between the Needs of the Self and the Body	1
2.3	Harmony of the Self with the Body	1
2.4	Harmony in the Family – the Basic Unit of Human Interaction	1
2.5	Understanding Harmony in the Society	1
Module 3: Introduction to Constitution of India		5 hours
3.1	Definition and Historical Background of the Constitution	1
3.2	Salient Features of the Constitution	1
3.3	Preamble of the Constitution-Union and Its Territory	1
3.4	Meaning and Types of Citizenship	1
3.5	Termination of Citizenship	1
Module 4: State Policies and Fundamental Rights		8 hours
4.1	Definition of the State- Fundamental Rights- General Nature and Classification	1
4.2	Right to Equality and Right to Freedom-Right Against Exploitation- Right to Freedom of Religion	1
4.3	Cultural and Educational Rights- Right to Constitutional Remedies	1
4.4	Protection Against Conviction for Offences	1
4.5	Right to Information (RTI) and Its Applications	1
4.6	Directive Principles of State Policy	1
4.7	Classification of Directives	1
4.8	Fundamental Duties	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Explain the basic guidelines for value education. What is the need for these guidelines.
2. Explain the process of self-exploration. What is the expected result of self-exploration?
3. What are the basic human aspirations and what are the requirements to fulfill them? Support your answer with two examples.

Course Outcome 2 (CO 2):

1. Distinguish between 'animal consciousness' and 'human consciousness'.
2. 'Relationship is – between one Self (I1) and another Self (I2)'. Examine this statement.
3. What is the building block for harmony in the society? Explain with examples.

Course Outcome 3 (CO 3):

1. Describe the historical background of the Indian Constitution.
2. Explain the salient features of the Indian constitution.
3. Summarize the importance of preamble in the implementation of constitution.

Course Outcome 4 (CO 4):

1. What are fundamental rights? Examine each of them.
2. Examine the scope of freedom of speech and expression underlying the constitution.
3. Explain the concept of Union and its territory.
4. What is the Fee for seeking information from Central Government Public Authorities?
5. Explain the provision of appeal under the RTI Act.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24MC2T04

Course Name: Universal Human Values and Constitutional Rights

Max. Marks: 50 Duration: 2 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Identify the solution which helps human being to transform from animal Consciousness to human consciousness.
2. What is the building block for harmony in the society?
3. Define and explain the term Constitution.
4. "The freedom of speech and expression is subject to reasonable restrictions". Explain the statement.

PART B

Answer any one question from each module.

5. Explain the basic guidelines for value education. What is the need for these guidelines. (9)

OR

6. Choose any five things that you consider as human values. Write all the basic guidelines, and check if they satisfy the basic guidelines. (9)

7. Distinguish between 'animal consciousness and 'human consciousness'. (9)

OR

8. "Relationship is – between one Self(I1) and another Self(I2)". Examine this statement. (9)

9. Summarize the various methods of acquiring Indian citizenship. (10)

OR

10. Examine the salient features of the Indian constitution. (10)

11. Explain the meaning, significance and classification of the Directive Principles of State Policy. (10)

OR

12. Explain the fundamental duties of an Indian Citizen. (10)

B24MC2T05	ENERGY CONSERVATION AND ENVIRONMENTAL SUSTAINABILITY	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	0	0	2	P/F	2024

Preamble

This course aims to equip students with fundamental knowledge of energy resources, the need for energy conservation, and the importance of environmental sustainability. It emphasizes the role of engineers in adopting renewable energy technologies, reducing environmental impact, and promoting sustainable development for a greener and more resilient future.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Classify various energy resources and describe the importance of energy conservation (Cognitive Knowledge Level: Understand)
CO 2	Explain the principles of renewable energy systems and their applications (Cognitive Knowledge Level: Understand)
CO 3	Recognize major environmental impacts due to energy consumption and explain basic pollution control measures. (Cognitive Knowledge Level: Understand)
CO 4	Describe sustainability concepts and apply simple strategies for environmental protection and green practices in day-to-day engineering tasks (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2					2	3	1		1		2
CO 2	2					2	3	1		1		2
CO 3	2					2	3	1		1		3
CO 4	2					3	3	1		1		3

Assessment Pattern

Bloom's Category	Continuous Assessment	End Semester Examination (% Marks)
	Test 1 (%Marks)	
Remember	30	30
Understand	50	50
Apply	20	20
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (1) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 4 questions carrying 3 marks each. Part B contains 2 questions from each module out of which one has to be answered. In part B, each question of the first two modules carries 9 marks and each question of the last two modules carries 10 marks.

SYLLABUS

MODULE 1 (6 hours)

Energy Resources and Conservation

Types of Energy Resources: Renewable and Non-renewable (with examples), Global and Indian Energy Scenarios, Importance of Energy Conservation, Energy Policy and Planning.

Energy Auditing and Efficiency Improvement Techniques - Case studies, Energy-efficient Buildings and Smart Cities.

MODULE 2 (6 hours)

Renewable Energy Technologies

Solar Energy, Wind Energy, Other Renewable Sources: Biomass and bioenergy systems, small hydropower, ocean thermal, wave, and tidal energy, Geothermal energy.
Energy Storage and Smart Grid Integration: Battery technologies - Role in renewable energy conservation and stability - Decentralized generation and net metering, Advanced and Emerging Technologies: Green hydrogen - Floating solar farms - Offshore wind.

MODULE 3 (6 hours)

Environmental Impact and Pollution Control

Pollution Types and Sources: Air pollution: industrial emissions, vehicular sources - Water pollution: domestic, industrial, agricultural waste - Soil pollution: hazardous waste, agrochemicals, Pollution Control Methods: Physical, chemical, biological techniques - Air & water treatment technologies.

Climate Change and Global Warming: Greenhouse gases and carbon footprint - International agreements, Waste Management Strategies - 3Rs (Reduce, Reuse, Recycle) - waste-to-energy, Environmental Regulations in India: Environmental Protection Act, Air & Water Acts - Hazardous Waste Management Rules, Carbon Neutrality and Zero-emission Policies.

MODULE 4 (6 hours)

Sustainability and Green Practices

Principles of Sustainable Development: Intergenerational equity, resource efficiency - Link with UN Sustainable Development Goals (SDGs), Green Buildings and Infrastructure, Green Certification Systems, Carbon Credits.

Carbon Pricing and Energy Subsidies: Internal carbon pricing by organizations - Government schemes, Life Cycle Assessment (LCA): Phases of LCA: Goal definition, inventory, impact assessment - Smart Sustainable Cities and Resilient Infrastructure: Urban planning for sustainability.

Text Books and References

1. Charles M. Gottschalk, Industrial Energy Conservation, John Wiley & Sons, 1996.
2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers
3. R.R. Rao, Environmental Science and Engineering, PHI
4. Craig B. Smith, Energy Management Principles, Pergamon Press.
5. Paul O'Callaghan, Energy Management, McGraw Hill Book Co.
6. Wayne C. Turner, Energy Management Hand Book, The Fairmount Press, Inc., 1997.
7. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
8. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	24 Hours
Module 1: Energy Resources and Conservation		6 hours
1.1	Types of Energy Resources (Renewable and Non-renewable), examples. Global and Indian Energy Scenario: Consumption and production trends, sector-wise demand	1
1.2	Energy Conservation: Residential, Industrial, Transport sectors – behavioural & technological interventions	1
1.3	Energy Policy and Planning: National Energy Policy, Energy Conservation Act, BEE initiatives	1
1.4	Energy Auditing: Preliminary & Detailed audits, Performance Indicators, Case Studies	2

1.5	Energy-efficient Buildings & Smart Cities: Passive design, daylighting, automation	1
Module 2: Renewable Energy Technologies		6 hours
2.1	Solar Energy: PV systems, solar thermal, rooftop/grid-tied applications	1
2.2	Wind Energy: Onshore/offshore systems, hybrid solar-wind systems	1
2.3	Other Renewables: Biomass, small hydro, ocean, tidal, geothermal energy	1
2.4	Energy Storage: Battery types, conservation role, stability, smart grid integration	1
2.5	Smart Grids and Net Metering: Decentralized generation	1
2.6	Advanced Technologies: Green hydrogen, floating solar farms, offshore wind	1
Module 3: Environmental Impact and Pollution Control		6 hours
3.1	Pollution Types: Air, water, and soil pollution – sources and effects	1
3.2	Pollution Control: Physical, chemical, and biological treatment methods	1
3.3	Climate Change: GHGs, carbon footprint, international agreements (Kyoto, Paris)	1
3.4	Waste Management: Solid, liquid, biomedical, hazardous – 3Rs, waste-to-energy, Environmental regulations	1
3.5	Carbon Neutrality: National missions, zero-emission policies, corporate initiatives	1
3.6	Circular Economy: Waste elimination	1
Module 4: Sustainability and Green Practices		6 hours
4.1	Sustainable Development: Principles, SDGs, resource efficiency	1
4.2	Green Buildings: Concepts, features, materials, passive design, renewables integration, green certifications	1
4.3	Carbon Credits: Earning, trading, CDM, voluntary carbon markets	1

4.4	Carbon Pricing and Subsidies: Internal pricing, UJALA, PM-KUSUM, FAME	1
4.5	Life Cycle Assessment (LCA): Phases, case studies	1
4.6	Smart Cities and Resilience: Urban planning	1
Students shall present a seminar based on case studies of Life Cycle Assessment (LCA) conducted on a product of their choice.		

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. List the major renewable and non-renewable energy sources with suitable examples.
2. Explain the significance of energy conservation in the industrial and domestic sectors.
3. Describe the importance of energy conservation in the context of the global and Indian energy scenario.

Course Outcome 2 (CO 2):

1. Describe the working principle of solar photovoltaic and solar thermal systems.
2. Compare wind energy and small hydropower systems based on availability, reliability, and applications.
3. Explain the role of energy storage and smart grid integration in ensuring renewable energy reliability.

Course Outcome 3 (CO 3):

1. Identify major sources of air and water pollution in urban areas.
2. Explain the role of battery storage and smart grid integration in enhancing the efficiency of renewable energy systems.
3. Apply the concept of 3Rs to develop a basic household or institutional waste management plan.

Course Outcome 4 (CO 4):

1. Describe the concept of sustainable development and its connection with UN Sustainable Development Goals (SDGs).
2. Explain the basic features of green buildings and the benefits of green certification.
3. Describe simple green practices that can be adopted by engineers in daily professional work to promote environmental sustainability.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24MC2T05

Course Name: ENERGY CONSERVATION AND ENVIRONMENTAL SUSTAINABILITY

Max. Marks: 50 Duration: 2 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List any three renewable energy sources with one example each.
2. Explain the concept of net metering in decentralized energy generation.
3. What are the major sources of air pollution in urban areas?
4. Describe any two strategies for promoting sustainability in everyday engineering practices.

PART B

Answer any one question from each module.

5. (a) Classify energy resources with examples. (4)

   (b) Explain the significance of energy conservation in the Indian context. (5)

OR

6. (a) Describe energy auditing and mention any two efficiency improvement techniques. (5)
   (b) What is the role of energy-efficient buildings in smart city development? (4)

7. (a) Explain the working principle of wind turbines with a neat diagram. (5)
   (b) Describe any two advanced renewable energy technologies. (4)

OR

8. (a) Discuss the types and role of energy storage systems in renewable energy. (5)
   (b) Explain the concept of smart grid integration. 4)

9. (a) What are the major environmental impacts of energy consumption? (4)
   (b) Explain physical, chemical, and biological methods of water pollution control. (6)

OR

10. (a) Describe the working of waste-to-energy technologies. (5)
    (b) List and briefly explain any two environmental regulations in India. (5)

11. (a) Define sustainable development and explain its principles. (4)
    (b) What are carbon credits and how do they promote sustainability (6)

OR

12. (a) Explain the key phases of Life Cycle Assessment (LCA). (5)
    (b) What is the importance of green buildings and certification systems in achieving sustainable urban infrastructure? (5)

B24CSM31	PYTHON PROGRAMMING (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course provides a comprehensive introduction to Python, covering fundamental programming concepts, selection structures, functions, loops, data structures, recursion, and file handling. By the end of the course, learners will have gained essential programming skills, enabling them to develop efficient algorithms and work with real-world data effectively.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Demonstrate an understanding of fundamental programming concepts, selection structures, and basic graphics programming in Python.(Cognitive knowledge level:Apply)
CO 2	Implement and analyze functions, loops, and string manipulations to solve computational problems efficiently.(Cognitive knowledge level:Apply)
CO 3	Utilize data structures such as lists, tuples, dictionaries, and sets to store, retrieve, and manipulate data effectively.(Cognitive knowledge level:Apply)
CO 4	Develop modular programs using functions, recursion, and abstraction techniques to enhance code reusability and problem-solving skills.(Cognitive knowledge level:Apply)
CO 5	Handle files and exceptions in Python, including text and binary file operations, to manage data and ensure robust program execution.(Cognitive knowledge level:Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	2	1							1
CO 2	3	3	3	2	2							1
CO 3	3	3	3	3	3	1	1					1
CO 4	3	3	3	3	3	1	1					2
CO 5	3	3	2	2	3	1	1					2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember			
Understand	20	20	20
Apply	40	40	40
Analyse	40	40	40
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance — 10 marks

Continuous Assessment Test (2 numbers) — 25 marks

Assignment/Quiz/Course Project — 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Introduction to Python and Selection Structures

Programming Languages and Operating Systems, The History of Python, Getting Started with Python, Programming Style and Documentation.
Selections-Boolean Types, Values, and Expressions, Generating Random Numbers, if Statements, if-else, Nested if, Conditional Expressions, Logical Operators and Operator Precedence.
Case Studies: BMI Calculation, Computing Taxes, Leap Year, Lottery.

MODULE 2 (9 hours)

Functions, Strings, and Loops

Mathematical Functions, Strings, and Objects, Common Python Functions, Strings and Characters, String Methods, Formatting Numbers and Strings, Introduction to Objects and Methods.
Case Study: Revising the Lottery Program.
Loops -The while Loop and for Loop,Nested Loops, Loop Design Strategies,Controlling a Loop with User Confirmation,break and continue Statements.
Case Study: Checking Palindromes, Displaying Prime Numbers.

MODULE 3 (10 hours)

Lists, Tuples, Set and Dictionaries

Lists - List Basics, Copying, Searching, and Sorting Lists, Passing Lists to Functions, Returning Lists from Functions.
Case Study: Analyzing Numbers, Counting the Occurrences of Each Letter.
Tuples, Sets, Comparing the Performance of Sets and Lists, Dictionaries.
Case Study: Counting Keywords. Dictionaries and Word Occurrences.

MODULE 4 (9 hours)

Functions and Recursion

Functions- Defining and Calling Functions, Functions with/without Return Values, Positional and Keyword Arguments, Passing Arguments by Reference Values, Modularizing Code, The Scope of Variables. Function Abstraction and Stepwise Refinement.
Case Study: Generating ASCII Characters, Converting Hexadecimal to Decimal. Recursion.Problem Solving Using Recursion, Recursive Helper Functions.Recursion vs. Iteration, Tail Recursion.
Case Study: Computing Factorials, Fibonacci Numbers.

MODULE 5 (10 hours)

Files and Exception Handling

Files and Exception Handling -Text Input and Output, File Dialogs.Modules. Case Study: Counting Each Letter in a File, Retrieving Data from the Web
Exception Handling Basics, Raising Exceptions, Processing Exceptions Using Exception Objects, Defining Custom Exception Classes, Binary I/O Using Pickling.
Case Study: Address Book.

Text Books

1. Introduction to Python Programming and Data Structures by Y. Daniel Liang.

Reference Books

1. Python Programming: An Introduction to Computer Science by John Zelle.
2. Python Crash Course by Eric Matthes.
3. Think Python: How to Think Like a Computer Scientist by Allen B. Downey.
4. Data Structures and Algorithms in Python by Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser.
5. Automate the Boring Stuff with Python by Al Sweigart.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Introduction to Python and Selection Structures		7 hours
1.1	Programming Languages and Operating Systems, The History of Python	1
1.2	Getting Started with Python, Programming Style and Documentation.	1
1.3	Selections-Boolean Types, Values, and Expressions.	1
1.4	Generating Random Numbers	1
1.5	if Statements, if-else, Nested if	1
1.6	Conditional Expressions	1
1.7	Logical Operators and Operator Precedence.	1
Module 2: Functions, Strings and Loops		9 hours
2.1	Mathematical Functions, Strings, and Objects	1
2.2	Common Python Functions	1
2.3	Strings and Characters, String Methods, Formatting Numbers and Strings,	1
2.4	Introduction to Objects and Methods.Case Study: Revising the Lottery Program.	1
2.5	Loops -The while Loop and for Loop	1
2.6	Nested Loops, Loop Design Strategies	1
2.7	Controlling a Loop with User Confirmation	1
2.8	break and continue Statements	1
Case Study: Checking Palindromes, Displaying Prime Numbers (1 hour)		
Module 3: Lists, Tuples, Set and Dictionaries		10 hours
3.1	List Basics	1
3.2	Copying, Searching, and Sorting Lists	1
3.3	Passing Lists to Functions	1
3.4	Returning Lists from Functions	1

Case Study: Analyzing Numbers (1 hour)		
3.5	Counting the Occurrences of Each Letter	1
3.6	Tuples, Sets	1
3.7	Comparing the Performance of Sets and Lists	1
3.8	Dictionaries	1
Case Study: Counting Keywords, Word Occurrences (1 hour)		
Module 4: Functions and Recursion		9 hours
4.1	Defining and Calling Functions	1
4.2	Functions with/without Return Values	1
4.3	Positional and Keyword Arguments, Passing Arguments by Reference Values	1
4.4	Modularizing Code, The Scope of Variables	1
4.5	Function Abstraction and Stepwise Refinement	1
Case Study: Generating ASCII Characters, Converting Hexadecimal to Decimal (1 hour)		
4.6	Recursion, Problem Solving Using Recursion, Recursive Helper Functions	1
4.7	Recursion vs. Iteration, Tail Recursion	1
Case Study: Computing Factorials, Fibonacci Numbers (1 hour)		
Module 5: Files and Exception Handling		10 hours
5.1	Text Input and Output	1
5.2	File Dialogs, Modules	1
Case Study: Counting Each Letter in a File(1 hour)		
5.3	Retrieving Data from the Web	1
5.4	Exception Handling Basics	1
5.5	Raising Exceptions	1
5.6	Processing Exceptions Using Exception Objects	1
5.7	Defining Custom Exception Classes	1
5.8	Binary I/O Using Pickling	1
Case Study: Address Book(1 hour)		

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Explain the impact of programming languages on computational problem-solving and how Python simplifies this process.
2. Discuss the significance of structured programming and how Python enforces structured coding practices.

Course Outcome 2 (CO 2):

1. Explain the difference between iterative and recursive approaches in problem-solving, with examples.
2. Discuss how string manipulation techniques are used in data processing applications such as text analytics.

Course Outcome 3 (CO 3):

1. Explain how Python lists can be used to implement stack and queue data structures.
2. Discuss the applications of dictionaries in real-world scenarios such as database indexing and caching.

Course Outcome 4 (CO 4):

1. Discuss the role of higher-order functions in Python and explain their significance in functional programming.
2. Explain the advantages and challenges of recursive algorithms compared to iterative approaches.

Course Outcome 5 (CO 5):

1. Discuss how file handling in Python is used for data persistence in real-world applications.
2. Explain the role of exception handling in debugging and improving the reliability of Python programs.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24CSM31

Course Name: PYTHON PROGRAMMING (MINOR)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What are the different types of programming errors in Python?
2. Explain the significance of the if-else statement in decision-making
3. What is the difference between while and for loops in Python?
4. Explain any two string methods in Python with examples.
5. How does a Python dictionary differ from a list?
6. Explain the significance of the set data structure in Python.
7. What is the difference between positional and keyword arguments in Python functions?
8. Explain the concept of tail recursion with an example.
9. What is the difference between text I/O and binary I/O in Python?
10. Explain how exception handling improves program robustness in Python.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Discuss the evolution of Python as a programming language and compare it with other popular languages. (7)
    (b) Explain the role of selection structures (if, if-else, nested if) in decision-making, with relevant examples like tax computation. (7)

OR

12. (a) Describe different types of programming errors in Python. How can they be identified and resolved? (7)
    (b) Explain the concept of Boolean expressions and logical operators in Python with practical use cases. (7)

13. (a) Discuss the importance of functions in Python programming. How do functions improve code modularity and reusability? (7)
    (b) Explain different loop control mechanisms in Python (break, continue, while, for) with case studies. (7)

OR

14. (a) Compare and contrast string manipulation techniques in Python with examples. (7)
    (b) Discuss how mathematical functions and string formatting techniques are applied in real-world scenarios. (7)

15. (a) Compare and contrast lists, tuples, and dictionaries in Python. Explain their advantages and best-use cases. (7)
    (b) Discuss various list operations (insertion, deletion, sorting, searching) and their applications in real-world scenarios. (7)

OR

16. (a) Explain how dictionaries in Python are used for mapping data efficiently. Provide examples of word count applications. (7)
    (b) Discuss the performance differences between sets and lists in Python and explain when to use each data structure. (7)

17. (a) Discuss function abstraction and stepwise refinement in Python, explaining how it improves software development. (7)
    (b) Explain recursion with case studies on factorial computation, Fibonacci series, and the Tower of Hanoi. (7)

OR

18. (a) Compare iteration and recursion in Python, discussing their advantages and disadvantages. (7)

(b) Explain the scope of variables in Python functions. How does variable scope impact program execution and debugging? (7)

19. (a) Discuss the importance of file handling in Python. Explain how text and binary files are processed with examples. (7)

(b) Explain the concept of exception handling in Python and how it enhances program robustness. Provide case studies. (7)

OR

20. (a) Discuss how Python interacts with external resources like file storage. Provide real-world examples. (7)

(b) Explain how custom exception handling can be implemented in Python. Discuss the role of defining custom exception classes. (7)

<table>
<tr><td rowspan="2">B24CSM32</td><td rowspan="2">MATHEMATICS FOR MACHINE LEARNING (Minor)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>CREDIT</td><td>YEAR OF INTRODUCTION</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>3</td><td>4</td><td>2024</td></tr>
</table>

Preamble

This course provides learners the mathematical foundation necessary for understanding and developing machine learning models. The course covers Linear Algebra, Vector Calculus, Probability and Distributions, Optimization and Machine Learning problems. Since machine learning relies heavily on concepts from several branches of mathematics, this course equips students with essential skills to grasp the underlying principles of various algorithms and aid in the creation of new Machine Learning solutions, understand & debug existing ones, and learn about the inherent assumptions & limitations of the current methodologies.

Prerequisites

A sound background in higher secondary school Mathematics.

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Apply the concepts of linear equations, matrices, vector spaces, linear independence, basis, and rank to solve problems, and use linear mappings, matrix representation, and basis changes in computational applications. (Cognitive Knowledge Level: Apply)
CO 2	Apply concepts from analytic geometry, matrix decompositions, orthogonality, eigenvalues, eigenvectors, and singular value decomposition (SVD) to solve problems related to matrix approximations, dimensionality reduction, and data transformations.(Cognitive Knowledge Level: Apply)
CO 3	Perform calculus operations on functions of several variables and matrices, including partial derivatives and gradients (Cognitive Knowledge Level: Apply)
CO 4	Utilize the concepts, rules and results about probability, random variables, additive and multiplicative rules, conditional probability, probability distributions and Bayes theorem to find solutions of computational problems (Cognitive Knowledge Level: Apply)
CO 5	Train Machine Learning Models using unconstrained and constrained optimization methods (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2								1
CO 2	3	2	2									1
CO 3	3	2	2	2								1
CO 4	3	2	2	2								1
CO 5	3	2	2	2								1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (8 hours)

Linear Algebra

Systems of Linear Equations – Matrices, Solving Systems of Linear Equations. Vector Spaces –Vector Spaces, Linear Independence, Basis, and Rank. Linear Mappings – Matrix Representation of Linear Mappings, Basis Change, Image and Kernel.

MODULE 2 (10 hours)

Analytic Geometry, Matrix Decompositions

Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Orthogonal Projections – Projection into One-Dimensional Subspaces, Projection onto General Subspaces, Gram-Schmidt Orthogonalization. Determinant and Trace, Eigen values and Eigen vectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation.

MODULE 3 (8 hours)

Vector Calculus

Differentiation of Univariate Functions - Partial Differentiation and Gradients, Gradients of Vector Valued Functions, Gradients of Matrices, Useful identities for Computing Gradients. Back propagation and Automatic Differentiation – Gradients in Deep Network, Automatic Differentiation. Higher Order Derivatives- Linearization and Multivariate Taylor Series.

MODULE 4 (9 hours)

Probability and Distributions

Construction of a Probability Space - Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem. Summary Statistics and Independence – Gaussian Distribution - Conjugacy and the Exponential Family - Change of Variables/Inverse Transform.

MODULE 5 (6 hours)

Optimization

Optimization Using Gradient Descent - Gradient Descent With Momentum, Stochastic Gradient Descent. Constrained Optimization and Lagrange Multipliers - Convex Optimization - Linear Programming - Quadratic Programming.

Text Books

1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong published by Cambridge University Press.

Reference Books

1. Linear Algebra and Its Applications, 4th Edition by Gilbert Strang
2. Introduction to Applied Linear Algebra by Stephen Boyd and Lieven Vandenberghe, 2018 published by Cambridge University Press.
3. Convex Optimization by Stephen Boyd and Lieven Vandenberghe, 2004 published by Cambridge University Press.
4. Pattern Recognition and Machine Learning by Christopher M Bishop, 2006, published by Springer.
5. Learning with Kernels – Support Vector Machines, Regularization, Optimization, and Beyond by Bernhard Scholkopf and Smola, Alexander J Smola, 2002, published by MIT Press.
6. Information Theory, Inference, and Learning Algorithms by David J. C MacKay, 2003. published by Cambridge University Press.
7. Machine Learning: A Probabilistic Perspective by Kevin P Murphy, 2012 published by MIT Press.
8. The Nature of Statistical Learning Theory by Vladimir N Vapnik, 2000, published by Springer.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Linear Algebra		8 hours
1.1	Matrices, Solving Systems of Linear Equations	1
1.2	Vector Spaces	1
1.3	Linear Independence	1
1.4	Basis and Rank (Lecture – 1)	1
1.5	Basis and Rank (Lecture – 2)	1
1.6	Linear Mappings	1
1.7	Matrix Representation of Linear Mappings	1
1.8	Basis Change, Image and Kernel	1
Module 2: Analytic Geometry, Matrix Decompositions		11 hours
2.1	Norms, Inner Products,	1
2.2	Lengths and Distances, Angles and Orthogonality	1
2.3	Orthonormal Basis, Orthogonal Complement	1
2.4	Orthogonal Projections – Projection into One-Dimensional Subspaces,	1
2.5	Projection onto General Subspaces,	1
2.6	Gram-Schmidt Orthogonalization	1
2.7	Determinant and Trace Eigen values and Eigen vectors.	1
2.8	Cholesky Decomposition	1
2.9	Eigen decomposition and Diagonalization	1
2.10	Singular Value Decomposition	1
2.11	Matrix Approximation	1
Module 3: Vector Calculus		9 hours
3.1	Differentiation of Univariate Functions - Partial Differentiation and Gradients	1
3.2	Gradients of Vector Valued Functions (Lecture 1)	1

3.3	Gradients of Vector Valued Functions (Lecture 2)	1
3.4	Gradients of Matrices	1
3.5	Useful Identities for Computing Gradients	1
3.6	Back propagation and Automatic Differentiation – Gradients in Deep Network	1
3.7	Automatic Differentiation	1
3.8	Higher Order Derivatives	1
3.9	Linearization and Multivariate TaylorSeries.	1
Module 4:Probability and Distributions		10 hours
4.1	Construction of a Probability Space	1
4.2	Discrete and Continuous Probabilities	1
4.3	Sum Rule, Product Rule	1
4.4	Bayes' Theorem.	1
4.5	Summary Statistics and Independence (Lecture 1)	1
4.6	Summary Statistics and Independence (Lecture 2)	1
4.7	Bernoulli, Binomial, Uniform (Discrete) Distributions	1
4.8	Uniform (Continuous), Poisson Distributions	1
4.9	Gaussian Distribution	1
4.10	Conjugacy and the Exponential Family (Beta – Bernoulli, Beta – Binomial Conjugacies)	1
Module 5: Optimization		7 hours
5.1	Optimization Using Gradient Descent	1
5.2	Gradient Descent With Momentum, Stochastic Gradient Descent	1
5.3	Constrained Optimization and Lagrange Multipliers (Lecture 1)	1
5.4	Constrained Optimization and Lagrange Multipliers (Lecture 2)	1
5.5	Convex Optimization	1
5.6	Linear Programming	1
5.7	Quadratic Programming	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Find the set S of all solution sinx of the following in homogeneous linear systems Ax = b, where A and b are defined as follows: A= $\begin{bmatrix} 1 & -1 & 0 & 0 & 1 \\ 1 & 1 & 0 & -3 & 0 \\ 2 & -1 & 0 & 1 & -1 \\ -1 & 2 & 0 & -2 & -1 \end{bmatrix}$ B= $\begin{bmatrix} 3 \\ 6 \\ 5 \\ -1 \end{bmatrix}$.

2. Determine the inverses of the following matrix if possible A= $\begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$.

Course Outcome 2 (CO 2):

1. Find the singular value decomposition (SVD) of the following matrix $\begin{bmatrix} 0 & 1 & 1 \\ \sqrt{2} & 2 & 0 \\ 0 & 1 & 1 \end{bmatrix}$.

2. Diagonalize the following matrix, if possible $\begin{bmatrix} 3 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 1 & 0 & 0 & 3 \end{bmatrix}$.

Course Outcome 3 (CO 3):

1. Find the second order Taylor series expansion for $f(x, y) = (x + y)^2$ about (0, 0).

2. Suppose you were trying to minimize $f(x, y) = x^2 + 2y + 2y^2$. Along what vector should you travel from (5,12)?

Course Outcome 4 (CO 4):

1. Let A and B be events such that P(A)=0.45 , P(B)=0.35 and $P(A \cup B) = 0.5$. Find $p(A \mid B)$.

2. A biased coin (with probability of obtaining a head equal to p¿ 0) is tossed repeatedly and independently until the first head is observed. Compute the probability that the first head appears at an even numbered toss.

Course Outcome 5 (CO 5):

1. Consider the univariate function $f(x) = x^3 + 6x^2 - 3x - 5$. Find its stationary points and indicate whether they are maximum, minimum, or saddle points.
2. Is the function $f(x, y) = 2x^2 + y^2 + 6xy - x + 3y - 7$ convex, concave, or neither? Justify your answer.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24CSM32

Course Name: MATHEMATICS FOR MACHINE LEARNING (MINOR)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain any 3 vector axioms.
2. Show that the linear mapping G defined as G((x,y)) = (x + 1, y + 2) is not linear.
3. Find the norm of the vector $u = (2, -2, 3, -4)$.
4. Find the Eigenvalues and Eigenvectors of the 2 x 2 matrix $\begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$.
5. Let $f(x, y, z) = xye^r$, where $r = x^2 + z^2 - 5$. Calculate the gradient of f at the point (1, 3, -2).
6. Compute the Taylor polynomials $Tn, n = 0, ..., 5$ of $f(x) = sin(x) + cos(x)$ at $x_0 = 0$.
7. Two cards are drawn in succession from a pack of 52 cards. Find the chance that the first is a king and the second a queen if the first card is (i) replaced, (ii) not replaced.
8. Show that if two events A and B are independent, then A and B are independent.
9. Explain the principle of the gradient descent algorithm.
10. Briefly explain the difference between (batch) gradient descent and stochastic gradient descent. Give an example of when you might prefer one over the other.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Show that in the space R^3 the vectors $x = (1,1,0)$, $y = (0,1,2)$, and $z = (3,1,-4)$ are linearly dependent. (5)

    (b) A set of n linearly independent vectors in R^n forms a basis. Does the set of vectors $(2,4,-3)$, $(0,1,1)$, $(0,1,-1)$ form a basis for R^3? Explain your reasons. (9)

OR

12. (a) Find the rank and inverse of the matrix A= $\begin{bmatrix} 2 & -1 & 1 \\ 3 & 1 & -5 \\ 1 & 1 & 1 \end{bmatrix}$. (8)

    (b) Find a basis for the vector space V spanned by vectors v1 = (1, 1, 0), v2 = (0, 1, 1), v3 = (2, 3, 1), and v4 = (1, 1, 1). (6)

13. (a) Verify triangle inequality for x = (1, 1, 1) and y= (1, 2, 3) in V_3(R) with standard inner product. (7)

    (b) Apply Gram-Schmidt orthogonalization process to construct an orthonormal basis for V_3(R) with standard inner product for the basis{V1,V2,V3}, where V1=(1,0,1), V2=(1,3,1) and V3=(3,2,1). (7)

OR

14. (a) Compute the Singular Value Decomposition of A= $\begin{bmatrix} 0 & 1 \\ 1 & 1 \\ 1 & 0 \end{bmatrix}$. (7)

    (b) Diagonalize A = $\begin{bmatrix} 0 & 0 & -2 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}$ and hence find A^{13}. (7)

15. (a) A rectangular box open at the top is to have volume 32 cubic feet. Find its dimensions if the total surface area is minimum. (7)

    (b) Find the linear approximation to the function $f(x,y) = 2 - \sin(-x - 3y)$ at the point $(0,\pi)$ and then use your answer to estimate $f(0.001,\pi)$. (7)

OR

16. (a) Discuss the maxima and minima of $xy(a - x - y)$. (5)

    (b) Compute the Taylor Series Expansion of the multivariate Function $f(x,y) = x^2 + 2xy + y^3$ at $(x_0, y_0) = (1,2)$. (9)

17. (a) There are two bags. The first bag contains four mangoes and two apples; the second bag contains four mangoes and four apples. We also have a biased coin, which shows "heads" with probability 0.6 and "tails" with probability 0.4. If the coin shows "heads", we pick a fruit at random from bag 1; otherwise we pick a fruit at random from bag 2. Your friend flips the coin (you cannot see the result), picks a fruit at random from the corresponding bag, and presents you a mango. What is the probability that the mango was picked from bag 2? (6)

    (b) Suppose that one has written a computer program that sometimes compiles and sometimes not (code does not change). You decide to model the apparent stochasticity (success vs. no success) x of the compiler using a Bernoulli distribution with parameter μ: $p(x \mid \mu) = \mu^x(1-\mu)^{1-x}, \quad x \in \{0,1\}$ Choose a conjugate prior for the Bernoulli likelihood and compute the posterior distribution p(μ — $x_1, ..., x_N$). (8)

OR

18. (a) Two dice are rolled. (6)
    A = 'sum of two dice equals 3'
    B = 'sum of two dice equals 7'
    C = 'at least one of the dice shows a 1'
    i. What is P(A—C)?
    ii. What is P(B—C)?
    iii. Are A and C independent? What about B and C?

    (b) Define the probability density function and probability mass function. (8)

19. (a) Find the extrema of $f(x,y,z) = x - y + z$ subject to $g(x,y,z) = x^2 + y^2 + z^2 = 2$. (8)

    (b) Determine whether the following functions are convex function or concave. Justify your answer. (6)
    i. $f(x) = 3x^2 + 7x - 9$
    ii. $f(x) = -9x^2 - x - 1$

OR

20. (a) Derive the gradient descent training rule assuming that the target function is represented as $o_d = w_0 + w_1x_1 + ... + w_nx_n$. Define explicitly the cost/ error function E, assuming that a set of training examples D is provided, where each training example d D is associated with the target output t_d. (8)

    (b) Find the maximum value of $f(x,y,z) = xyz$ given that $g(x,y,z) = x + y + z = 3$ and $x, y, z >= 0$. (6)

B24CSM33	DATA COMMUNICATION CONCEPTS (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This is a basic course in communication for awarding B. Tech. Minor in Computer Science and Engineering with specialization in Networking. The purpose of this course is to prepare learners to understand the communication entities and the associated issues in the field of Computer Science. This course covers fundamental concepts of data transmission media, digital analog transmissions, multiplexing spread spectrum, error detection correction and switching. Concepts in data communication help the learner to understand the concepts in networking and mobile communication.

Prerequisites

NIL

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Describe the characteristics of signals used for Analog and Digital transmissions (Cognitive Knowledge Level: Understand)
CO 2	Discuss the features and issues in data transmission (Cognitive Knowledge Level: Understand)
CO 3	Select transmission media based on characteristics and propagation modes (Cognitive Knowledge Level: Apply)
CO 4	Use appropriate signal encoding techniques for a given scenario (Cognitive Knowledge Level: Apply)
CO 5	Explain error detection, correction techniques, and switching techniques used in data communication (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	1			3					1
CO 2	2	2	1	1	3							1
CO 3	2	1	3	1		3						1
CO 4	2	1	3	1		3						1
CO 5	2	2	1	1	3							1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance — 10 marks

Continuous Assessment Test (2 numbers) — 25 marks

Assignment/Quiz/Course Project — 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (9 hours)

Data Transmission Basics

Communication model - Simplex, Half duplex, Full duplex transmission. Periodic Analog signals - Sine wave, Amplitude, Phase, Wavelength, Time and frequency domain, Bandwidth. Analog digital data and signals. Transmission impairments - Attenuation, Delay distortion, Noise. Data rate limits - Noiseless channel, Nyquist bandwidth, Noisy channel, Shannon's capacity formula.

MODULE 2 (10 hours)

Transmission Media

Guided Transmission Media - Twisted pair, Coaxial cable, Optical fiber. Unguided media - Radio waves, Terrestrial microwave, Satellite microwave, Infrared. Wireless Propagation - Ground wave propagation, Sky Wave propagation, Line-of-Sight (LoS) Propagation.

MODULE 3 (7 hours)

Digital Transmission and Analog Transmission

Digital data to Digital signal – Non-Return-to-Zero (NRZ), Return-to-Zero (RZ), Multilevel binary, Biphase. Analog data to Digital signal - Sampling theorem, Pulse Code Modulation (PCM), Delta Modulation (DM). Digital data to Analog signal: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK). Analog data to Analog signal: Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM).

MODULE 4 (11 hours)

Multiplexing :

Multiplexing- Space Division Multiplexing-Frequency Division Multiplexing: Wavelength Division Multiplexing - Time Division Multiplexing: Characteristics, Digital Carrier system, SONET/SDH Statistical time division multiplexing: Cable Modem - Code Division Multiplexing. Multiple Access– CDMA.

MODULE 5 (8 hours)

Error Detection, Correction and Switching:

Digital data communication techniques - Asynchronous transmission, Synchronous transmission. Detecting and correcting errors - Types of Errors, Parity check, Checksum, Cyclic Redundancy Check (CRC), Forward Error Correction (FEC), Hamming Distance, Hamming Code. Basic principles of Switching - Circuit Switching, Packet Switching, Message Switching, Asynchronous Transfer Mode(ATM)- connection-cells.

Text Books

1. Data Communications and Networking, Forouzan B. A., 6/e, McGraw-Hill, 2022.
2. Data and Computer Communication, 10/e-William Stallings, Pearson Education, Inc., 2013.

Reference Books

1. Mobile Communications-Schiller J., 2/e, Pearson Education, 2009.
2. Fundamentals of Networking and Communication -Curt M. White,7/e, Cengage learning, 2012.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	**Topic**	**No. of Lecture/ Tutorial Hours**
	Total Hours	45 Hours
Module 1: Data Transmission Basics		9 hours
1.1	Introduction, Communication model - Simplex, Half duplex, Full duplex transmission	1
1.2	Periodic Analog signals - Sine wave, Amplitude, Phase, Wavelength	1
1.3	Time and frequency domain, Bandwidth	1

1.4	Analog data and signals	1
1.5	Digital data and signals	1
1.6	Transmission impairments - Attenuation, Delay distortion, Noise	1
1.7	Data rate limits - Noiseless channel, Nyquist bandwidth	1
1.8	Noisy channel, Shannon's capacity formula	2
Module 2: Transmission media		10 hours
2.1	Guided Transmission Media - Twisted pair, Coaxial cable	2
2.2	Optical fiber	1
2.3	Unguided media - Radio waves	1
2.4	Terrestrial microwave, Satellite microwave	2
2.5	Infrared	1
2.6	Wireless Propagation - Ground wave propagation	1
2.7	Wave propagation, Line-of-Sight (LoS) Propagation	2
Module 3: Digital Transmission and Analog Transmission		7 hours
3.1	Digital data to Digital signal – Non-Return-to-Zero (NRZ), Biphase	1
3.2	Return-to-Zero (RZ), Multilevel binary	1
3.3	Analog data to Digital signal - Sampling theorem	1
3.4	Pulse Code Modulation (PCM), Delta Modulation (DM)	1
3.5	Digital data to Analog signal: Amplitude Shift Keying (ASK)	1
3.6	Frequency Shift Keying (FSK), Phase Shift Keying (PSK)	1
3.7	Analog data to Analog signal: Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM)	1
Module 4: Multiplexing		11 hours
4.1	Multiplexing- Space Division Multiplexing	1
4.2	Frequency Division Multiplexing: Wavelength Division Multiplexing	2
4.3	Time Division multiplexing: Characteristics,	1

4.4	Digital Carrier system, SONET/SDH	2
4.5	Statistical time division multiplexing	2
4.6	Modem - Code Division Multiplexing	1
4.7	Multiple Access– CDMA.	1
4.8	CDMA.	1
Module 5: Error Detection, Correction and Switching		8 hours
5.1	Digital data communication techniques - Asynchronous Synchronous transmission	1
5.2	Detecting and correcting errors - Types of Errors	1
5.3	Parity check, Checksum	1
5.4	Cyclic Redundancy Check (CRC), Forward Error Correction (FEC), BCH codes	1
5.5	Reed Solomon Codes, Parity check matrix codes, Low density parity check codes, Hamming Distance, Hamming Code	1
5.6	Memory update Policies	1
5.7	Basic principles of Switching - Circuit Switching, Packet Switching, Message Switching	1
5.8	Asynchronous Transfer Mode(ATM)-connections and cells	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. What is a periodic analog signal? List the main properties of a periodic analog signal.
2. Differentiate between simplex, half-duplex, and full-duplex modes of transmission with appropriate use cases.
3. Explain how analog signals are represented in time and frequency domains. Use sine waves to illustrate amplitude, phase, and frequency.

Course Outcome 2 (CO 2):

1. What is attenuation? How can it be handled?

2. Describe the construction and characteristics of twisted-pair, coaxial cable, and optical fiber.
3. Compare radio wave, microwave, and infrared transmission with respect to range, frequency, and application.

Course Outcome 3 (CO 3):

1. How can interference be reduced using optical fiber?
2. Differentiate between NRZ, RZ, multilevel binary, and biphase encoding techniques with signal diagrams.
3. Explain the process of converting analog data to digital signal using PCM and Delta Modulation.

Course Outcome 4 (CO 4):

1. Encode the data sequence 101011100 using Multilevel binary and Biphase schemes.
2. Compare hardwired control with microprogrammed control.
3. Explain SONET/SDH architecture and its significance in digital communication systems.

Course Outcome 5 (CO 5):

1. Using Cyclic Redundancy Check (CRC), given the dataword 11110000 and the divisor 10011, show the generation of the codeword at the sender and the checking of the codeword at the receiver.
2. llustrate the concept of Hamming code with an example and calculate the Hamming distance.
3. Compare circuit switching, packet switching, and message switching in terms of efficiency, delay, and use cases.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24CSM33

Course Name: DATA COMMUNICATION CONCEPTS (MINOR)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is bandwidth? Find the lowest frequency, if a periodic signal has a bandwidth of 20 Hz and the highest frequency is 60 Hz. Draw the Spectrum if the signal contains all frequencies of same amplitude.
2. Assume that a TV picture is to be transmitted over a channel with 4.5 MHz bandwidth and a 35 dB Signal-to-Noise-Ratio. Find the capacity of the channel.
3. What is the purpose of cladding in optical fibres?
4. Which wireless propagation is suitable for satellite communication? Justify your answer.
5. Explain the working of Delta Modulation with an example.
6. Illustrate the equivalent square wave pattern of the bit string 01001101 using Non-Returnto-Zero(NRZ) - Level and NRZ-Invert encoding schemes.
7. Distinguish between synchronous and statistical Time Division Multiplexing.
8. What is meant by Hamming distance.
9. Find the minimum hamming distance for the following cases:

- Detection of two errors
- Correction of two errors
- Detection of 3 errors or correction of 2 errors
- Detection of 6 errors or correction of 2 errors

10. Find the parity bit for simple even parity check for the following.
    (a) 1001010
    (b) 0001100
    (c) 1000000
    (d) 1110111

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) With the help of suitable figures, distinguish between time domain and frequency domain. (4)
    (b) Describe the different types of transmission impairments. (10)

OR

12. (a) Differentiate between Attenuation and Delay Distortion, (6)
    (b) Distinguish between Nyquist bandwidth and Shannon capacity. Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with
        i. Two signal levels
        ii. Four signal levels.

    Determine the maximum bit rate in both these cases. (8)

13. (a) For a parabolic reflective antenna operating at 12 GHz with a diameter of 2 m, calculate the effective area and the antenna gain. (7)
    (b) List any four advantages and disadvantages of twisted pair, coaxial cable and fiber optic cable. (7)

OR

14. (a) Compare the features of terrestrial microwave and satellite microwave. (6)
    (b) With the help of suitable diagrams, differentiate Multi-mode and Single-mode optical fibres. How the rays are propagated in Step-index and Graded-index Multi-mode fibres. (8)

15. (a) Distinguish between data rate and signal rate. (7)
    (b) What is polar encoding? Encode the pattern 010011001110 using the two Biphase schemes. (7)

OR

16. (a) Show the equivalent analog sine wave pattern of the bit string 010011010 using Amplitude Shift Keying, Frequency Shift Keying and Phase Shift Keying. (4)

    (b) State Sampling theorem. Explain Pulse Code Modulation with suitable figures. (10)

17. (a) Four channels are multiplexed using Time Division Multiplexing. If each channel sends 100 bytes/sec and we multiplex one byte per channel, determine the frame size, duration of a frame, frame rate and bit rate of the link. (7)

    (b) Differentiate between Synchronous TDM and Statistical TDM. Why is a statistical time division multiplexer more efficient than a synchronous time division multiplexer. (7)

OR

18. (a)) Explain the different techniques by which the disparity in input data rate is handled by Time Division Multiplexing. (7)

    (b) Suppose Alice and Bob are communicating using Code Division Multiple Access. Alice uses the code [+1 +1] and Bob uses the code [+1 -1]. Alice sends the data bit 0 and Bob sends the data bit 1. Show the data in the channel and how they can detect what the other person has sent. (7)

19. (a) Explain parity check with examples. (7)

    (b) Describe the need for a switch. What are the different phases in circuit switching? (7)

OR

20. (a) With the help of a suitable example, explain the virtual circuit approach of packet switching. (7)

    (b) Find the Hamming code for the data-word 1011001. Assume odd parity. (7)

MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.Tech
Artificial Intelligence and Machine Learning

SEMESTER 4

SYLLABUS

SEMESTER 4

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T04C	GRAPH THEORY	3-1-0-3	4	4
B	B24CS2T04	OPERATING SYSTEMS	3-1-0-3	4	4
C	B24CS2T05	FORMAL LANGUAGES AND AUTOMATA THEORY	3-1-0-3	4	4
D	B24CS2T06	DATABASE MANAGEMENT SYSTEMS	3-1-0-3	4	3
E	B24HU2T03	ENTREPRENEURSHIP AND SOFTWARE MANAGEMENT SYSTEMS	2-1-0-2	3	3
F	B24CD2T01	MACHINE LEARNING CONCEPTS	2-1-0-2	3	3
G	B24CS2L05	LOGIC SYSTEM DESIGN AND OPERATING SYSTEMS LAB	0-0-3-3	3	2
H	B24CS2L06	DATABASE LAB	0-0-3-3	3	2
M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
		TOTAL		36	25

MINOR

COURSE NO.	COURSES
B24CSM41	OBJECT ORIENTED PROGRAMMING IN JAVA
B24CSM42	INTRODUCTION TO MACHINE LEARNING
B24CSM43	INTRODUCTION TO COMPUTER NETWORKS

HONOURS

COURSE NO.	COURSES
B24CSH41	ADVANCED TOPICS IN COMPUTER GRAPHICS
B24CSH42	COMPUTATIONAL FUNDAMENTALS FOR BIOINFORMATICS
B24CSH43	PRINCIPLES OF PROGRAM ANALYSIS AND VERIFICATION

B24MA2T04C	GRAPH THEORY	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

Graph Theory is a vital area of discrete mathematics with wide-ranging applications in computer science, engineering, and real-world problem solving. This course introduces students to fundamental concepts of graph theory which includes different graph structures like Eulerian and Hamiltonian graphs, directed graphs, planar graphs, connectivity concepts and matrix representations. Through both theoretical foundations and classical algorithms like Prim's Kruskal's, Dijkstra's and Ford-Fulkerson, students will develop the skills to model, analyze, and solve complex network-based problems.

Prerequisites

Discrete Mathematical Structures (B24MA2T03C)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand basic concepts of graphs, vertices and their properties, types of paths, classification of graphs and their properties. (Cognitive Knowledge Level: Understand)
CO 2	Demonstrate the fundamental theorems on Eulerian and Hamiltonian graphs. (Cognitive Knowledge Level: Understand)
CO 3	Identify equivalent definitions of trees and make use of Prim's and Kruskal's algorithms for finding minimum cost spanning tree and Dijkstra's algorithm for finding shortest paths. (Cognitive Knowledge Level: Apply)
CO 4	Utilize connectivity concepts and identify planar graphs. (Cognitive Knowledge Level: Apply)
CO 5	Explain about vector spaces and graph representations using matrices. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1							1		1
CO 2	2	1	1	1						1		1
CO 3	2	1	1	1						1		1
CO 4	2	1	1	1						1		1
CO 5	2	1	1			1				1		1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

SYLLABUS

MODULE 1 (8 hours)

Introduction to Graphs

Introduction- Basic definition — Application of graphs — finite, infinite and bipartite graphs — Incidence and Degree — Isolated vertex, pendant vertex and Null graph. Paths and circuits — Isomorphism, sub graphs, walks, paths and circuits, connected graphs, disconnected graphs and components.

MODULE 2 (8 hours)

Eulerian and Hamiltonian graphs

Euler graphs, Operations on graphs, Hamiltonian paths and circuits, Travelling salesman problem. Directed graphs — types of digraphs, Digraphs and binary relation, Directed paths, Fleury's algorithm.

MODULE 3 (10 hours)

Trees and Graph Algorithms

Trees — properties, pendant vertex, Distance and centres in a tree - Rooted and binary trees, counting trees, spanning trees, Prim's algorithm, Kruskal's algorithm, Dijkstra's shortest path algorithm.

MODULE 4 (11 hours)

Connectivity and Planar Graphs

Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, Fundamental circuits, Network flows, Ford-Fulkerson algorithm, Planar graphs, Kuratowski's theorem (proof not required), Different representations of planar graphs, Euler's theorem, Geometric dual.

MODULE 5 (8 hours)

Vector spaces in Graphs and Graph Representations

Vector space associated with graphs- Sets with 1 operation, sets with 2 operations, Vectors and vector spaces, Vector space associated with a graph, Matrix representation of graphs- Adjacency matrix, Incidence Matrix, Circuit Matrix, Path Matrix.

Text Books

1. Narsingh Deo, Graph theory with Applications to Engineering and Computer Science, Dover Publications, 2016.

Reference Books

1. R. Diestel, Graph Theory, free online edition, 2016: diestel-graph-theory.com/basic.html.
2. Douglas B. West, Introduction to Graph Theory, Prentice Hall India Ltd.,2001.
3. Robin J. Wilson, Introduction to Graph Theory, Longman Group Ltd.,2010.
4. J.A. Bondy and U.S.R. Murty. Graph theory with Applications.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1:Introduction to Graphs		8 hours
1.1	Introduction- Basic definition — Application of graphs — finite and infinite graphs, bipartite graphs	1
1.2	Incidence and Degree — Isolated vertex, pendent vertex and Null graph 1	1
1.3	Paths and circuits	1
1.4	Isomorphism	1
1.5	Sub graphs, walks	1
1.6	Paths and circuits	1

1.7	Connected graphs.	1
1.8	Disconnected graphs and components	1
Module 2: Eulerian and Hamiltonian graphs		8 hours
2.1	Euler graphs	1
2.2	Operations on graphs	1
2.3	Hamiltonian paths and circuits	1
2.4	Hamiltonian paths circuits	1
2.5	Travelling salesman problem	1
2.6	Directed graphs — types of digraphs	1
2.7	Digraphs and binary relation, Directed paths	1
2.8	Fleury's algorithm	1
Module 3: Trees and Graph Algorithms		10 hours
3.1	Trees — properties	1
3.2	Trees — properties	1
3.3	Trees — properties, pendent vertex	1
3.4	Distance and centres in a tree	1
3.5	Rooted and binary tree	1
3.6	Counting trees	1
3.7	Spanning trees, Fundamental circuits	1
3.8	Prim's algorithm	1
3.9	Kruskal's algorithm	1
3.10	Dijkstra's shortest path algorithm	1
Module 4: Connectivity and Planar Graphs		11 hours
4.1	Vertex Connectivity, Edge Connectivity	1
4.2	Cut set and Cut Vertices	1
4.3	Fundamental circuits	1
4.4	Fundamental circuits	1
4.5	Network Flows	1

4.6	Ford-Fulkerson algorithm	1
4.7	Planar graphs	1
4.8	Kuratowski's theorem	1
4.9	Different representations of planar graphs	1
4.10	Euler's theorem	1
4.11	Geometric dual	1
Module 5: Vector spaces in Graphs and Graph Representations		8 hours
5.1	Sets with one operation	1
5.2	Groups of subgraphs	1
5.3	Sets with two operations	1
5.4	Finite Fields and vector spaces	1
5.5	Vector space associated with a graph.	1
5.6	Matrix representation of graphs- Adjacency matrix, Incidence Matrix	1
5.7	Circuit Matrix, Path Matrix	1
5.8	Theorems relating matrices	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

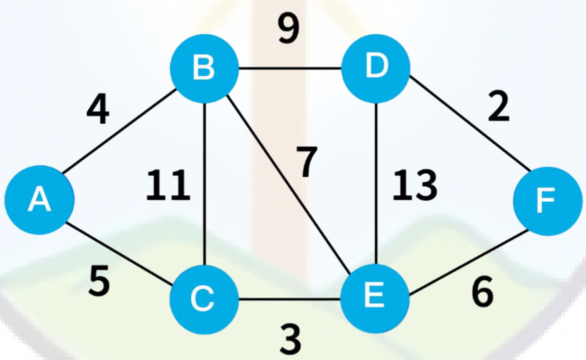
1. Differentiate a walk, path and circuit in a graph.
2. Is it possible to construct a graph with 12 vertices such that two of the vertices have degree 3 and the remaining vertices have degree 4? Justify.
3. Prove that a simple graph with n vertices must be connected if it has more than $\frac{(n-1)(n-2)}{2}$ edges.
4. Prove: If a graph (connected or disconnected) has exactly two odd degree vertices, then there must be a path joining these two vertices.

Course Outcome 2 (CO 2):

1. Define Hamiltonian circuit and Euler graph. Give one example for each.
2. Define directed graphs. Differentiate between symmetric digraphs and asymmetric digraphs.
3. Prove that a connected graph G is an Euler graph if all vertices of G are of even degree.
4. Prove: A graph G of n vertices always has a Hamiltonian path if the sum of degrees of every pair of non-adjacent vertices v_i, v_j in G satisfies the condition $d(v_i) + d(v_j) \geq n$.

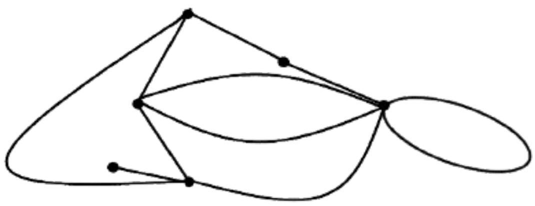
Course Outcome 3 (CO 3):

1. Prove that a tree with n vertices has $n - 1$ edges.
2. Define binary tree. Find the number of pendant vertices in a binary tree.
3. State and prove max-flow min-cut theorem.
4. Run Dijkstra's algorithm on a given graph.



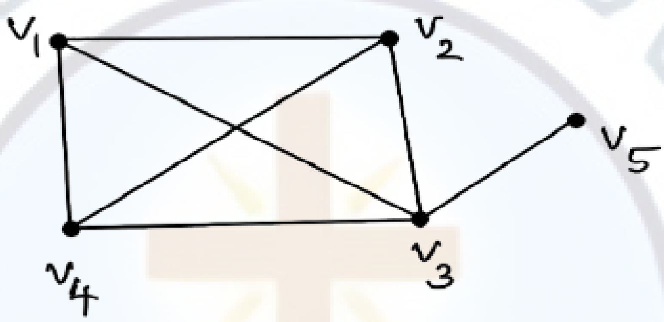
Course Outcome 4 (CO 4):

1. Define edge connectivity, vertex connectivity and separable graphs. Give an example for each.
2. Prove that a connected planar graph with n vertices and e edges has $e - n + 2$ regions.
3. Prove: Every cut set in a connected graph G must contain at least one branch of every spanning tree of G.
4. Draw the geometrical dual G^* of a given graph. Check whether G and G^* are are self-duals or not, substantiate your answer clearly.



Course Outcome 5 (CO 5):

1. Show that if $A(G)$ is the incidence matrix of a connected graph G with n vertices, then the rank of $A(G)$ is $n-1$.
2. Define a vector space.
3. Illustrate a vector space associated with a graph with an example.
4. Find the adjacency matrix of a given graph.



MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24MA2T04C

Course Name: GRAPH THEORY

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Construct a simple graph of 12 vertices with two of them having degree 1, three having degree 3 and the remaining seven having degree 10.
2. What is the largest number of vertices in a graph with 35 edges, if all vertices are of degree at least 3?
3. Define a Euler graph. Give an example of Eulerian graph which is not Hamiltonian.
4. Give an example of a strongly connected simple digraph without a directed Hamiltonian path.
5. What is the sum of the degrees of any tree of n vertices?
6. Define spanning tree with an example.
7. Show that in a simple connected planar graph G having n vertices, e edges, and no triangles $e \leq 3n - 6$.
8. Prove that edge connectivity is an upper bound for vertex connectivity.
9. Consider the circuit matrix B and incidence matrix A of a simple connected graph whose columns are arranged using the same order of edges. Prove that every row of B is orthogonal to every row of A.

10. Define a field with an example.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Prove that for any simple graph with at least two vertices, there exist two vertices of the same degree. (7)

    (b) Define subgraph, edge disjoint subgraph and vertex disjoint subgraph with example. (7)

OR

12. (a) Determine whether the following graphs are isomorphic or not. Justify your answer. (7)

    (b) Prove that a simple graph with n vertices and k components can have at most $\frac{(n-k)(n-k+1)}{2}$ edges. (7)

13. (a) Let S be a set of 5 elements. Construct a graph G whose vertices are subsets of S of size 2 and two such subsets are adjacent in G if they are disjoint. (7)

    i. Draw the graph G.

    ii. How many edges must be added to G in order for G to have a Hamiltonian cycle?

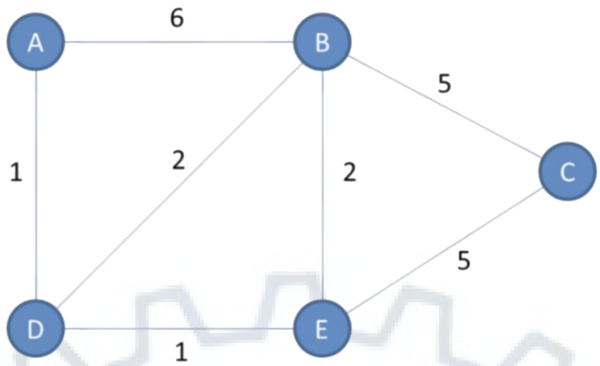
    (b) Let G be a graph with exactly two components, both being Eulerian. What is the minimum number of edges to be added to G to obtain an Eulerian graph? (7)

OR

14. (a) Prove that there are $\frac{(n-1)}{2}$ edge disjoint Hamiltonian circuits in a complete graph with n vertices where $n \geq 3$. (7)

    (b) Define strongly connected, weakly connected, symmetric and asymmetric digraphs with examples. (7)

15. (a) A tree T has at least one vertex of degree 4, and at least one vertex of degree 3. Prove that T has at least 5 leaves. (7)

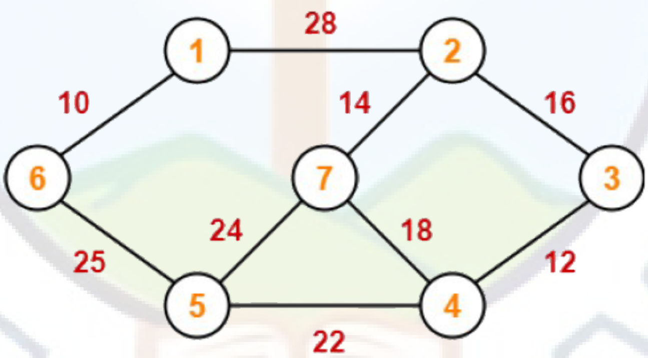


(b) Use Dijkstra's algorithm to find the shortest path from vertex a to all other vertices. (7)

OR

16. (a) Define pendant vertex. Prove that the number of pendant vertices in a binary tree with n vertices is $\frac{(n+1)}{2}$. (7)

(b) Using Prim's algorithm, find the minimum spanning tree for the following weighted graph. (7)

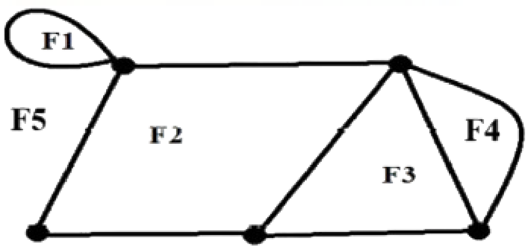


17. (a) State and prove Euler's Theorem relating the number of faces, edges and vertices in a planar graph. (7)

(b) Let G be a connected graph and e an edge of G. Show that e is a cut-edge if and only if e belongs to every spanning tree of G. (7)

OR

18. (a) Construct the geometric dual of the graph below. (7)



(b) Define cut-set. Prove that every circuit in G has an even number of edges in common with any cut-set. (7)

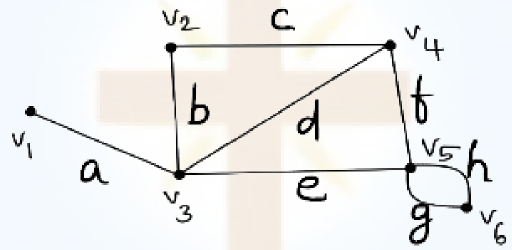
19. (a) Draw a connected graph and show that the rank of its incidence matrix is one less than the number of vertices. (7)

(b) Prove that the ring sum of two circuits in a graph G is either a circuit or an edge-disjoint union of circuits. (7)

OR

20. (a) Define a set with 2 operations. Give an example of a vector space associated with a graph by defining the operations. (7)

(b) Define circuit matrix of a graph. Write the circuit matrix of following graph. (7)



B24CS2T04	OPERATING SYSTEMS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course offers students a deep understanding of how operating systems manage system resources through topics like process management, memory allocation, synchronization, and file systems, alongside real-world case studies. This course equips them to analyze, design, and optimize system-level solutions, preparing them for careers in software development, system administration, and embedded systems, as well as advanced studies in computer science.

Prerequisites

Problem Solving and Programming Techniques(A)(B24ES1T01A), Data Structures(B24CS2T01), Computer Organization And Architecture(B24CS2T02)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Explain the fundamental concepts of operating systems and boot processes. (Blooms Level: Understand)
CO 2	Demonstrate the concept of process management and process scheduling. (Blooms Level: Apply)
CO 3	Implement synchronization techniques to solve critical-section problems and demonstrate deadlock handling strategies. (Cognitive knowledge Level: Apply)
CO 4	Understand memory management techniques and their role in optimizing system performance. (Cognitive knowledge Level: Apply)
CO 5	Interpret the roles of file system structures and storage devices in managing system storage. (Cognitive knowledge Level: Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2										2
CO 2	3	2	2									2
CO 3	3	2	2									2
CO 4	3	2	2									2
CO 5	3	2	2									2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (6 hours)

Introduction:

Operating System basic concepts – Computer System Architecture.
Case study: CPU vs GPU vs NPU.
Operating system services – System calls, user and kernel modes, Types of system calls – Operating System structure: Simple structure, Layered approach, Microkernel, Modules – System Boot.

MODULE 2 (9 hours)

Process Management:

Process Management: Process concept: Process state, Process Control Block and Context Switch – Operations on processes – Interprocess communication: Shared-Memory Systems, Message-Passing systems – Multithreading: Benefits, Models.
Process Scheduling: Basic concepts –Schedulers, – Scheduling criteria – Scheduling algorithms: First come First Served, Shortest Job First, Priority scheduling, Round-Robin scheduling, Multilevel feedback queue scheduling.

MODULE 3 (13 hours)

Process Coordination:

Process Synchronization: The Critical-Section problem – Peterson's solution – Synchronization Hardware – Mutex Locks – Semaphores – Classic problems of synchronization: Producer Consumer, Dining Philosophers and Readers-Writers.
Case study: Linux Kernel Synchronization Methods - Spin Locks
Deadlocks: Deadlock characterization – Methods for handling deadlocks – Prevention – Avoidance – Detection – Recovery from deadlock.

MODULE 4 (9 hours)

Memory management:

Address space – Swapping – Contiguous memory allocation – Segmentation – Paging: Basic method. Virtual Memory – Demand Paging – Page Replacement algorithms: FIFO, optimal, LRU, LRU-Approximation. Thrashing.

MODULE 5 (8 hours)

Storage Management:

File System: File concept: Attributes, Operations, types, structure – Access methods – File-system Mounting – Protection. File-System implementation: Overview, Partitions, Virtual file systems Magnetic Disks – Solid-State Disks – Disk Structure – Disk scheduling – Disk formatting.

Text Books

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", 10th Edition, Wiley India 2018.
2. Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau Arpaci, "Operating Systems: Three Easy Pieces", -Dusseau Books, LLC ,2017 https://pages.cs.wisc.edu/ remzi/OSTEP/(online version).
3. Robert Love, Linux Kernel Development, Robert Love, 3/e, 2018.

Reference Books

1. Andrew S Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice Hall, 2015.
2. William Stallings, "Operating systems", 6th Edition, Pearson, Global Edition, 2015.
3. Garry Nutt, Nabendu Chaki, Sarmistha Neogy, "Operating Systems", 3rd Edition, Pearson Education.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Introduction		6 hours
1.1	Operating System basic concepts	1
1.2	Computer System Architecture. Case study: CPU vs GPU vs NPU	1
1.3	Operating system services	1
1.4	System calls, user and kernel modes, Types of system calls	1
1.5	Operating System structure: Simple structure, Layered approach, Microkernel, Modules	1
1.6	System Boot	1

Module 2: Process management		9 hours
2.1	Process concept: Process state, Process Control Block and Context Switch	1
2.2	Operations on processes	1
2.3	Interprocess communication: Shared-Memory, Message-Passing	1
2.4	Multithreading: Benefits, Models	1
2.5	Process Scheduling: Basic concepts, Schedulers, Scheduling criteria	1
2.6	Scheduling algorithms: First come First Served	1
2.7	Shortest Job First	1
2.8	Priority scheduling	1
2.9	Round-Robin scheduling, Multilevel feedback queue scheduling.	1
Module 3: Process Coordination		13 hours
3.1	Process Synchronization: The Critical-Section problem	1
3.2	Peterson's solution	1
3.3	Synchronization Hardware	1
3.4	Mutex Locks	1
3.5	Semaphores	1
3.6	Classic problems of synchronization: Producer Consumer	1
3.7	Dining Philosophers and Readers-Writers	1
Case Study: Linux Kernel Synchronization Methods - Spin Locks(1 hour)		
3.8	Deadlocks: Deadlock characterization	1
3.9	Methods for handling deadlocks: Prevention	1
3.10	Deadlock Avoidance	1
3.11	Deadlock Detection	1
3.12	Recovery from deadlock	1
Module 4: Memory Management		9 hours
4.1	Address space	1

4.2	Swapping	1
4.3	Contiguous memory allocation	1
4.4	Segmentation	1
4.5	Paging: Basic method	1
4.6	Virtual Memory – Demand Paging	1
4.7	Page Replacement algorithms: FIFO, Optimal	1
4.8	LRU, LRU-Approximation	1
4.9	Thrashing	1
Module 5: Storage Management		8 hours
5.1	File concept: Attributes, Operations, File types, structure	1
5.2	Access methods, File-system Mounting, Protection	1
5.3	File-System implementation: Overview	1
5.4	Partitions, Virtual file systems	1
5.5	Magnetic Disks	1
5.6	Solid-State Disks, Disk Structure	1
5.7	Disk scheduling: FCFS, SSTF, SCAN	1
5.8	Disk scheduling C-SCAN, LOOK, Disk formatting	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Differentiate Multiprogramming and Multitasking.
2. Illustrate the significance of bootstrap program during system boot.

Course Outcome 2 (CO 2):

1. Find the count of newly created process when the following code snippet is executed:

```
int main ()
{
```

```
for(i=0; i<3 ; i++)
 fork();
return 0;
}
```

2. Consider the following process arrived at time 0 in the order P1, P2, P3, P4. Find the average waiting time and turnaround time for FCFS, SJF and RR (Q=4) scheduling algorithms.

Process	**P1**	**P2**	**P3**	**P4**
Burst Time(ms)	10	4	8	2

Course Outcome 3 (CO 3):

1. Consider a banking system that maintains an account balance with two functions: deposit (amount) and withdraw (amount). These two functions are passed the amount that is to be deposited or withdrawn from the bank account balance. Assume that two users calls the withdraw() and the deposit()concurrently. Describe how a race condition is possible and what might be done to prevent the race condition from occurring.
2. There are three process P1, P2, P3 and two resources Ra and Rb with two instances each. P1 is holding one instance of Ra, P2 is holding one instance of Rb, P3 is holding one instance of Ra and one instance of Rb. Now P1 request for Rb and P2 requests for Ra. Draw the resource allocation graph for this scenario. Identify the state of the system. Check whether there is any chance of a deadlock.

Course Outcome 4 (CO 4):

1. Given six memory partitions of 100KB,500 KB, 200 KB, 300 KB, 600 KB (in order). How would the first-fit, best-fit and worst-fit algorithms place processes of size 212KB, 417 KB, 112KB, 426KB (in order).
2. Consider the following page reference string: 7,2,3,1,2,5,3,4,6,7,7,1,0,5,4,6,2,3,0,1. Assuming demand paging with three frames, how many page faults would occur for the following page replacement algorithms. i) LRU replacement ii) FIFO replacement iii) Optimal replacement.

Course Outcome 5 (CO 5):

1. Compare indexed allocation method with linked allocation method.
2. Assume that the read write head is at 97. The head is moving from 299 to 0. Requests are in the order 94, 82, 101, 110, 198, 75, 87, 124, 136. Find the seek distance for the following disk scheduling algorithms: i) Shortest seek time first ii) C-Scan.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CS2T04

Course Name: OPERATING SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Describe the role of bootstrap loader in booting a computer system.
2. Identify the role of mode bit in dual mode operation of the operating system.
3. Illustrate the significance of PCB during context switch.
4. Differentiate pre-emptive and non-preemptive scheduling.
5. Examine whether mutex lock meets all the requirements of a critical section problem.
6. With an example show how a wait-for graph is used to detect deadlock
7. Consider a logical address space of 32 pages with 1024 bytes per page mapped to a physical memory of 256 frames. Calculate the size of logical address and physical address in bits.
8. Explain the role of swapping in virtual memory.
9. Define the terms i) Seek time ii) Rotational latency iii) Disk bandwidth.
10. List any three file attributes and there significance in file system.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Explain the layered approach of OS structure. How's it different from modular approach. (7)

    (b) Explain in detail the various services of the operating system. (7)

OR

12. Describe the purpose of system call. What are the different ways to pass parameters to system call. List the basic types of system calls with examples. (14)

13. Illustrate the IPC mechanisms of shared memory and message passing. Distinguish the synchronous and asynchronous methods of message passing. (14)

OR

14. The arrival time, CPU burst and Priority of a set of processes are given in the table below. Find the average waiting time and turnaround time for SRTF, pre-emptive priority and non-preemptive priority scheduling algorithms. (14)

Process	Arrival Time	CPU Burst (ms)	Priority
P0	0	4	3
P1	2	5	2
P2	3	1	1
P3	4	3	4

15. Solve readers-writers problem using semaphore. The solution should meet all the requirements of a critical section problem. (14)

OR

16. (a) With the help of proper examples, explain how resource allocation graph can be used to avoid deadlock. (6)

    (b) Given the snapshot of system at time T0. Check whether the system is in a deadlock using deadlock detection algorithm. If P4 requests for (0, 1, 2) at time T1, determine the state of the system. (8)

	Allocation		
	A	**B**	**C**
P1	0	1	2
P2	0	0	0
P3	6	3	2
P4	3	5	4

Request		
A	**B**	**C**
0	1	2
7	5	0
6	5	2
0	0	0

Available		
A	**B**	**C**
0	1	0

17. (a) Compare fixed-sized partitions and variable-sized partitions. Discuss whether memory is lost due to fragmentation in any these methods. (6)

    (b) Explain segmentation showing physical address calculation with the help of an example. What is the significance of validation bit in segmentation table? (8)

OR

18. (a) Describe how page faults are handled by the operating system. (5)

    (b) Calculate the number of page faults for the reference string 1, 2, 9, 3, 2, 5, 3, 4, 9, 1, 9, 6, 3 with three-page frames, using the i) FIFO ii) OPT iii) LRU algorithms. (9)

19. Explain the significance of file systems in secondary storage devices. How is it implemented? (14)

OR

20. Consider a disk drive that has 100 cylinders. The current position of the head is at cylinder 55. The disk queue has requests: 45, 92, 20, 63, 7, 66, 30, 35. Find the seek distance of the head for the following disk scheduling algorithms: i) SSTF ii) Elevator iii) SCAN iv) C-LOOK. Assuming that the direction of head is towards the inner tracks. (14)

B24CS2T05	FORMAL LANGAUGES AND AUTOMATA THEORY	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

Formal Languages and Automata Theory is a fundamental area of theoretical computer science that studies the mathematical structures used to define and recognize languages. This course explores different classes of formal languages, their representations using automata, and their computational properties. It covers key models such as finite automata, pushdown automata, and Turing machines, highlighting their significance in language processing and problem-solving. Understanding these concepts provides a foundation for applications in compiler design, artificial intelligence, and complexity theory.

Prerequisites

Dicsrete Mathematics(B24MA2T03C)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Classify formal languages into regular, context-free, context-sensitive, and unrestricted categories, and design finite state automata, regular grammars, and regular expressions.(Cognitive knowledge level : Understand)
CO 2	Analyze and convert between various representations of regular languages, including regular expressions, finite automata, and regular grammars, using formal techniques like subset construction, state minimization, and the Pumping Lemma to evaluate language properties and non-regularity.(Cognitive knowledge level : Apply)
CO 3	Design, analyze, and simplify context-free grammars, construct parse trees and derivations, identify ambiguity, apply normal forms, and utilize formal techniques such as the Pumping Lemma and closure properties to determine the characteristics of context-free languages.(Cognitive knowledge level : Apply)
CO 4	Design push-down automata for context-free languages and linear bounded automata for context-sensitive grammars.(Cognitive knowledge level : Apply)
CO 5	Design Turing Machines to recognize recursive and recursively enumerable languages, and explain the concepts of decidability, undecidability of problems, and the Halting problem.(Cognitive knowledge level : Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3										1
CO 2	3	3	1	2								1
CO 3	3	3	3	2								1
CO 4	3	3	3	2								1
CO 5	3	3	1	2								1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	15	15	15
Understand	40	40	40
Apply	45	45	45
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (9 hours)

Regular Languages and Finite Automata

Introduction to formal language theory– Alphabets, Strings, Concatenation of strings, Languages.
Chomsky classification of formal languages Need for mathematical modeling - automata, automata through simple models.
Regular Languages - Regular grammar, The formal definition of a regular expression, Building Regular Expressions, Pattern Matching .
Finite Automata- Deterministic Finite State Automata (DFA), Nondeterministic Finite State Automata (NFA), NFA with epsilon transitions, Eliminating epsilon transitions.
Applications of finite automata - text search, keyword recognition.

MODULE 2 (10 hours)

Equivalence of Regular Expression and Finite Automata

Converting Regular Expressions to NFA, Equivalence of NFAs and DFAs - The Subset Construction. DFA State Minimization (proof required), Equivalence of regular expression with finite automata, Converting FA to Regular Expressions, Equivalence of Regular grammar with FA - Conversion in both directions .
Properties of Regular Languages - Closure and Decision Properties of Regular Languages, The Pumping Lemma for Regular Languages (with formal proof), Pumping lemma as a tool to prove non-regularity of languages.

MODULE 3 (10 hours)

Context Free Languages and Context Free Grammar

Context-Free Grammars - Formal definition of a context-free grammar, Designing context-free grammars, Leftmost and Rightmost Derivations Using a Grammar, Parse Trees, Ambiguous Grammars, CFGs and programming languages.
Simplification of Context-Free Languages - Elimination of useless symbols and productions, Eliminating epsilon productions, Eliminating unit productions, Chomsky normal form, Greibach normal form.
Properties of Context-Free Languages - The Pumping Lemma for Context-Free Languages (with formal proof), Closure Properties of Context-Free Languages.

MODULE 4 (8 hours)

Pushdown Automata and Context Sensitive Languages

Pushdown Automata - Formal definition of a pushdown automaton, Equivalence DPDA and NPDA (proof required), conversions in both Directions, Examples of pushdown automata Equivalence NPDAs and CFGs - conversions in both Directions.
Context Sensitive Languages - Context Sensitive Grammar (CSG), Linear Bounded Automata.

MODULE 5 (8 hours)

Recursively Enumerable Languages and Turing Machines

The formal definition of a Turing machine, Examples of Turing machines, Turing machines as language acceptors, Turing machines as computers of functions, Variants of Turing Machines, Recursive and recursively enumerable languages. Universal Turing Machine and Diagonalization, Decidable and Undecidable Problems, Halting problem.

Text Books

1. John E Hopcroft, Rajeev Motwani and Jeffrey D Ullman, Introduction to Automata Theory, Languages, and Computation, 3/e, Pearson Education, 2007.
2. Dexter C. Kozen, Automata and Computability, Springer (1999).
3. Peter Linz and Susan H. Rodger, An Introduction to Formal Languages and Automata, Jones and Bartlett Publishers, Inc, 7/e, 2022.

Reference Books

1. Michael Sipser, Introduction To Theory of Computation, Cengage Publishers, 2013.
2. John C Martin, Introduction to Languages and the Theory of Computation, McGraw-Hill Education, 4/e, 2010.
3. Kavi Mahesh, Theory of Computation: A Problem-Solving Approach, Wiley, 1/e, 2012.
4. Harry R. Lewis, Christos Papadimitriou, Elements of the Theory of Computation, Pearson Education, 2/e, 2015.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Regular Languages and Finite Automata		9 hours
1.1	Introduction to formal language theory– Alphabets, Strings, Concatenation of strings, Languages.	1
1.2	Chomsky classification of formal languages	1
1.3	Need for mathematical modeling - automata, automata through simple models, automata through simple models	1
1.4	Regular Languages - Regular grammar, The formal definition of a regular expression, The formal definition of a regular expression	1
1.5	Building Regular Expressions, Pattern Matching	1
1.6	Finite Automata- Deterministic Finite State Automata (DFA)	1
1.7	Nondeterministic Finite State Automata (NFA)	1
1.8	NFA with epsilon transitions, Eliminating epsilon transitions	1
1.9	Applications of finite automata - text search, keyword recognition	1
Module 2: Equivalence of Regular Expression and Finite Automata		10 hours
2.1	Converting Regular Expressions to NFA	1
2.2	Equivalence of NFAs and DFAs - The Subset Construction	1
2.3	Equivalence of NFAs and DFAs (proof required)	1
2.4	DFA State Minimization	1
2.5	Equivalence of regular expression with finite automata	1
2.6	Converting FA to Regular Expressions	1
2.7	Equivalence of Regular grammar with FA - Conversion in both directions	1

2.8	Closure and Decision Properties of Regular Languages	1
2.9	The Pumping Lemma for Regular Languages (with formal proof)	1
2.10	Pumping lemma as a tool to prove non-regularity of languages	1
Module 3: Context Free Languages and Context Free Grammar		10 hours
3.1	Context-Free Grammars - Formal definition of a context-free grammar	1
3.2	Designing context-free grammars, Leftmost and Rightmost Derivations Using a Grammar	1
3.3	Parse Trees, Ambiguous Grammars	1
3.4	CFGs and programming languages	1
3.5	Simplification of Context-Free Languages - Elimination of useless symbols and productions,	1
3.6	Eliminating epsilon productions, Eliminating unit productions	1
3.7	CFG to Chomsky normal form	1
3.8	CFG to Greibach normal form	1
3.9	Properties of Context-Free Languages - The Pumping Lemma for Context-Free Languages (with formal proof)	1
3.10	Closure Properties of Context-Free Languages	1
Module 4: Pushdown Automata and Context Sensitive Languages		8 hours
4.1	Pushdown Automata -Formal definition of a pushdown automaton	1
4.2	Equivalence DPDA and NPDA (proof required)	1
4.3	conversions in both Directions	1
4.4	Examples of pushdown automata	1
4.5	Equivalence NPDAs and CFGs	1
4.6	conversions in both Directions	1
4.7	Context Sensitive Languages - Context Sensitive Grammar (CSG)	1

4.8	Linear Bounded Automata	1
Module 5: Recursively Enumerable Languages Turing Machines		8 hours
5.1	Turing Machines - The formal definition of a Turing machine	1
5.2	Examples of Turing machines -Turing machines as language acceptors	1
5.3	Turing machines as computers of functions	1
5.4	Variants of Turing Machines	1
5.5	Recursive and recursively enumerable languages	1
5.6	Universal Turing Machine and Diagonalization	1
5.7	Decidable and Undecidable Problems	1
5.8	Halting problem	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Given the language L = $\{w|w \in \{0,1\}$ and w ends with 01$\}$, construct a deterministic finite automaton (DFA) to recognize L. Explain the steps involved in designing the DFA.
2. Construct a regular expression to represent the set of all binary strings that contain at least one occurrence of the substring "101". Convert this regular expression into an equivalent finite automaton and explain the steps involved.

Course Outcome 2 (CO 2):

1. Given the regular expression $(0|1)*01(0|1)*$, construct an equivalent NFA using the standard conversion process. Then, apply the subset construction method to convert the NFA into an equivalent DFA. Show all intermediate steps.
2. Minimize the number of states in the following DFA using the state minimization technique. Explain each step of the minimization process and verify that the minimized DFA is equivalent to the original. (Provide a DFA with at least 6 states for the question.)

Course Outcome 3 (CO 3):

1. Given the context-free grammar (CFG) below, construct a parse tree for the string `aabb`. Determine whether the grammar is ambiguous by finding multiple leftmost or rightmost derivations for the same string. If ambiguous, modify the grammar to remove ambiguity.

   S → aSb | SS |ϵ

2. Convert the following context-free grammar (CFG) into Chomsky Normal Form (CNF). Explain each transformation step in detail.

   $S \rightarrow AB \mid aB$

   $A \rightarrow aA \mid \epsilon$

   $B \rightarrow bB \mid b$

Course Outcome 4 (CO 4):

1. Design a Deterministic Pushdown Automaton (DPDA) to recognize the language

   $$L = \{w\#w^R \mid w \in \{a, b\}^*\},$$

   where # is a separator, and w^R denotes the reverse of w. Explain how the DPDA processes an input string.

2. Construct a Non-Deterministic Pushdown Automaton (NPDA) for the language

   $$L = \{a^n b^n \mid n \geq 1\}.$$

   Show all the necessary steps in the process.

Course Outcome 5 (CO 5):

1. Design a Turing Machine to compute the square of a natural number. Assume that the input is provided in unary representation.

2. Argue that it is undecidable to check whether a Turing Machine M enters a given state during the computation of a given input x.

MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CS2T05

Course Name: FORMAL LANGAUGES AND AUTOMATA THEORY

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Construct a simple regular expression for a language containing all binary strings that end with "11".
2. Construct a finite automaton that accepts the language of all strings over a, b containing at least one occurrence of "ab".
3. Convert the regular expression `(01*01)*` into an equivalent NFA using Thompson's construction. Draw the final NFA.
4. Show that the set of all strings over a, b with an even number of a's is closed under union and concatenation.
5. Define useless symbols in CFG with an example..
6. Convert the following CFG to Chomsky Normal Form (CNF)
   $S \rightarrow AB \mid a$
   $A \rightarrow BC \mid b$
   $B \rightarrow b$
   $C \rightarrow \epsilon$.
7. Design a PDA for the language of odd length binary palindromes.

8. write a Context Sensitive Grammar for the language$L = \{a^n b^n c^n \mid n \geq 1\}$(no explanation is required, just write the set of productions in the grammar).

9. Given the string `"0011"`, show how a Turing Machine processes it for the language $L = \{0^n 1^n \mid n \geq 1\}$.

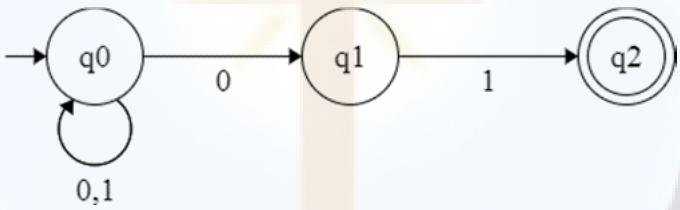
10. Differentiate between Recursive and Recursively Enumerable Languages.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) A vending machine dispenses a product when it receives exactly 3 coins (each worth 1 unit). Design a finite automaton (DFA or NFA) to model this behavior and explain its working with state transitions. (8)

    (b) Define extended transition function for an NFA. Show the processing of input w=0101 for the following NFA. (6)



OR

12. (a) Construct a finite automaton for recognizing valid email addresses (simplified format). Explain how the automaton differentiates between valid and invalid inputs. (8)

    (b) Construct a DFA for a language that accepts all strings over 0,1 where the number of 1's is divisible by 3. Explain the approach and justify state transitions. (6)

13. (a) Convert the following regular grammar into an equivalent finite automaton: Production Rules:
    S → aA | bB
    A → aS | bC | ϵ
    B → bS | aC
    C → aA | bB (6)

    (b) Convert the finite automaton below into an equivalent regular expression: (8)
    States: A, B, C
    Final State: C
    Transitions:

$$\delta(A, 0) = B$$

$$\delta(A, 1) = A$$

$$\delta(B,0) = C$$
$$\delta(B,1) = B$$
$$\delta(C,0) = C$$
$$\delta(C,1) = C$$

OR

14. (a) Minimize the given DFA
$Q = \{q_0, q_1, q_2, q_3, q_4, q_5\}, F = \{q_2, q_5\}$ (8)

State	0	1
q0	q1	q3
q1	q2	q4
q2	q1	q5
q3	q4	q0
q4	q5	q1
q5	q4	q2

(b) Convert the following finite automaton into a regular expression using state elimination: (6)

- States: {A, B, C, D}
- Start State: A
- Final State:{D}
- Transitions:
$\delta(A,a) = B$
$\delta(A,b) = A$
$\delta(B,a) = C$
$\delta(B,b) = B$
$\delta(C,a) = C$
$\delta(C,b) = D$
$\delta(D,a) = D$
$\delta(D,b) = D$

15. (a) Using an example, explain ambiguity in Context Free Grammar. (6)

(b) Convert the following CFG to Greibach Normal Form (GNF) and explain why GNF is useful. (8)
S $\rightarrow$ AB | a
B $\rightarrow$ bB | b
A $\rightarrow$ aA | ϵ

OR

16. (a) Convert the following CFG to Chomsky Normal Form (CNF) and explain each step: (7)
    S $\rightarrow$ BA | b
    B $\rightarrow$ bA | a
    A $\rightarrow$ aB | ϵ

    (b) Design a CFG for the language $L = \{w \in \{a,b\}^* \mid w \text{ has equal number of } a\text{'s and } b\text{'s}\}$. Prove whether the CFG is ambiguous or unambiguous by deriving the string `"abba"`. (7)

17. (a) Define a Linear Bounded Automaton (LBA). Construct an LBA for the language $L = \{0^n 1^n 2^n \mid n \geq 1\}$ and explain how it processes the string "001122". (7)

    (b) Construct an DPDA for the language

$$L = \{a^n b^{2n} \mid n \geq 1\}$$

    and explain the transition process for $n = 2$. (7)

OR

18. (a) Construct a Context-Sensitive Grammar (CSG) for the language

$$L = \{w \in \{a,b\}^* \mid \text{number of a's is twice the number of b's}\}$$

    Show the derivation for the string `"aabb"`. (7)

    (b) With an example illustrate how a multi-state PDA can be transformed into an equivalent single-state PDA. (7)

19. (a) Describe the concept of a Universal Turing Machine (UTM) and explain its significance. (6)

    (b) Design a Turing Machine to accept the language $L = \{a^n b^n \mid n \geq 1\}$. Describe its transitions and explain the working of the machine with an example. (8)

OR

20. (a) Explain the concepts of recursive and recursively enumerable languages. How are they related to Turing Machines? Provide relevant examples. (6)

    (b) Explain the Halting Problem in the context of Turing machines. Why is it significant in computability theory? (8)

B24CS2T06	DATABASE MANAGEMENT SYSTEMS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course provides a clear understanding of fundamental principles of Database Management Systems (DBMS) with special focus on relational databases to the learners. The topics covered in this course are basic concepts of DBMS, Entity Relationship (ER) model, Relational Database principles, Relational Algebra, Structured Query Language (SQL), Physical Data Organization, Normalization and Transaction Processing Concepts. This course helps the learners to manage data efficiently by identifying suitable structures to maintain data assets of organizations and to develop applications that utilize database technologies.

Prerequisites

Data Structures(B24CS2T01),Problem Solving and Programming Techniques(A) (B24ES1T01A), Industrial Programming (B24CS1T02)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Model conceptual database schema using ER models and explain fundamental database concepts. (Cognitive Knowledge Level: Understand)
CO 2	Analyze data organization, indexing, and relational algebra for efficient data management. (Cognitive Knowledge Level: Apply)
CO 3	Construct SQL queries to define, manipulate, and manage data within the database. (Cognitive Knowledge Level: Apply)
CO 4	Apply normalization and functional dependency principles to optimize database design and query processing. (Cognitive Knowledge Level: Apply)
CO 5	Interpret transaction management techniques, concurrency control mechanisms, and recovery methods to assess their role in ensuring database consistency and reliability; differentiate NoSQL database models and evaluate their applicability to various scenarios. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	1	2	1				1		2
CO 2	3	3	2	2	2							2
CO 3	2	3	3	2	2	1						2
CO 4	2	3	3	2	2						1	2
CO 5	2	2	2	1	3	1						2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (9 hours)

Introduction to Databases

Concept and Overview of Database Management Systems (DBMS) - Characteristics of Database system, Database Users, structured, semi-structured and unstructured data.
Data Models and Schema - Three Schema architecture. Database Languages, Database architectures and classification.
ER model – Entity types, entity set, attributes and keys, Relationships and constraints, cardinality, participation, notations, weak entities. Structure of Relational Databases - Integrity Constraints, Domain constraints, Entity integrity, Referential integrity constraints. Synthesizing ER diagram to relational schema.

MODULE 2 (7 hours)

Physical Data Organization, Indexing and Relational Algebra

Physical Data Organization - Review of terms: physical and logical records, blocking factor, Heap files.
Indexing and Hashing Concepts - Ordered Indices, Hash Indices, Dense and Sparse Indices, Multi Level Indices, Cluster Index, Dynamic Hashing.
Introduction to Relational Algebra - select, project, cartesian product operations, join - Equi-join, natural join.

MODULE 3 (10 hours)

Introduction to SQL Queries and Triggers

Introduction to Structured Query Language (SQL), Data Definition Language (DDL), Table definitions and operations – CREATE, DROP, ALTER, INSERT, DELETE, UPDATE.
SQL DML (Data Manipulation Language) - SQL queries on single and multiple tables, Nested queries (correlated and non-correlated) Aggregation and grouping, Views. Cursors- Implicit Cursors, Explicit cursors. Triggers- Row-level triggers, Statement-Level Triggers.

MODULE 4 (9 hours)

Database Design and Query Processing

Different anomalies in designing a database, The idea of normalization, Functional dependency, Armstrong's Axioms (proofs not required)
Closures and their computation, Equivalence of Functional Dependencies (FD), Minimal Cover (proofs not required).
First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF)
Query Processing and Optimization: Steps of Query processing, Measures of Query costs.

MODULE 5 (10 hours)

Transaction Management and Emerging Trends in Databases

Transaction Processing Concepts - overview of concurrency control, Transaction Model. Significance of concurrency Control and Recovery, Transaction States, System Log, Desirable Properties of transactions.
Serial schedules, Concurrent and Serializable Schedules, Conflict equivalence and conflict serializability, Recoverable and cascade-less schedules.
Locking, Two-phase locking.
Introduction to NoSQL Concepts - types of NoSQL databases- CAP Theorem- BASE properties- Use Cases and limitations of NoSQL. Multidimensional Data Models.

Text Books

1. Fundamentals of Database Systems, Elmasri, Navathe, Pearson 7/e.
2. Making the Sense of NoSQL: A guide for Managers and rest of us, Dan McCreary and Ann Kelly, Manning, 2014.

Reference Books

1. Database System Concepts, Sliberschatz A., H. F. Korth and S. Sudarshan, Mc Graw Hill, 7/e,2011.
2. NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data), Olivier Pivert, Wiley 2018.
3. Beginning Database Design Solutions, Rod Stephens, Wiley, 2/e, 2023.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Introduction to Databases		9 hours
1.1	Concept and Overview of Database Management Systems (DBMS) - Characteristics of Database system, Database Users.	1
1.2	Structured, semi-structured and unstructured data. Data Models and Schema.	1

1.3	Three Schema architecture, Database Languages.	1
1.4	Database architectures and classification.	1
1.5	ER model – Entity types, entity set, attributes and keys,	1
1.6	Relationships and constraints, Cardinality, participation, notations	1
1.7	Weak entities. ER Diagram exercises	1
1.8	Structure of Relational Databases - Integrity Constraints, Domain constraints, Entity integrity, Referential integrity constraints	1
1.9	Synthesizing ER diagram to relational schema.	1
Module 2: Physical Data Organization, Indexing and Relational Algebra		7 hours
2.1	Physical Data Organization - Review of terms: physical and logical records, blocking factor, Heap files.	1
2.2	Indexing and Hashing Concepts - Ordered Indices, Hash Indices	1
2.3	Indexing and Hashing Concepts - Dense and Sparse Indices	1
2.4	Multi Level Indices, Cluster Index	1
2.5	Dynamic Hashing	1
2.6	Introduction to Relational Algebra - select, project, cartesian product operations	1
2.7	Join- Equi-join, natural join. Relational Algebra examples	1
Module 3: Introduction to SQL Queries and Triggers		10 hours
3.1	Introduction to Structured Query Language (SQL), Data Definition Language (DDL)	1
3.2	Table definitions and operations – CREATE, DROP, ALTER, INSERT, DELETE, UPDATE.	1
3.3	SQL DML (Data Manipulation Language) - SQL queries on single table.	1
3.4	SQL queries on multiple tables	1
3.5	Nested queries (correlated and non-correlated)	1
3.6	Aggregation and grouping	1
3.7	Views	1

3.8	Cursors- Implicit Cursors, Explicit cursors.	1
3.9	Triggers- Row-level triggers, Statement-Level Triggers	1
3.10	Query examples using Cursors and Triggers	1
Module 4: Database Design and Query Processing		9 hours
4.1	Different anomalies in designing a database, The idea of normalization.	1
4.2	Functional dependency, Armstrong's Axioms (proofs not required)	1
4.3	Closures and their computation	1
4.4	Equivalence of Functional Dependencies (FD)	1
4.5	Minimal Cover (proofs not required).	1
4.6	First Normal Form (1NF)	1
4.7	Second Normal Form (2NF)	1
4.8	Third Normal Form (3NF)	1
4.9	Query Processing and Optimization: Steps of Query processing, Measures of Query costs.	1
Module 5: Transaction Management and Emerging Trends in Databases		10 hours
5.1	Transaction Processing Concepts - overview of concurrency control, Transaction Model.	1
5.2	Significance of concurrency Control and Recovery, Transaction States, System Log.	1
5.3	Desirable Properties of transactions, Serial schedules	1
5.4	Concurrent and Serializable Schedules	1
5.5	Conflict equivalence and conflict serializability	1
5.6	Recoverable and cascade-less schedules.	1
5.7	Locking, Two-phase locking.	1
5.8	Introduction To NoSQL Concepts - types of NoSQL databases.	1
5.9	CAP Theorem- BASE properties. Use Cases and limitations of NoSQL	1
5.10	Multidimensional Data Models.	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Draw an ER Diagram for the university management system based on the given requirements. Clearly indicate:
   Entities (e.g., Student, Course, Professor, Department)

   Relationships (e.g., enrollment, teaching, department assignment)

   Attributes (both key attributes and descriptive attributes)

   Cardinalities (one-to-many, many-to-many, etc.)

   Primary keys for each entity

2. Design an ER diagram for the following scenario: There is a set of teams, each team has an ID (unique identifier), name, main stadium, and to which city this team belongs. Each team has many players, and each player belongs to one team. Each player has a number (unique identifier), name, DoB, start year, and shirt number that he uses. Teams play matches, in each match there is a host team and a guest team.

Course Outcome 2 (CO 2):

1. Consider an EMPLOYEE file with 10000 records where each record is of size 80 bytes. The file is sorted on employee number (15 bytes long), which is the primary key. Assuming un-spanned organization, block size of 512 bytes and block pointer size of 5 bytes. Compute the number of block accesses needed for retrieving an employee record based on employee number if
   (i) No index is used
   (ii) Multi-level primary index is used.

2. Design and implement an SQL trigger that automatically executes when a new order is inserted into the Orders table. The trigger should perform the following tasks:

   Update Inventory: Deduct the order_quantity from the corresponding stock_quantity in the Books table.

   Log the Transaction: Insert a new record into the OrderHistory table capturing the order_id, book_id, current date as order_date, the stock_quantity before the update (old_stock), and the updated stock_quantity (new_stock).

Course Outcome 3 (CO 3):

1. For the SQL query, SELECT A, B FROM R WHERE B='apple' AND C = 'orange' on the table R(A, B, C, D), where A is a key, write any three equivalent relational algebra expressions.

2. In the following tables, foreign keys have the same name as primary keys except DIRECTED-BY, which refers to the primary key ARTIST-ID. Consider only single- director movies. MOVIES(MOVIE-ID, MNAME, GENRE, LENGTH, DIRECTED-BY) ARTIST(ARTIST-ID, ANAME)
   ACTING(ARTIST-ID, MOVIE-ID) Write SQL expressions for the following queries:
   (a) Name(s) and director name(s) of movie(s) acted by 'Jenny'.
   (b) Names of actors who have never acted with 'Rony'
   (c) Count of movies genre-wise.
   (d) Name(s) of movies with maximum length

Course Outcome 4 (CO 4):

1. Given the FDs P→Q, P→R, QR→S, Q→T, QR→U, PR→U, write the sequence of Armstrong's Axioms needed to arrive at the following FDs: (a) P → T (b) PR → S (c) QR → SU

2. Consider a relation PLAYER (PLAYER-NO, PLAYER-NAME, PLAYER-POSN, TEAM, TEAM-COLOR, COACH-NO, COACH-NAME, TEAM-CAPTAIN). Assume that PLAYER-NO is the only key of the relation and that the following dependencies hold:
   TEAM→{TEAM-COLOR, COACH-NO, TEAM-CAPTAIN}
   COACH-NO→COACH-NAME.
   i. Is the relation in 2NF? If not, decompose to 2NF.
   ii. Is the relation in 3NF? If not, decompose to 3NF.

Course Outcome 5 (CO 5):

1. Describe the salient features of NoSQL databases. Give example of a document in MongoDB.

2. Determine if the following schedule is *recoverable*. Is the schedule *cascade-less*? Justify your answer. r1(X), r2(Z), r1(Z), r3(X), r3(Y), w1(X), c1, w3(Y), c3, r2(Y), w2(Z), w2(Y), *c2.*

MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CS2T06

Course Name: DATABASE MANAGEMENT SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Differentiate between Super key, Candidate key and Primary key.
2. Describe the concept of a weak entity used in data modelling. Define the terms owner entity type, identifying relationship type.
3. Explain any three differences between dense index and sparse index
4. Differentiate between theta join and natural join operations.
5. Compare DDL and DML with the help of an example.
6. Illustrate the concept of trigger in SQL with an example.
7. Cite the Armstrong's axioms of FD.
8. Describe First Normal Form (1NF), Second Normal Form (2NF), and Third Normal Form (3NF) with appropriate examples.
9. Describe log-based recovery in DBMS and its importance with an example.
10. Summarize the features of NoSQL databases.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Draw an ER diagram based on the following information: (7)

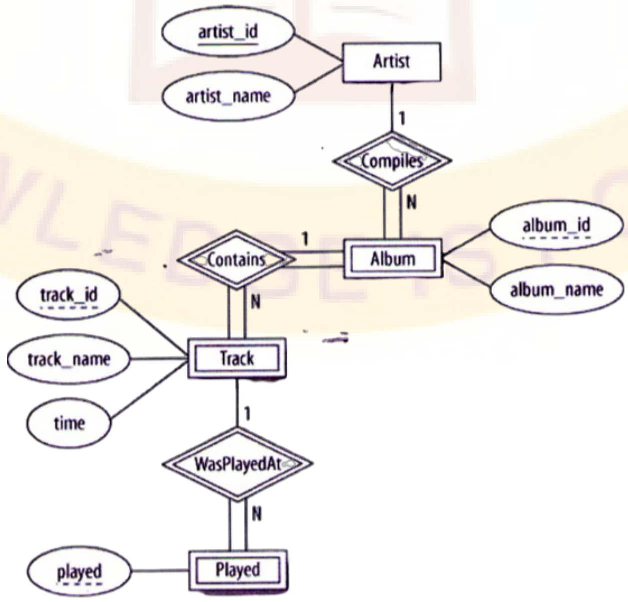
- Manufacturers have a name, which we may assume is unique, an address, and a phone number.
- Products have a model number and a type. Each product is made by one manufacturer and different manufacturers may have different products with the same model number. However, you may assume that no manufacturer would have two products with the same model number.
- Customers are identified by their unique social security number. They have email addresses, and physical addresses. Several customers may live at the same(physical) address, but we assume that no two customers have the same email address.
- An order has a unique order number, and a date. An order is placed by one customer. For each order, there are one or more products ordered, and there is a quantity for each product on the order.

(b) Explain the difference between logical data independence and physical data independence in a database system. Illustrate each concept with a real-world example. (7)

OR

12. (a) Describe any three types of database end users. Explain their roles and provide examples of how they interact with a database system. (7)

(b) Interpret the following ER diagram: (7)



13. (a) With the help of an example, explain Single-level indexing and multi-level indexing. Explain the difference (any four) between single level indexing and multi-level indexing. (8)

    (b) Explain a situation where a multi-level index would be significantly less effective than a single-level index, and vice versa. (6)

OR

14. (a) Consider the following schema. (8)
    Suppliers(sid(pk), sname, address)
    Parts(pid(pk), pname, color)
    Catalog(sid,pid(pk), cost)
    The primary key fields are underlined; Foreign keys have the same name as primary keys. Assume integer domain for the attributes sid, pid, cost and string domain for the attributes sname, address, pname, color. Write relational algebra expressions for the given questions. (Use * symbol for natural join and symbol for join)

    i. Find the names of suppliers who supply some red part.
    ii. Find the sids of suppliers who supply some red or green part.
    iii. Find the sids of suppliers who supply every red part or supply every green part.
    iv. Find the pids of parts supplied by at least two different suppliers

    (b) Explain the left outer join, right outer join and full outer join operations with suitable example (6)

15. (a) A company has two tables: Sales (SaleID - Primary Key, ProductID - Foreign Key, QuantitySold, SaleDate) and Inventory (ProductID - Primary Key, ProductName, StockQuantity, Price). Write an SQL trigger "UpdateStockAfterSale" to automatically update StockQuantity in the Inventory table when a new sale is recorded in Sales. Explain its working with an example, including the initial Inventory state, an INSERT into Sales, and the updated Inventory table. (7)

    (b) A company maintains an Employee database with the following table: Employee (EmpID, Name, Department, Salary, JoiningDate). Write SQL Queries to perform the following operations: (7)

    i. Insert a new employee record into the table.
    ii. Update the salary of an employee based on their EmpID.
    iii. Delete an employee record who has left the company.
    iv. Retrieve the names and salaries of employees working in the "IT" department.

OR

16. (a) Write SQL DDL statements based on the following database schema (Assume suitable domain types): (8)
    Employee (eid(pk), name, designation, salary, compid)
    Company (compid(pk),cname, address, turnover)

i. Create the above mentioned tables assuming each company has many employees. Mention the primary key, foreign key and not null constraints.

ii. Insert values into both the tables. Mention in which order insertions will be carried out.

iii. Modify the table Employee to include a new column "years-of-exp"

iv. Increment the salary of employees whose salary is less than Rs 25000 by 5%.

(b) Illustrate any three ways of using lNSERT statement in SQL. (6)

17. (a) Given a relation R(A, B, C, D, E) with the functional dependencies A → B, B → C, CD → E, find the closure of A and explain its significance in determining the keys of the relation. (6)

(b) Describe the different steps of query processing and explain their significance. How are query cost measures used to evaluate query performance? (8)

OR

18. (a) P and Q are two set of FDs for a relational schema R(A, B, C, D). $p = \{A \rightarrow B, B \rightarrow C, C \rightarrow D\}$ and $Q = A \rightarrow BC, C \rightarrow D$. Check whether P covers Q and Q covers P? Also check whether P and Q are equivalent. (6)

(b) Consider a relation R with five attributes (A, B, C, D, E). You are given the following dependencies: A → B, BC → E, and ED → A.

i. List all keys for R.

ii. Is R in 3NF?

iii. Convert the relation to the next higher normal form. (8)

19. (a) Determine if the following schedule is recoverable. Is the schedule cascadeless? Justify your answer. (7)
rl(X), r2(Z), rl(Z), r3(X), r3(Y), wl(X), cl, w3(Y), c3, r2(Y), w2(Z), w2(Y), c2
(Note: ri(X)/wi(X) means transaction Ti issues read/write on item X; ci means transaction Ti commits.)

(b) Check whether the following schedule is conflict serializable or not and find an equivalent serial schedule if possible.
rl(X), r2(Z), rl(Z), r3(X), r3(Y), wl(X), w3(Y), r2(Y), w2(Z), w2(Y)
(Note: ri(X)/wi(X) means tansaction Ti issues read/write on item X) (7)

OR

20. (a) Describe the different states of a transaction with the help of a neat sketch. (7)

(b) Differentiate serial and concurrent schedules. Elaborate conflict serializability with suitable example. (7)

B24HU2T03	ENTREPRENEURSHIP AND SOFTWARE MANAGEMENT SYSTEMS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

This course aims to learn the techniques to effectively plan, manage, execute, and control projects within time and cost targets with a focus on Information Technology and Service Sector.This course helps to learn fundamentals of Agile methodology,agile principles and agile project management techniques such as Scrum, XP and incremental design.

Prerequisites

Nil

Course Outcomes

After the completion of the course, the student will be able to:

CO 1	Understand the fundamentals of digital business models, startup financials, modern tech marketing, and AI-driven decision-making in the tech startups. (Cognitive Knowledge Level: Understand)
CO 2	Recognize the significance of engaging with business stakeholders to identify and gather requirements for a software system. (Cognitive Knowledge Level: Understand)
CO 3	Implement Agile methodologies throughout the Software Development Life Cycle. (Cognitive Knowledge Level: Apply)
CO 4	Apply various SCRUM practices in project management. (Cognitive Knowledge Level: Apply)
CO 5	Integrate Extreme Programming (XP) methods and incremental design principles into Agile software design and development. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3								2	2
CO 2	2	2	2								2	2
CO 3	3	3	3								2	2
CO 4	3	3	3								2	2
CO 5	3	3	3								2	2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (6 hours)

Entrepreneurship, Business Design, Marketing and Startup Pitching

Entrepreneurial Mindset-SimVenture, GoVenture; Identifying Business Opportunities-Google Trends, SurveyMonkey; Innovation and Business Model Tools- Canvanizer, Miro; Digital Business Models- Shopify, Chargebee; Business Model Canvas-Miro, Lucidchart; Startup Financials and Pitching for Tech Startups-LivePlan, Pitch; Modern Tech Marketing and AI-Driven Decisions- HubSpot, Marketo, Google Analytics, Hotjar, IBM Watson.

MODULE 2 (6 hours)

Introduction to Software Engineering and Agile Software

Introduction to Software Engineering - Professional software development - Git and GitHub/GitLab; Software engineering ethics- OWASP ZAP. Software process models - The waterfall model, Incremental development - Jira, Trello, Lucidchart/ Draw.io. Process activities - Software specification - Figma, UI/UX protyping, Jira; Software design and implementation - Visual Studio Code, Eclipse, Git, GitHub; Software validation-Cypress(web testing), JUnit, Pytest (unit testing), Postman (API testing); Software evolution-VS Code with Git integration, CI tools like CircleCI; Coping with change - Prototyping, Incremental delivery, Boehm's Spiral Model-Adobe XD/Figma, Azure DevOps/GitLab; Agile software development - Agile methods, agile manifesto - values and principles- Scrum, Kanban, XP-Roles like Product Owner, Scrum Master, Dev Team- Agile tools like Jira, Azure Boards, Miro.

MODULE 3 (6 hours)

Agile Development and project management

Agile Management – Agile Software Development-Jira, Azure Boards; Traditional Model vs. Agile Model-Lucidchart, Draw.io, Miro; Classification of Agile Methods-Scrum, Kanban, XP;Agile Manifesto and Principles-Miro, Jamboard; Agile Project Management – Agile Team Interactions-Microsoft Teams, Zoom, Miro, FigJam; Ethics in Agile Teams-Poll Everywhere;Agility in Design-Figma, Adobe XD; Testing-Cypress, PyTest, Postman; Agile Documentations-Google Docs; Agile Drivers, Capabilities and Value-Jira Reports, EazyBI, Google Data Studio, Power BI.

MODULE 4 (8 hours)

Introduction to SCRUM practices in project management

Agile Scrum Framework-Jira Scrum Boards, Azure DevOps; Scrum Artifacts-Jira, Trello; Meetings-Zoom, Microsoft Teams, Miro, FigJam; Activities and Roles-GitHub

Projects; Scrum Team Simulation-ScrumSim, Agile Lego Simulation Kits; Scrum Planning Principles-Planning Poker Online, Miro templates for estimation, Agile Cards; Product and Release Planning-Product Plan(Linear); Sprinting: Planning, Execution, Review and Retrospective-Jira Sprint Boards, Burndown plugins; User story definition and Characteristics- UserStoryMap.io, StoriesOnBoard, Jira User Story Templates, Acceptance tests and Verifying stories-Cucumber, SpecFlow, TestRail, Postman; Burn down chart-Jira Agile Reports, EazyBI, Excel/Google Sheets; Daily scrum- Slack with Geekbot, Microsoft Teams Check-ins; Scrum Case Study-Jira + GitHub, Confluence + Miro, Notion + Trello, LMS platforms like Moodle, Google Classroom.

MODULE 5 (10 hours)

Agile software design and development:

Agile design practices- Figma, Sketch, Adobe XD, Lucidchart, Draw.io, Miro; Role of design Principles; Need and significance of Refactoring-IntelliJ IDEA, VS Code; Refactoring Techniques-ReSharper, Eclipse Refactoring Tools, PyCharm Code Actions; Continuous Integration-GitHub Actions, GitLab CI/CD, CircleCI; Automated build tools-npm, Webpack; Version control-Git, GitHub, GitLab; Agility and Quality Assurance: Agile Interaction Design-Figma, Marvel App, UXPin; Agile approach to Quality Assurance-Zephyr, Allure, Xray for Jira; Test Driven Development-JUnit, NUnit, RSpec, PyTest, Jest; Pair programming: Issues and Challenges-Visual Studio Live Share, CodeTogether; Introduction to Extreme Programming (XP): XP Life cycle-Jira XP Templates, Agilefant; The XP Team, XP Concepts-SonarQube, CodeScene, Refactoring; Technical Debt-SonarCloud, CodeClimate; Timeboxing, Stories, Velocity-Jira Velocity Reports, Burndown Charts, Agile Cards, Scrumpy Poker; Adopting XP: Pre-requisites, Challenges-Atlassian suite (Jira, Bitbucket),Scrum wise, XP-focused Trello boards, Agile Maturity Assessment tools.

Text Books

1. Peter F. Drucker, Innovation and Entrepreneurship, HarperBusiness, 2006.
2. Alexander Osterwalder and Yves Pigneur, Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, Wiley, 2010.
3. Mike Cohn, Succeeding with Agile: Software Development Using Scrum, Addison-Wesley, 1/e, 2009.
4. David J. Anderson and Eli Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall , 2003.
5. Hazza and Dubinsky, Agile Software Engineering, Series: Undergraduates Topics in Science ,Springer, 2009.
6. Robert C. Martin, Agile Software Development- Principles, Patterns and Practices, Prentice Hall, 2013.
7. Ken Schawber, Mike Beedle, Agile Software Development with Scrum, Pearson, 2001.

8. Craig Larman, Agile and Iterative Development: A manager's Guide, Addison-Wesley, 2004.

Reference Books

1. Heidi M. Neck, Christopher P. Neck & Emma L. Murray, Entrepreneurship: The Practice and Mindset, SAGE Publications Inc., 3rd Edition, 2023.
2. Alejandro Cremades, The Art of Startup Fundraising: Pitching Investors, Negotiating the Deal, and Everything Else Entrepreneurs Need to Know, Wiley, 2023.
3. Roman Pichler, Agile Product Management with Scrum, Addison-Wesley, 1/e, 2010.
4. Kenneth S. Rubin, Essential Scrum: A Practical Guide to the Most Popular Agile Process, Addison Wesley, 2012.
5. James Shore and Shane Warden, The Art of Agile Development, O'Reilly Media, 2007.
6. Cohn, Mike, User Stories Applied: For Agile Software Development, Addison Wisley, 2004.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	36 Hours
Module 1: Entrepreneurship, Business Design, Marketing and Startup Pitching		6 hours
1.1	Entrepreneurial Mindset, Identifying Business Opportunities	1
1.2	Innovation and Business Model Tools, Digital Business Models	1
1.3	Business Model Canvas	1
1.4	Startup Financials and Pitching for Tech Startups	1
1.5	Modern Tech Marketing	1
1.6	AI-Driven Decisions	1
Module 2: Introduction to Software Engineering and Agile Sotware		6 hours
2.1	Introduction to Software Engineering, Professional software development, Software engineering ethics	1

2.2	Software process models - The waterfall model, Incremental development	1
2.3	Process activities - Software specification, Software design and implementation	1
2.4	Software validation, Software evolution.	1
2.5	Coping with change - Prototyping, Incremental delivery, Boehm's Spiral Model.	1
2.6	Agile software development - Agile methods, agile manifesto - values and principles	1
Module 3: Agile Development and project management		6 hours
3.1	Agile Management and Agile Software Development	1
3.2	Traditional Model vs. Agile Model	1
3.3	Classification of Agile Methods, Agile Manifesto and Principles, Agile Project Management	1
3.4	Agile Team Interactions, Ethics in Agile Teams	1
3.5	Agility in Design, Testing, Agile Documentations	1
3.6	Agile Drivers, Capabilities and Value.	1
Module 4: Introduction to SCRUM practices in project management		8 hours
4.1	Agile Scrum Framework, Scrum Artifacts, Meetings, Activities and Roles	1
4.2	Scrum Team Simulation, Scrum Planning Principles, Product and Release Planning (Lecture 1)	1
4.3	Scrum Team Simulation, Scrum Planning Principles, Product and Release Planning (Lecture 2)	1
4.4	Sprinting: Planning, Execution, Review and Retrospective	1
4.5	User story definition and Characteristics	1
4.6	Acceptance tests and Verifying stories	1
4.7	Burn down chart, Daily scrum	1
Case Study: Scrum (1 hour)		
Module 5:Agile software design and development		10 hours
5.1	Agile design practices, Role of design Principles	1
5.2	Need and significance of Refactoring, Refactoring Technique	1

5.3	Continuous Integration, Automated build tools, Version control	1
5.4	Agility and Quality Assurance: Agile Interaction Design, Agile approach to Quality Assurance, Test Driven Development (Lecture 1)	1
5.5	Agility and Quality Assurance: Agile Interaction Design, Agile approach to Quality Assurance, Test Driven Development (Lecture 2)	1
5.6	Pair programming: Issues and Challenges	1
5.7	Introduction to Extreme Programming (XP): XP Life cycle, The XP Team, XP Concepts	1
5.8	Refactoring, Technical Debt	1
5.9	Time boxing, Stories, Velocity	1
5.10	Adopting XP: Pre-requisites, Challenges	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Define the term Entrepreneurial Mindset. List any four characteristics of a successful entrepreneur.
2. Explain how a Business Model Canvas helps in identifying and analyzing a new business opportunity.
3. Apply any Innovation Tool (e.g., SWOT analysis, Design Thinking) to identify a business opportunity in the Digital Business sector.
4. Analyze the components of a successful Startup Pitch and evaluate how AI-driven decisions can enhance Modern Tech Marketing strategies.
5. Design a Business Model Canvas for a technology startup of your choice. Include key elements like Value Proposition, Customer Segments, Revenue Streams, and Cost Structure.

Course Outcome 2 (CO 2):

1. List the core values of the Agile Manifesto and explain their significance in Agile software development.

2. Explain the key differences between the Waterfall model and Incremental development in terms of their software process flow.
3. Apply the Boehm's Spiral Model to a real-world software development scenario and describe how risk analysis is integrated at each phase.
4. Analyze how prototyping supports software specification and validation activities in the development process.

Course Outcome 3 (CO 3):

1. List any four principles of the Agile Manifesto and briefly describe their purpose..
2. Compare and contrast the Traditional Software Development Model with the Agile Model in terms of flexibility, team structure, and documentation.
3. Explain the classification of Agile methods and give one example for each category.
4. Demonstrate how Agile team interactions influence project outcomes in a real-world software development scenario.

Course Outcome 4 (CO 4):

1. Define a user story and list its main characteristics in the Scrum framework.
2. Explain the roles and responsibilities of the Scrum Master, Product Owner, and Development Team in a Scrum project.
3. Illustrate the process of a typical Sprint cycle by describing its key phases: planning, execution, review, and retrospective.
4. Describe the purpose and usage of a burn down chart. How does it help in monitoring project progress?

Course Outcome 5 (CO 5):

1. What is refactoring in agile design, and why is it significant in software development?
2. Explain how Test-Driven Development (TDD) contributes to Agile quality assurance.
3. Demonstrate the use of version control and continuous integration tools in managing collaborative code development.
4. Describe the XP lifecycle and the role of "stories" and "velocity" in planning and tracking XP projects.
5. Analyze the challenges and potential benefits of adopting Pair Programming in an Agile team.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24HU2T03

Course Name: ENTREPRENEURSHIP AND SOFTWARE MANAGEMENT SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Differentiate between Traditional Business Models and Digital Business Models with suitable examples.
2. Explain the importance of Identifying Business Opportunities in entrepreneurship.
3. How does Software Validation help in software development?
4. Why is continuous customer collaboration emphasized in Agile development?
5. Compare the traditional software development model with the Agile model in terms of flexibility, customer involvement, and delivery approach.
6. Explain any three principles of the Agile Manifesto and how they contribute to effective software development.
7. What are the three main Scrum Artifacts, and what is their purpose?
8. Briefly explain the importance of the Daily Scrum meeting in Agile Scrum.
9. What is Refactoring, and why is it important in Agile development?
10. Briefly explain the concept of Test-Driven Development (TDD) and its benefits in Agile.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Explain the concept of Entrepreneurial Mindset. Discuss how developing an entrepreneurial mindset helps in identifying and evaluating business opportunities in the digital era. (7)

    (b) Analyze the role of Innovation Tools in developing a competitive business model. Illustrate how a startup can use any two innovation tools to improve its business model. (7)

OR

12. (a) Apply the Business Model Canvas framework to develop a business idea for a technology-based startup. Explain each component briefly with respect to your idea. (7)

    (b) Design a marketing strategy for a tech startup using AI-driven decision-making tools. Evaluate how modern tech marketing approaches help startups achieve competitive advantage. (7)

13. (a) Explain the role of Professional Software Development and discuss the key challenges faced by software engineers. (7)

    (b) Compare and contrast the Waterfall Model and Incremental Development in terms of flexibility, risk handling, and efficiency. (7)

OR

14. (a) Describe the key phases of Software Specification, Design, Implementation, Validation, and Evolution with real-world examples. (7)

    (b) Explain how Prototyping and Incremental Delivery help in handling changing customer requirements. (7)

15. (a) Compare and contrast the Traditional Software Development Model with the Agile Model. (7)

    (b) Explain the Agile Manifesto and its core principles with suitable examples. (7)

OR

16. (a) Discuss the significance of Agile Team Interactions and Ethics in Agile Teams. (7)

    (b) How do Agile Drivers, Capabilities, and Value contribute to Agile Project Management? (7)

17. (a) Explain the key roles in the Agile Scrum Framework and their responsibilities. (7)

    (b) Discuss the importance of Sprint Planning, Execution, Review, and Retrospective in Scrum. (7)

OR

18. (a) What is a Burndown Chart? Explain its significance in tracking project progress in Scrum. (7)

    (b) Describe the characteristics of a good User Story and explain how Acceptance Tests help in verifying stories. (7)

19. (a) Explain the role of design principles in Agile Design Practices and their impact on software development. (7)

    (b) Demonstrate how Continuous Integration and Automated Build Tools improve software quality in Agile development with a real-world example. (7)

OR

20. (a) Analyze the challenges of adopting Extreme Programming (XP) and suggest strategies to overcome them. (7)

    (b) Evaluate the effectiveness of Pair Programming in Agile development. Discuss its benefits and potential drawbacks. (7)

B24CD2T01	MACHINE LEARNING CONCEPTS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

This course enables the learners to understand the advanced concepts and algorithms in machine learning. The course covers the standard and most popular supervised learning algorithms such as linear regression, logistic regression, decision trees, basic clustering algorithms and performance measures. This course helps the students to provide machine learning based solutions to real world problems.

Prerequisites Linear Algebra and Mutivariable Calculus(B24MA1T01), Discrete

Mathematics (B24MA2T03C), Industrial Progamming(B24CS1T02), Data Structures (B24CS2T01)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Apply concepts of vector spaces and analytic geometry to solve computational problems (Cognitive Knowledge Level: Apply).
CO 2	Illustrate machine learning techniques, artificial neural networks including perceptrons, multilayer networks and activation functions. (Cognitive Knowledge Level: Understand)
CO 3	Apply the concepts of regression and classification techniques (Cognitive Knowledge Level: Apply)
CO 4	Understand clustering techniques such as partition-based, hierarchical and density-based methods. (Cognitive Knowledge Level: Understand)
CO 5	Evaluate the performance of machine learning models(Cognitive Knowledge Level:Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2			3							2
CO 2	3	3										2
CO 3	2	2		2	3						2	2
CO 4		2		3	2							2
CO 5		2		2	2							2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Vector Spaces:

Vector Spaces, inverse and transpose, vector subspace, Linear Independence Overview of machine learning - supervised, semi-supervised, unsupervised learning, reinforcement learning, Proximity Measures, Probably Approximately Correct Learning (PAC), VC Dimension.

MODULE 2 (10 hours)

Analytic Geometry :

Norms, Inner Products, Positive definite, Determinant and Trace, Eigenvalues and Eigenvectors Biological neurons- Artificial neural networks, Basic models of artificial neural networks – Connections, Learning, McCulloch and Pitts Neuron, Hebb network. Perceptron, Multilayer feed forward network, Activation functions (Sigmoid, ReLU, Tanh).

MODULE 3 (6 hours)

Regression:

Linear regression with one variable, Linear regression with multiple variables, Non Linear regression. Solution using gradient descent algorithm and matrix method. Logistic regression, ID3.

MODULE 4 (7 hours)

Clustering:

Similarity measures, Hierarchical Clustering-Agglomerative, Divisive, Dendrogram, K-means , K-medoids clustering, Density based clustering.

MODULE 5 (6 hours)

Performance Measures:

Classification Performance measures - Accuracy, Precision, Recall, Specificity, False Positive Rate (FPR), F1 Score, Receiver Operator Characteristic (ROC) Curve, AUC.
Regression Performance Evaluation Metrics: Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination.
Clustering Performance Evaluation Metrics: Purity, Jaccard index, Normalized Mutual Information, Clustering Accuracy, Silhouette Coefficient, Dunn's Index.

Text Books

1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong published by Cambridge University Press.

Reference Books

1. Linear Algebra and Its Applications, 4th Edition by Gilbert Strang.
2. Linear Algebra Done Right by Axler, Sheldon, 2015 published bySpringer.
3. Introduction to Applied Linear Algebra by Stephen Boyd and Lieven Vandenberghe, 2018 published by Cambridge UniversityPress.
4. Convex Optimization by Stephen Boyd and Lieven Vandenberghe, 2004 published by Cambridge UniversityPress.
5. Pattern Recognition and Machine Learning by Christopher M Bishop, 2006, published bySpringer.
6. Learning with Kernels – Support Vector Machines, Regularization, Optimization, and Beyond by Bernhard Scholkopf and Smola, Alexander J Smola.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	36 Hours
Module 1: Vector Spaces		7 hours
1.1	Vector Spaces –Vector Spaces	1

1.2	Inverse and transpose	1
1.3	Vector subspace, Linear Independence	1
1.4	Overview of machine learning - supervised, semi-supervised, unsupervised learning	1
1.5	Reinforcement learning, Proximity Measures	1
1.6	Probably Approximately Correct Learning (PAC)	1
1.7	VC Dimension	1
Module 2: Analytic Geometry		10 hours
2.1	Analytic Geometry : Norms, Inner Products	1
2.2	Positive definite	1
2.3	Determinant and Trace	1
2.4	Eigenvalues and Eigenvectors	1
2.5	Biological neurons-Artificial neural networks	1
2.6	Basic models of artificial neural networks – Connections	1
2.7	Learning, McCulloch and Pitts Neuron	1
2.8	Hebb network. Perceptron	1
2.9	Multilayer feed forward network	1
2.10	Activation functions (Sigmoid, ReLU, Tanh)	1
Module 3: Regression		6 hours
3.1	Regression - Linear regression with one variable	1
3.2	Linear regression with multiple variables	1
3.3	Non Linear regression	1
3.4	Solution using gradient descent algorithm and matrix method	1
3.5	Logistic regression	1
3.6	ID3	1
Module 4: Clustering		7 hours
4.1	Clustering-Similarity measures	1
4.2	Hierarchical Clustering-Agglomerative,Divisive	1

4.3	Dendrogram, K-means	1
4.4	K-means	1
4.5	K-medoids clustering	1
4.6	K-medoids clustering	1
4.7	Density based clustering	1
Module 5: Performance Measures		6 hours
5.1	Classification Performance measures - Accuracy, Precision, Recall, Specificity	1
5.2	False Positive Rate (FPR), F1 Score, Receiver Operator Characteristic (ROC) Curve, AUC	1
5.3	Regression Performance Evaluation Metrics: Mean Absolute Error (MAE), Root Mean Squared Error (RMSE)	1
5.4	R Squared/Coefficient of Determination	1
5.5	Clustering Performance Evaluation Metrics: Purity, Jaccard index, Normalized Mutual Information	1
5.6	Clustering Accuracy, Silhouette Coefficient, Dunn's Index	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. 1. Prove that a matrix with positive definite inner product has all positive eigenvalues. Provide an example matrix and verify its positive definiteness using norms and inner products.

2. Let $A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$.

   (a) Verify whether the matrix A is symmetric and positive definite.

   (b) Compute its determinant, trace, and eigenvalues.

   (c) Interpret the results in the context of vector space transformations.

Course Outcome 2 (CO 2):

1. Explain the structure of a multilayer feedforward neural network. How do activation functions like Sigmoid, Tanh, and ReLU influence the learning capacity of the network?
2. Draw and describe the McCulloch-Pitts model of a neuron. Highlight its limitations and how they are addressed in more advanced models like the perceptron.

Course Outcome 3 (CO 3):

1. Given a dataset with two features, implement linear regression using the gradient descent method and show the steps of parameter updates for two iterations
2. Using a small decision tree, demonstrate the working of the ID3 algorithm. Show how information gain is calculated for attribute selection.

Course Outcome 4 (CO 4):

1. Apply K-means clustering for the dataset (1,1),(2,1),(4,3),(5,4)(1,1), (2,1), (4,3), (5,4)(1,1),(2,1),(4,3),(5,4) with K=2K=2K=2 and initial centroids (1,1)(1,1)(1,1) and (5,4)(5,4)(5,4). Perform two iterations.
2. Compare agglomerative and divisive hierarchical clustering. Which one is more computationally efficient and in what scenarios?

Course Outcome 5 (CO 5):

1. Given a confusion matrix, calculate Accuracy, Precision, Recall, Specificity, and F1-Score. Interpret each value in the context of a binary classification task.
2. For a given actual vs. predicted output table, compute Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared. Discuss the model's performance.

MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CD2T01

Course Name: Machine Learning Concepts

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define a vector space. What are the necessary conditions for a set to be considered a vector space?
2. Briefly compare supervised, unsupervised, semi-supervised, and reinforcement learning
3. Define eigenvalues and eigenvectors. How are they useful in dimensionality reduction?
4. Compare biological neurons with artificial neurons. What are the main components of an artificial neuron?.
5. How does linear regression with multiple variables differ from the single-variable case?
6. Differentiate between entropy and information gain in the context of the ID3 algorithm.
7. Explain the K-means clustering algorithm. What are its key steps?
8. In what kind of data distribution is density-based clustering more suitable compared to K-means?
9. Define False Positive Rate (FPR). How is it related to specificity?
10. Explain the ROC (Receiver Operating Characteristic) curve. What does each point on the curve represent?

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Differentiate between inverse and transpose of a matrix. Show with an example how both are computed and mention two applications of each in machine learning. (7)

    (b) What are proximity measures? Explain the importance of distance/similarity metrics in machine learning with at least two examples such as Euclidean and Cosine similarity (7)

OR

12. (a) Define linear independence. Explain how to determine whether a set of vectors is linearly independent (7)

    (b) Explain the concept of Probably Approximately Correct (PAC) learning. What are the key ideas behind this theory and how does it help in understanding learning algorithms? (7)

13. (a) Explain norm in vector spaces? Explain different types of norms (L1, L2, etc.) and their significance in machine learning with suitable examples (7)

    (b) Explain multilayer feedforward neural network? Explain its structure, the role of hidden layers, and how learning occurs in such networks (7)

OR

14. (a) Define eigenvalues and eigenvectors. Derive the eigenvalue equation and show how they are computed for a 2×2 matrix. Mention one application in dimensionality reduction. (7)

    (b) Compare Sigmoid, Tanh, and ReLU activation functions in terms of their mathematical form, output range, and effect on gradient-based learning. (7)

15. (a) Explain the working of the gradient descent algorithm used to minimize the cost function in linear regression. Also, discuss the role of the learning rate in determining the speed and success of convergence, with the help of a diagram illustrating convergence behavior. (7)

    (b) Describe how polynomial regression extends linear models to capture non-linear relationships. Discuss the implications of increasing the polynomial degree on bias, variance, and overall model performance. (7)

OR

16. (a) Describe the steps involved in the K-means clustering algorithm. (7)

    (b) Explain the impact of the choice of initial centroids on the final clusters in K-means. (7)

17. (a) Given a binary classification problem where x = [2,3] and the weights w = [0.5, 0.25], compute the output of the logistic regression model using the sigmoid function. Also calculate the probability and classify the result (threshold = 0.5). (7)

(b) Given a dataset with the following attributes and class labels:

Outlook	**Temperature**	**Humidity**	**Wind**	**PlayTennis**
Sunny	Hot	High	Weak	No
Sunny	Hot	High	Strong	No
Overcast	Hot	High	Weak	Yes
Rain	Mild	High	Weak	Yes

Calculate the entropy of the dataset and the information gain for the attribute "Outlook". (7)

OR

18. (a) Given the following 2D data points:
(1,1), (2,1), (4,3), (5,4)
Apply K-means clustering with $K = 2$. Use initial centroids as (1,1) and (5,4). Perform two iterations showing assignment and centroid update steps. Also, provide final cluster assignments and centroids. (7)

(b) Given the following two data points:
$A = (2, 3, 5)$
$B = (4, 1, 7)$
Calculate the following similarity/distance measures between A and B using:
- Euclidean Distance
- Cosine Similarity
- Manhattan Distance
Show all steps and interpret the result in terms of similarity. (7)

19. (a) What is the F1 Score? Derive its formula and explain why it is useful in imbalanced datasets. Compare its effectiveness with that of accuracy. (7)

(b) A regression model was evaluated using the following predicted and actual values: Actual: [3, -0.5, 2, 7] Predicted: [2.5, 0.0, 2, 8] Calculate the Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared score. Show all steps clearly. (7)

OR

20. (a) Explain the significance of R-squared (coefficient of determination) in regression. How does it help in evaluating the goodness of fit? What are its limitations? (7)

(b) What is Normalized Mutual Information (NMI) in clustering evaluation? How does it differ from raw mutual information and accuracy? Explain with a simple example. (7)

B24CS2L05	LOGIC SYSTEM DESIGN AND OPERATING SYSTEMS LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

This laboratory course integrates hands-on experimentation with digital logic circuits and core operating system concepts to strengthen practical understanding. In Part A, students will design and simulate combinational and sequential logic circuits—such as adders, counters, and shift registers—using open-source simulators, reinforcing foundational digital design principles. Part B focuses on operating system functionalities, including shell scripting, process management, CPU scheduling, synchronization, and memory management, implemented in Linux using C. Through these exercises, students will bridge theoretical knowledge with real-world applications, developing skills in problem-solving, system design, and performance evaluation. The course aligns with the syllabus of B24CS1T01 (Logic System Design) and B24CS2T04 (Operating Systems) for comprehensive assessment.

Prerequisites

Problem Solving and Programming Techniques(A)(B24ES1T01A), Data Structures(B24CS2T01), Logic System Design(B24CS1T01), Computer Organization and Architecture(B24CS2T02)

Course Outcomes

After the completion of the course the student will be able to

CO 1	Design and implement combinational logic circuits such as adders, multiplexers, demultiplexers, code converters etc., and realize Boolean expressions using circuit simulators.(Cognitive Knowledge Level: Apply)
CO 2	Design various sequential circuits like shift registers, counters etc., and simulate their working.(Cognitive Knowledge Level: Apply)
CO 3	Implement shell scripts using control structures and system commands.(Cognitive Knowledge Level: Apply)
CO 4	Apply system calls and IPC mechanisms to create, manage, and synchronize processes for concurrent execution.(Cognitive Knowledge Level: Apply)
CO 5	Evaluate CPU scheduling algorithms and page replacement strategies.(Cognitive Knowledge Level: Apply)
CO 6	Implement deadlock handling mechanisms to evaluate system state.(Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	3	1				1		1		2
CO 2	2	3	3	1				1		1		2
CO 3	2	3	3	1				1		1		2
CO 4	2	3	3	1				1		1		2
CO 5	2	3	3	1				1		1		2
CO 6	2	3	3	1				1		1		2

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance — 10 marks

Continuous Assessment — 20 marks

Viva-Voce/ Test — 15 marks

Lab Record — 5 marks

SYLLABUS

LIST OF EXPERIMENTS

PART A	
1	Design and implement a combinational logic circuit for Half adder, full adder, Multiplexer, Demultiplexer, Encoder, Decoder.
2	Implement a Boolean function using MUX IC.
3	Design and implement the following shift registers using D flip flops (ii) Serial in parallel out (ii) Parallel in parallel out.
4	Design and implement an asynchronous counter - N bit up counter, mod-N counter.
5	Design and implement a synchronous sequence generator.
PART B	
6	Shell programming: Write simple functions with condition and loop statements.
7	Implement system calls: fork, exec, getpid, wait, exit.
8	Implement inter-process Communication using shared memory.
9	Implement FCFS, SJF, Non-preemptive priority, Round-Robin CPU scheduling algorithms.
10	Solve one of the classic synchronization problems using semaphores.
11	Implement Banker's algorithm for deadlock avoidance.
12	Implement FIFO, OPT and LRU page replacement algorithms.

Reference Books

1. M. Morris Mano, Digital Logic Computer Design, 4/e, Pearson Education, 2013.
2. Thomas L Floyd, Digital Fundamentals, 10/e, Pearson Education, 2009.
3. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007.
4. Andrew S Tanenbaum, "Modern Operating Systems" , 4th Edition, Prentice Hall, 2015.
5. William Stallings, "Operating systems", 6th Edition, Pearson, Global Edition, 2015.
6. Garry Nutt, Nabendu Chaki, Sarmistha Neogy, "Operating Systems", 3rd Edition, Pearson Education.

B24CS2L06	DATABASE LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

This lab course provides hands-on experience in designing, implementing, and managing databases using SQL and NoSQL. Students will learn database schema design, querying, transaction control, and advanced features like stored procedures and triggers. The course bridges theory with practical application, preparing students for real-world database management.

Prerequisites

NIL

Course Outcomes

After the completion of the course the student will be able to

CO 1	Develop database schema for a given real world problem-domain using standard design and modeling approaches. (Cognitive Knowledge Level: Apply)
CO 2	Construct queries using SQL for database creation, interaction, modification, and updation. (Cognitive Knowledge Level: Apply)
CO 3	Plan and implement triggers and cursors, procedures, functions, and control structures using PL/SQL. (Cognitive Knowledge Level: Apply)
CO 4	Perform CRUD operations in NoSQL Databases. (Cognitive Knowledge Level: Apply)
CO 5	Design database applications using front-end tools and back-end DBMS. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	2	3	1		1	1	1		2
CO 2	3	3	3	2	2			1	1			2
CO 3	3	3	3	3	2			1	1			2
CO 4	3	3	3	3	3			1	1			2
CO 5	3	3	3	3	3	1		1	2	2	3	2

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Viva-Voce/ Test	15 marks
Lab Record	5 marks

SYLLABUS

LIST OF EXPERIMENTS

1	Design a database schema for an application with ER diagram from a problem description.
2	Creation of database schema - DDL (create tables, set constraints, enforce relationships, create indices, delete and modify tables). Export ER diagram from the database and verify relationships (with the ER diagram designed in step 1).
3	Database initialization - Data insert, Data import to a database (bulk import using UI and SQL Commands).
4	Practice SQL commands for DML (insertion, updating, altering, deletion of data, and viewing/querying records based on condition in databases).
5	Implementation of various aggregate functions, Order By, Group By and Having clause in SQL.
6	Implementation of set operators nested queries, and join queries.
7	Practice of SQL TCL DCL commands like Rollback, Commit, Savepoint, Practice of SQL DCL commands for granting and revoking user privileges.
8	Practice of SQL commands for creation of views and assertions.

9	Creation and execution of stored procedures implementation of reusable function in PL/SQL.
10	Creation of event-driven actions in database using Triggers, Manage query results using explicit and implicit cursors.
11	Perform basic CRUD (Create, Read, Update, Delete) operations on a Cassandra table.
12	Perform CRUD operations with MongoDB.
13	Develop a database application using any front-end tool as a group project. The application constructed should have a minimum of five tables. Submit a detailed report of the project.

Reference Books

1. Sliberschatz Korth and S. Sudarshan, Database System Concepts, McGraw Hill, 7/e, 2017.
2. Adam Fowler, NoSQL for Dummies, John Wiley and Sons, 2015.
3. Olivier Pivert, NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data), Wiley 1/e, 2018.
4. Dan McCreary and Ann Kelly, Making the Sense of NoSQL: A guide for Managers and Rest of us, Manning 1/e, 2014.

B24CSM41	OBJECT ORIENTED PROGRAMMING IN JAVA(Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Inheritance, Exception handling, Event handling, Multithreaded programming and working with window-based graphics. This course helps the learners to develop Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

Prerequisites

Problem Solving and Programming Techniques(A) (B24ES1T01A)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Explain the fundamental concepts of object-oriented software design, the purpose and structure of UML diagrams, and the core components of the Java programming environment. (Cognitive Knowledge Level: Understand)
CO 2	Develop Java programs utilizing core language features such as primitive data types, operators, control statements, and object-oriented programming concepts including classes, objects, methods, and constructors. (Cognitive Knowledge Level: Apply)
CO 3	implement Java programs that demonstrate inheritance, polymorphism, packages, interfaces, and exception handling mechanisms to create robust and modular software.(Cognitive Knowledge Level: Apply)
CO 4	Utilize Java's advanced libraries for file handling, string processing, and collection management in practical applications. (Cognitive Knowledge Level: Apply)
CO 5	Construct interactive GUI applications using Swing components and event handling techniques and implement multithreaded programs for concurrent execution in Java.(Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1		1							1
CO 2	3	2	2		2							1
CO 3	2	2	3		1							1
CO 4	3	2	3		2							1
CO 5	3	2	3		3							1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (10 hours)

Introduction:

Approaches to Software Design - Functional Oriented Design, Object Oriented Design, Case Study of Automated Fire Alarm System.
Object Modeling Using UML – Basic Object Oriented concepts, UML (Unified Modeling Language) diagrams, Use case model, Class diagram, Interaction diagram, Activity diagram, State chart diagram.
Introduction to Java - Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM), Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues.

MODULE 2 (9 hours)

Core Java Fundamentals:

Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.
Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.
Control Statements - Selection Statements, Iteration Statements and Jump Statements.
Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, this Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Final Variables, Inner Classes, Command-Line Arguments, Variable Length Arguments.

MODULE 3 (10 hours)

More features of Java:

Inheritance - Super Class, Sub Class, The Keyword super, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, Using final with Inheritance.
Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing

Packages, Interfaces.
Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally.

MODULE 4 (8 hours)

Advanced features of Java:

Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Object Streams and Serialization, Reading and Writing Files.
Java Library - String Handling – String Constructors, String Length, Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, Using valueOf(), Comparison of StringBuffer and String.
Collections framework – Collections overview, Collections Class – ArrayList. Accessing Collections via an Iterator.

MODULE 5 (8 hours)

GUI Programming, Event Handling and Multithreaded Programming:

Swing fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Exploring Swing - JFrame, JLabel, JButton, JTextField.
Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model.
Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Suspending, Resuming and Stopping Threads.

Text Books

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Rajib Mall, Fundamentals of Software Engineering, 4th edition, PHI, 2014.
3. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11th Edition, Pearson, 2018.

Reference Books

1. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
2. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
3. Flanagan D., Java in A Nutshell, 8/e, O'Reilly, 2018.
4. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Introduction		10 hours
1.1	Approaches to Software Design - Functional Oriented Design, Object Oriented Design	1
1.2	Case Study of Automated Fire Alarm System	1
1.3	Object Modeling Using UML – Basic Object Oriented concepts.	1
1.4	UML (Unified Modeling Language) diagrams, Use case model.	1
1.5	UML (Unified Modeling Language) diagrams, Class diagram, Interaction diagram.	1
1.6	UML (Unified Modeling Language) diagrams, Activity diagram, State chart diagram.	1
1.7	Introduction to Java - Java programming Environment and Runtime Environment.	1
1.8	Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM)	1
1.9	Java compiler, Bytecode, Java applet, Java Buzzwords	1
1.10	Java program structure, Comments, Garbage Collection, Lexical Issues.	1
Module 2: Core Java Fundamentals		9 hours
2.1	Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables.	1
2.2	Arrays, Strings, Vector class.	1
2.3	Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	1

2.4	Control Statements - Selection Statements, Iteration Statements and Jump Statements.	1
2.5	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference	1
2.6	Introduction to Methods, Constructors, this Keyword.	1
2.7	Method Overloading, Using Objects as Parameters, Returning Objects	1
2.8	Recursion, Access Control, Static Members, Final Variables.	1
2.9	Inner Classes, Command-Line Arguments, Variable Length Arguments.	1
Module 3: More features of Java		10 hours
3.1	Inheritance - Super Class, Sub Class, The Keyword super,	1
3.2	Protected Members, Calling Order of Constructors	1
3.3	Method Overriding	1
3.4	The Object class, Abstract Classes and Methods, Using final with Inheritance.	1
3.5	Packages and Interfaces - Defining Package, CLASSPATH.	1
3.6	Access Protection, Importing Packages, Interfaces.	1
3.7	Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause	1
3.8	Try Block and catch Clause	1
3.9	Multiple catch Clauses, Nested try Statements.	1
3.10	throw, throws and finally.	1
Module 4: Advanced features of Java		8 hours
4.1	TInput/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class	1
4.2	Object Streams and Serialization	1
4.3	Reading and Writing Files	1
4.4	Java Library - String Handling – String Constructors, String Length	1

4.5	Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings	1
4.6	Using valueOf(), Comparison of StringBuffer and String	1
4.7	Collections framework – Collections overview, Collections Class – ArrayList. Accessing Collections via an Iterator	1
4.8	Accessing Collections via an Iterator	1
Module 5: GUI Programming, Event Handling, Multithreaded Programming		8 hours
5.1	Swing fundamentals - Swing Key Features, Model View Controller (MVC)	1
5.2	Swing Controls, Components and Containers	1
5.3	Exploring Swing - JFrame, JLabel, JButton, JTextField.	1
5.4	Event handling - Event Handling Mechanisms, Delegation Event Model.	1
5.5	Event Classes, Sources of Events.	1
5.6	Event Listener Interfaces, Using the Delegation Model.	1
5.7	Multithreaded Programming - The Java Thread Model, The Main Thread	1
5.8	Creating Thread, Creating Multiple Threads, Suspending, Resuming and Stopping Threads	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. For the following passage develop UML diagrams and then implement it as a Java program in accordance with your UML design.
   Passage: College Office collects semester fee and college bus fee for each student. A clerk at the college office collects the fees from each student. The bus fee is calculated depending on the distance of the corresponding bus stop from the college. The semester fee varies depending upon the semester as well as branch of each student. Students are supposed to pay the fees in full. Economically backward students are eligible for 50discount in semester fee. The consolidated fees receipt is issued to each student by the clerk, which contains the student name, admission number, semester and branch of student along with details of fees collected. Students can log in and view the details

of fees remitted and dues if any. The system allows students and clerk level login to the system. Clerk is able to view reports of each class showing status of fees payment of each student.

2. Draw a Class Diagram for an Online Shopping System including classes like User, Product, Order, Payment, and Cart. Show the relationships between them.

Course Outcome 2 (CO 2):

1. Write a Java program to prepare the rank list of students based one their performance in the Fourth Semester B.Tech. Degree examination. The output should be stored in a file.

2. Imagine a toll booth and a bridge. Cars passing by the booth are expected to pay an amount of Rs.50/- as toll tax. Mostly they do, but sometimes a car goes by without paying. The toll booth keeps track of the number of cars passed by, the total no: of the cars that has passed without paying and the total amount of money collected. Build a class 'Tollbooth' with two instance variables: a type unsigned int to hold the total number of cars and a type double to hold the total amount of money collected. A constructor should initialize both data members to zero. A method called payingCar() should increment the car total and add Rs.50/- to the cash total. Another method, called nopayCar(), increments the car total but adds nothing to the cash total. Finally, a method called display() displays the total no. of cars passed and the total amount collected.

Course Outcome 3 (CO 3):

1. Write a program to demonstrate how event handling and exception handling are supported in Java.

2. Write sample programs to interpret the concepts as listed:

   (a) Inheritance- Different types

   (b) Abstract classes

   (c) Method Overloading and Method Overriding

Course Outcome 4 (CO 4):

1. Write a program to demonstrate the start, run, sleep and join methods in Thread class.

2. Write a program that creates two threads- one to display the numbers from 1 to a given limit 'n' and the other thread to display 'n' letters of the English alphabet in order.

Course Outcome 5 (CO 5):

1. Write a GUI program to illustrate the use of JFrame, JTextField, JButton and JLabel by creating a login page
2. Write a GUI program that has two textfields and a button. Both textfields accept numbers. Each time on clicking the button, the numbers in the textfields should be swapped and displayed.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CSM41

Course Name: OBJECT ORIENTED PROGRAMMING IN JAVA (MINOR)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Briefly explain why Java is considered to be secure and portable.
2. Describe the concept of association among classes with an example.
3. Explain the different arithmetic operators in Java.
4. Explain the use for command line arguments with a suitable Java program.
5. Explain the use of CLASSPATH with an example.
6. What are the different types of exceptions?
7. Explain file handling features available in Java.
8. Write a simple program to read and print an integer value in Java.
9. Explain the concept of main thread in multi-threading.
10. Explain any two Event classes in Java.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Describe in detail polymorphism, abstraction and inheritance with suitable examples. (9)

    (b) Explain the role of Java Virtual Machine. (5)

OR

12. (a) Compare and contrast Functional Oriented and Object Oriented approach by considering a simple bus ticket reservation system. (5)

    (b) Explain class diagram with an example. (9)

13. (a) Explain primitive data types in Java. How are they different from other data types? (8)

    (b) Explain variables and arrays in Java. (6)

OR

14. (a) Using a suitable program, explain the concept of methods and constructors. (8)

    (b) Explain the keyword super and its usage in Java. (6)

15. (a) Using a table, explain the effect of access specifiers in inheritance. (6)

    (b) Describe in detail about exception handling using try block and catch clause in Java with the help of a suitable Java program. (8)

OR

16. (a) What is an interface in Java? Explain with a suitable example. (8)

    (b) Explain throw, throws and finally constructs with the help of a Java program. (6)

17. (a) Explain ArrayList collections framework. Also explain the use of iterator in accessing collections. (8)

    (b) Bring out the difference between "==" and equals() method with the help of a sample program. (6)

OR

18. (a) Compare Byte Streams and Character Streams. Write a program to demonstrate the usage of the PrintWriter class. (8)

    (b) Explain any three String constructors with the help of sample code for each. (6)

19. (a) Explain in detail the Delegation Event model for event handling in Java. (7)

    (b) Describe in detail the creation of a thread using the Runnable interface. (7)

OR

20. (a) What are the differences between a process and a thread? (4)

    (b) Write a Graphical User Interface (GUI) based Java program to implement a simple calculator supporting the operations addition, subtraction, multiplication and division. Use Swing controls to implement GUI. There may be three text boxes, the first two for operands and the last for result. Add four buttons for the above operations. Write neat comments in your program to show how you handle events. (10)

B24CSM42	INTRODUCTION TO MACHINE LEARNING (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course enables the learners to understand the basic concepts and algorithms in machine learning. The course covers the standard and most popular supervised learning algorithms such as linear regression, logistic regression, decision trees, Naive Bayes algorithm, basic clustering algorithms and classifier performance measures. This course helps the students to provide machine learning based solutions to real world problems.

Prerequisites

Basic understanding of probability theory and linear algebra.

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand machine learning paradigms and apply parameter estimation techniques for model optimization. (Cognitive Knowledge Level: Understand)
CO 2	Understand and implement neural networks with backpropagation, analyze training challenges such as vanishing gradients and overfitting, and apply adaptive learning rate methods like ADAGRAD, RMSProp, and ADAM. (Cognitive Knowledge Level: Apply)
CO 3	Apply supervised learning algorithms like Naive Bayes, KNN, SVM, and Decision Trees; perform model training and validation; and evaluate regression models using MAE, RMSE, and R-squared metrics. (Cognitive Knowledge Level: Apply)
CO 4	Apply clustering techniques and similarity measures, perform dimensionality reduction using PCA and MDS, and implement feature selection methods like entropy, correlation, and chi-square tests. (Cognitive Knowledge Level: Apply)
CO 5	Apply ensemble learning techniques such as voting, bagging, boosting, and stacking using models like Random Forest, and assess classification model performance using metrics including confusion matrix, precision, recall, F1-score, ROC, and AUC. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	2	3							2
CO 2	3	2	2	2	3							2
CO 3	3	3	3	3	3							2
CO 4	3	2	2	3	3							2
CO 5	3	3	2	3	3							2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (9 hours)

Introduction to ML:

Machine Learning vs. Traditional Programming, Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning. Types of ML problems: Classification, Clustering and Regression. Basics of parameter estimation - maximum likelihood estimation (MLE) and maximum aposteriori estimation (MAP), Bayesian formulation. Supervised Learning. Feature Representation and Problem Formulation, Role of loss functions and optimization. Regression - Linear regression with one variable, Linear regression with multiple variables - solution using gradient descent algorithm and matrix method, Non-linear Regression.

MODULE 2 (10 hours)

Neural Networks (NN):

Perceptron, Neural Network - Multilayer feed-forward network, Activation functions (Sigmoid, ReLU, Tanh), Back propagation algorithm, Issues in Back Propagation Learning (Vanishing and Exploding Gradient Problems, Local Minima and Saddle Points, Overfitting, Slow Convergence, Sensitivity to the selection of the Initial weights, Computational Cost), Use of Adaptive Learning Rate Methods (Back Propagation Algorithm with Momentum, Adaptive Gradient Descent Algorithm (ADAGRAD), Root Mean Square Propagation (RMSProp), Adaptive Momentum Estimation (ADAM)).

MODULE 3 (10 hours)

Classification Methods:

Naive Bayes Classifier - Working Principle, Types of Naive Bayes Classifiers, Illustrative examples. K-Nearest Neighbour Classifier (KNN):- Working Principle, Illustrative examples on designing KNN Classifiers; Support Vector machines (SVM) - Maximum Margin Classification. Decision Trees – Information Gain, Gain Ratio, ID3 algorithm. Generalisation and Overfitting - Idea of overfitting, LASSO and RIDGE regularization, Idea of Training, Testing, Validation. Regression - Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination.

MODULE 4 (8 hours)

Clustering Methods:

Clustering - Similarity measures, Hierarchical Clustering - Agglomerative Clustering, partitional clustering, Expectation maximization (EM) for soft clustering, K-means clustering, Density Based clustering. Feature selection techniques: Entropy, Correlation Coefficient, Chi-square Test, Forward &amp, Backward Selection; Dimensionality reduction: Principal Component Analysis, Multidimensional scaling.

MODULE 5 (8 hours)

Ensemble Learning:

Basic Techniques (Voting, Simple and Weighted Averaging Techniques), Advanced Techniques (Bagging, Boosting, Stacking) - The Random Forest Classifier. Assessment of Classification Models: Performance measures- Confusion Matrix, Accuracy, Precision, Recall, F1-Score, Receiver Operating Characteristics Curve (ROC), Area Under the Curve (AUC), Illustrative examples on Classification model assessment.

Text Books

1. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning, Second edition Springer 2007.
3. Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
4. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010.

Reference Books

1. M Gopal, Applied Machine Learning, McGraw Hill 2/e, 2018.
2. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
3. Manaranjan Pradhan, U Dinesh Kumar, Machine Learning using Python, Wiley, 1/e, 2019.
4. M.N. Murty, V.S.Ananthanarayana, Machine Learning: Theory and Practice,Universities Press 1/e, 2024.
5. Richert and Coelho, Building Machine Learning Systems with Python.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Introduction to ML		9 hours
1.1	Machine Learning vs. Traditional Programming	1
1.2	Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning.	1
1.3	Types of ML problems: Classification, Clustering and Regression.	1
1.4	Basics of parameter estimation – maximum likelihood estimation (MLE) and maximum aposteriori estimation (MAP), Bayesian formulation.	1
1.5	Supervised Learning - Feature Representation and Problem Formulation, Role of loss functions and optimization.	1
1.6	Regression - Linear regression with one variable	1
1.7	Linear regression with multiple variables	1
1.8	solution using gradient descent algorithm and matrix method	1
1.9	Non-linear Regression	1
Module 2: Neural Networks (NN)		10 hours
2.1	Perceptron, Neural Network	1
2.2	Multilayer feed-forward network	1
2.3	Activation functions(Sigmoid, ReLU, Tanh)	1
2.4	Back propagation algorithm	1
2.5	Issues in Back Propagation Learning (Vanishing and Exploding Gradient Problems	1
2.6	Local Minima and Saddle Points, Overfitting	1
2.7	Slow Convergence, Sensitivity to the selection of the Initial weights, Computational Cost)	1

2.8	Use of Adaptive Learning Rate Methods (Back Propagation Algorithm with Momentum	1
2.9	Adaptive Gradient Descent Algorithm (ADAGRAD), Root Mean Square Propagation (RMSProp)	1
2.10	1. Adaptive Momentum Estimation (ADAM)).	1
Module 3: Classification Methods		10 hours
3.1	Naive Bayes Classifier - Working Principle	1
3.2	Types of Naive Bayes Classifiers, Illustrative examples.	1
3.3	K-Nearest Neighbour Classifier (KNN): Working Principle, Illustrative examples on designing KNN Classifiers	1
3.4	Support Vector machines (SVM)	1
3.5	Maximum Margin Classification	1
3.6	Decision Trees – Information Gain, Gain Ratio, ID3 algorithm	1
3.7	Generalisation and Overfitting - Idea of overfitting	1
3.8	LASSO and RIDGE regularization	1
3.9	Idea of Training, Testing, Validation	1
3.10	Regression - Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination	1
Module 4: Clustering Methods		8 hours
4.1	Clustering - Similarity measures	1
4.2	Hierarchical Clustering - Agglomerative Clustering, partitional clustering	1
4.3	Expectation maximization (EM) for soft clustering	1
4.4	K-means clustering, Density Based clustering	1
4.5	Feature selection techniques: Entropy, Correlation Coefficient	1
4.6	Chi-square Test, Forward &amp, Backward Selection	1
4.7	Dimensionality reduction: Principal Component Analysis	1
4.8	Multidimensional scaling	1

Module 5: Ensemble Learning		8 hours
5.1	Ensemble Learning: Basic Techniques (Voting, Simple and Weighted Averaging Techniques)	1
5.2	Advanced Techniques (Bagging, Boosting, Stacking)	1
5.3	The Random Forest Classifier	1
5.4	Assessment of Classification Models- Performance measures	1
5.5	Confusion Matrix, Accuracy, Precision, Recall, F1-Score	1
5.6	Receiver Operating Characteristics Curve (ROC)	1
5.7	Area Under the Curve (AUC)	1
5.8	Illustrative examples on Classification model assessment	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. A dataset is provided where the output variable is known for some data points and unknown for others. Propose an appropriate machine learning paradigm to handle this and justify your choice.
2. Compare and contrast MLE, MAP, and MMSE in terms of their assumptions and optimality criteria. In what scenarios would one method be preferred over the others?

Course Outcome 2 (CO 2):

1. Implement a simple two-layer feedforward neural network with backpropagation on a binary classification problem.
2. Compare ADAGRAD, RMSProp, and ADAM optimizers. In which scenario would you prefer ADAM over the others?

Course Outcome 3 (CO 3):

1. Demonstrate how soft-margin SVM handles misclassification. Provide mathematical constraints and an illustrative example.

2. Using a provided dataset, build a Naïve Bayes classifier and compute the posterior probabilities for classification. Indicate how prior and likelihood are used.

Course Outcome 4 (CO 4):

1. Perform K-means clustering on a sample dataset with k = 2. Show initial centroid selection, assignment, and update steps.
2. You are given a dataset with multiple correlated features. Apply PCA and explain how it helps improve clustering performance.

Course Outcome 5 (CO 5):

1. Given predictions from multiple classifiers, perform majority voting and weighted averaging to determine the final class label. Justify your choice of weights.
2. Plot and analyze the ROC curve for a given classifier's predictions. Calculate the AUC and explain what it reveals about the model.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CSM42

Course Name: INTRODUCTION TO MACHINE LEARNING (MINOR)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Differentiate between supervised, unsupervised, and semi-supervised learning with suitable examples.
2. What is the role of parameter estimation in machine learning models?
3. Explain why logistic regression is used for classification instead of regression.
4. What is the bias-variance trade-off? How does it affect model selection?
5. Differentiate between hard margin SVM and soft margin SVM.
6. Why is KNN considered a lazy learning algorithm?
7. What is a similarity measure in clustering? Name any two commonly used measures.
8. Mention two differences between Hierarchical Clustering and K-means Clustering.
9. Differentiate between bagging and boosting.
10. Explain the concept of weighted averaging in ensemble models.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Explain how reinforcement learning can be used to train autonomous agents, such as self-driving cars. Discuss key challenges in implementing RL-based systems. (7)

    (b) Describe a real-world problem that can be solved using unsupervised learning. Discuss the steps involved in implementing a machine learning solution for this problem. (7)

OR

12. (a) Compare MLE, MAP, and MMSE in terms of their assumptions, computational complexity, and suitability for different types of data. (7)

    (b) Explain the significance of regularization in parameter estimation. How do L1 and L2 regularization techniques affect MLE-based models? (7)

13. (a) Compare and contrast the activation functions: Sigmoid, Tanh, and ReLU. Discuss their impact on the vanishing gradient problem in deep networks. (7)

    (b) Discuss in detail the challenges faced during the training of deep neural networks using backpropagation, such as vanishing/exploding gradients, overfitting, local minima, and computational cost. Provide strategies to overcome them. (7)

OR

14. (a) Explain the concept of adaptive learning rate methods in training neural networks. Compare Backpropagation with Momentum, ADAGRAD, RMSProp, and ADAM in terms of convergence and performance. (7)

    (b) Demonstrate with examples how momentum and adaptive optimizers improve gradient descent. Discuss how these methods impact convergence rate and stability during neural network training. (7)

15. (a) Compare hard margin SVM and soft margin SVM. Explain how the introduction of slack variables helps in handling non-linearly separable data. (7)

    (b) Explain different types of kernel functions in SVM. Discuss how choosing an appropriate kernel affects model performance. (7)

OR

16. (a) Compare and contrast KNN with SVM in terms of computational complexity, decision boundaries, and real-world applicability. (7)

    (b) Discuss the advantages and disadvantages of KNN. How does KNN perform on high-dimensional data? Suggest techniques to overcome challenges. (7)

17. (a) Explain how eigenvectors and eigenvalues are used in PCA to determine the principal components. Provide a numerical illustration if possible. (7)

(b) Describe the Hierarchical Agglomerative Clustering method. How does the dendrogram help in choosing the number of clusters? (7)

OR

18. (a) Given a dataset with high-dimensional features, explain how PCA reduces dimensionality and improves performance. Discuss its limitations. (7)

    (b) Explain how eigenvectors and eigenvalues are used in PCA to determine the principal components. Provide a numerical illustration if possible. (7)

19. (a) Describe in detail the working of boosting algorithms. How does it focus on difficult-to-classify instances? (7)

    (b) Explain voting and averaging techniques in ensemble learning. Provide examples where each is suitable. (7)

OR

20. (a) Explain how ROC and AUC are used to evaluate classification models. Draw a sample ROC curve and interpret its meaning. (7)

    (b) Given a classification model with the following confusion matrix, calculate accuracy, precision, recall, and F1-score. Discuss what these values indicate about the model's performance. . (7)

B24CSM43	INTRODUCTION TO COMPUTER NETWORKS (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course introduces students a clear understanding of how computer networks from local area networks to the massive and global Internet are built, how they allow computers to share information and communicate with one another. This course explores the physical aspects of computer networks, the layers of the OSI Reference Model, and inter-networking. It enables learners to compare and analyze existing network technologies, helping them select the most suitable network design for a given system.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Comprehend the OSI and TCP/IP models, the functioning of different network layers, and the protocol stack used in computer networks. (Cognitive Knowledge Level: Understand)
CO 2	Analyze data link layer functionalities, error detection and correction techniques, and medium access control protocols for efficient data transmission. (Cognitive Knowledge Level: Apply)
CO 3	Demonstrate an understanding of network layer operations, including addressing, routing algorithms, and congestion control mechanisms. (Cognitive Knowledge Level: Apply)
CO 4	Examine transport layer services, protocols, congestion control mechanisms. (Cognitive Knowledge Level: Apply)
CO 5	Understand client-server and peer-to-peer applications like HTTP, FTP, DNS, and P2P networks. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	1								2
CO 2	3	3	2	2								2
CO 3	3	3	3	3								2
CO 4	3	3	3	3		1						2
CO 5	2	3	2	3		2	1	3	2			3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment Test (2 numbers) 25 marks

Assignment/Quiz/Course Project 15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (10 hours)

Introduction & Physical Layer

Introduction, Uses of computer networks, Network Hardware, Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Wireless networks, Home networks, Internetworks, Network Software, Protocol hierarchies, Design issues for the layers, Connection-oriented and Connectionless services, Service primitives, Relationship of services to protocols, Reference models, The OSI reference model, The TCP/IP reference model, Comparison of OSI and TCP/IP reference models.
Physical layer- Modes of communication, Physical topologies, Signal encoding, Transmission media- Guided media, Unguided/wireless media, Performance indicators, Bandwidth, Throughput, Latency, Queuing time, Bandwidth-Delay product.

MODULE 2 (11 hours)

Data Link Layer

Data Link Layer: Functions and Services, Error detection and correction, Error detecting codes, Error correcting codes. Flow Control Mechanisms: Stop-and-Wait, Sliding Window Protocols, High-Level Data Link Control(HDLC)protocol. Medium Access Control (MAC) Protocols: ALOHA, CSMA/CD, CSMA/CA, IEEE 802.3 Ethernet (Wired LAN), Ethernet performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE 802.2: Logical Link Control, IEEE 802.11 (Wireless LAN), 802.11 protocol stack, Physical layer, MAC Sublayer protocol, Frame structure, Mobile IP. Bridges and switches- Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers, and Gateways.

MODULE 3 (9 hours)

Network Layer

Introduction: Network Layer Services & Functions, Logical addressing- IPv4 and IPv6 addresses, Network-layer protocols - Internet Protocol- IPV4 and IPv6, Unicast routing protocols- Distance Vector Routing, Link State Routing, Multicast routing - Multicasting Basics, Intra domain and inter-domain routing, Next generation IP, Congestion Control Techniques (Leaky Bucket, Token Bucket), Quality of Service (QoS) Techniques for Network Performance.

MODULE 4 (7 hours)

Transport Layer

Transport Layer Protocols: User Datagram Protocol (UDP)– Features and Applications, Transmission Control Protocol (TCP)– Features, Segment Structure, TCP Connection Establishment and release, TCP retransmission policy, Congestion Control- Open Loop Vs Closed Loop Congestion Control, Congestion Control in TCP.

MODULE 5 (8 hours)

Application Layer and Network Security

Application Layer: Application-Layer Protocols, Client-server applications - World Wide Web and HTTP, FTP, Electronic Mail, DNS, Peer-to-peer paradigm - P2P Networks.
Network Security Basics: Symmetric/asymmetric encryption, Digital Signatures, SSL/TLS, Common Attacks: DoS, Spoofing, Sniffing.

Text Books

1. Behrouz A Forouzan, Data Communication and Networking, 4/e, Tata McGraw Hill
2. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI (Prentice Hall India).

Reference Books

1. Larry L Peterson and Bruce S Dave, Computer Networks – A Systems Approach, 5/e, Morgan Kaufmann
2. Fred Halsall, Computer Networking and the Internet, 5/e.
3. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
4. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
5. W. Richard Stevens. TCP/IP Illustrated Volume 1, Addison-Wesley, 2005.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Introduction & Physical Layer		10 hours
1.1	Introduction, Uses of computer networks	1
1.2	Network Hardware, Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), Wireless networks, Home networks, Internetworks	1
1.3	Network Software, Protocol hierarchies, Design issues for the layers	1
1.4	Connection-oriented and Connectionless services, Service primitives, Relationship of services to protocols	1
1.5	Reference models, The OSI reference model	1
1.6	The TCP/IP reference model, Comparison of OSI and TCP/IP reference models	1
1.7	Physical layer- Modes of communication, Physical topologies	1
1.8	Signal encoding	1
1.9	Transmission media- Guided media, Unguided/wireless media	1
1.10	Performance indicators, Bandwidth, Throughput, Latency, Queuing time, Bandwidth-Delay product	1
Module 2: Data Link Layer		11 hours
2.1	Data Link Layer: Functions and Services	1
2.2	Error detection and correction, Error detecting codes	1
2.3	Error correcting codes	1
2.4	Flow Control Mechanisms: Stop-and-Wait, Sliding Window Protocols	1
2.5	High-Level Data Link Control(HDLC)protocol	1
2.6	Medium Access Control (MAC) Protocols: ALOHA, CSMA/CD, CSMA/CA	1

2.7	IEEE 802.3 Ethernet (Wired LAN)	1
2.8	Ethernet performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE 802.2: Logical Link Control	1
2.9	IEEE 802.11 (Wireless LAN), 802.11 protocol stack, Physical layer, MAC Sublayer protocol, Frame structure	1
2.10	Mobile IP	1
2.11	Bridges and switches, Bridges from 802.x to 802.y, Repeaters, Hubs, Bridges, Switches, Routers, and Gateways	1
Module 3: Network Layer		9 hours
3.1	Introduction : Network Layer Services & Functions	1
3.2	Logical addressing- IPv4 and IPv6 addresses	1
3.3	Network-layer protocols - Internet Protocol- IPV4 and IPv6	1
3.4	Unicast routing protocols- Distance Vector Routing	1
3.5	Link State Routing	1
3.6	Multicast routing - Multicasting Basics	1
3.7	Intra domain and inter-domain routing, Next generation IP	1
3.8	Congestion Control Techniques (Leaky Bucket, Token Bucket)	1
3.9	Quality of Service (QoS) Techniques for Network Performance	1
Module 4: Transport Layer		7 hours
4.1	Transport Layer Services & Protocols	1
4.2	User Datagram Protocol (UDP) – Features and Applications	1
4.3	Transmission Control Protocol (TCP) – Features, Segment Structure	1
4.4	TCP Connection Establishment and release	1
4.5	TCP retransmission policy	1
4.6	Open Loop Vs Closed Loop Congestion Control	1

4.7	TCP Congestion Control Mechanisms	1
Module 5: Application Layer and Network Security		8 hours
5.1	Overview of Application Layer Protocols, Client-server applications, Domain Name System (DNS) and its Role in the Internet	1
5.2	Hypertext Transfer Protocol (HTTP) and World Wide Web (WWW)	1
5.3	File Transfer Protocol (FTP) and Simple Mail Transfer Protocol (SMTP)	1
5.4	Peer-to-peer paradigm - P2P Networks	1
5.5	Network Security Basics: Symmetric/asymmetric encryption	1
5.6	Digital Signatures	1
5.7	SSL/TLS	1
5.8	Common Attacks: DoS, Spoofing, Sniffing.	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Compare TCP/IP and OSI reference model.
2. The purpose of physical layer is to transport a raw bit stream from one machine to another. Justify.

Course Outcome 2 (CO 2):

1. Ethernet frames must be at least 64 bytes long to ensure that the transmitter is still going in the event of a collision at the far end of the cable. Fast Ethernet has the same 64-byte minimum frame size but can get the bits out ten times faster. How is it possible to maintain the same minimum frame size?
2. What do you mean by bit stuffing?

Course Outcome 3 (CO 3):

1. Discuss the differences between IPV4 and IPV6.
2. Explain the different types of routing algorithms.

Course Outcome 4 (CO 4):

1. Discuss the differences between TCP and UDP.
2. Enumerate the different congestion control mechanisms in TCP.

Course Outcome 5 (CO 5):

1. Discuss the architecture of WWW.
2. Explain the different types of FTP Commands and replies.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CSM43

Course Name: INTRODUCTION TO COMPUTER NETWORKS (MINOR)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What does "negotiation" mean when discussing network protocols in a layered architecture? Give an example.
2. Define simplex, half-duplex, and full-duplex transmission modes. Give one example for each.
3. Data link protocols almost always put the CRC in a trailer rather than in a header. Why?
4. An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. What is the binary value after encoding?
5. Illustrate the Count to Infinity problem in routing.
6. Discuss the IPV6 frame format.
7. Explain the TCP Segment Header.
8. Discuss the TCP Connection Establishment method.
9. Explain the role of DNS in Internet.

10. What is SMTP. Explain its features.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Discuss the ISO-OSI model with the help of a neat diagram. (14)

OR

12. (a) Explain the different signal encoding techniques in the physical layer (8)
    (b) Compare the TCP/IP layer with the ISO-OSI layer in the physical layer. (6)

13. (a) Discuss the GoBackN and selective repeat sliding window protocols. (8)
    (b) Differentiate IEEE 802.3 with IEEE 802.11 (6)

OR

14. (a) Differentiate the different Medium Access Control(MAC) protocols. (14)

15. (a) Explain the different types of routing algorithms. (14)

OR

16. (a) What are the techniques for ensuring good QoS? (8)
    (b) Discuss the roles of intra-domain and inter-domain routing protocols with examples. (6)

17. (a) Discuss the structure of TCP Header. (8)
    (b) What are the TCP Congestion control mechanisms. (6)

OR

18. (a) What are the differences between TCP and UDP (8)
    (b) Describe the structure of UDP Header. (6)

19. (a) Discuss DNS and its role in Internet? (8)
    (b) Explain the different types of FTP Queries and Replies? (6)

OR

20. (a) Discuss the features of SMTP? (8)
    (b) Explain the features of WWW? (6)

B24CSH41	ADVANCED TOPICS IN COMPUTER GRAPHICS (Honours)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course helps the learners to make awareness about strong theoretical concept in computer graphics. It covers the three-dimensional environment representation in a computer, transformation of 2D/3D objects and basic mathematical techniques and algorithms used to build applications. This course enables the learners to develop the ability to create image processing frameworks for different domains and develop algorithms for emerging display technologies.

Prerequisites

A sound knowledge of Mathematics and concepts of any programming language.

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Describe the working principles of graphics devices and multimedia concepts. (Cognitive Knowledge level: Understand)
CO 2	Illustrate line drawing, circle drawing and polygon filling algorithms. (Cognitive Knowledge level: Apply)
CO 3	Demonstrate geometric representations and transformations on 2D and 3D objects. (Cognitive Knowledge level: Apply)
CO 4	Demonstrate the working of line and polygon clipping algorithms. (Cognitive Knowledge level: Apply)
CO 5	Summarize visible surface detection methods and illustrate projection algorithms. (Cognitive Knowledge level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2										1
CO 2	2	2	2	2	1							2
CO 3	2	2	2	2	2							1
CO 4	2	2	2	2	2							2
CO 5	2	2										1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember	30	30	30
Understand	30	30	30
Apply	40	30	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (10 hours)

Basics of Computer graphics and Fundamental of Multimedia:

Basics of Computer Graphics and its applications. Video Display devices- Refresh Cathode Ray Tubes(CRT), Random Scan Displays and systems, Raster scan displays and systems, Video Display devices- LED, OLED, Reflective displays and Touch Panel Technology.

Introduction to Multimedia, Authoring and Tools, Graphics and Image Data Representations, Popular File Formats, Fundamental Concepts and types of Video, Basics of Digital Audio and its types.

MODULE 2 (8 hours)

Line and Shape Drawing Algorithms:

Line drawing algorithms- DDA, Bresenham's algorithm. Circle drawing algorithms- Midpoint Circle generation algorithm, Bresenham's algorithm. Ellipse-Generating Algorithms, Properties of Ellipses, Midpoint Ellipse Algorithm.
Filled Area Primitives- Scan line polygon filling, Boundary filling and flood filling.

MODULE 3 (10 hours)

Geometric transformations:

Two-dimensional transformations- Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations- General Pivot-Point Rotation, General Fixed-Point Scaling, General Scaling Directions, Matrix representations and homogeneous coordinates. Basic 3D transformations.

MODULE 4 (9 hours)

Transformations and Clipping Algorithms :

Window to viewport transformation, Cohen Sutherland and Midpoint subdivision line clipping algorithms, Liang-Barsky Line Clipping, Nicholl-Lee-Nicholl Line Clipping, Sutherland Hodgeman and Weiler Atherton Polygon clipping algorithms, Text Clipping, Exterior Clipping

MODULE 5 (8 hours)

Three dimensional graphics and Graphics Functions:

Three dimensional viewing pipeline. Projections- Parallel and Perspective projections. Visible surface detection algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm, A-Buffer Method, Ray-Casting Method. C Graphics Basics Graphics programming, initializing the graphics, C Graphical functions, simple programs.

Text Books

1. Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 2019.
2. Donald Hearn and M. Pauline Baker, Computer Graphics, Pearson Education, 2/e 2002.
3. Ze-Nian Li and Mark S. Drew, Fundamentals of Multimedia, Pearson Education, 3/e 2021.

Reference Books

1. D. P. Mukherjee, Debasish Jana, Computer Graphics : Algorithms and Implementations, Prentice Hall India, 2/e, 2010.
2. Zhigang Xiang and Roy Plastock, Computer Graphics, McGraw Hill, 2/e, 2020.
3. David F. Rogers, Procedural Elements for Computer Graphics, McGraw Hill, 2/e, 2017.
4. Zhigang Xiang and Roy Plastock, Computer Graphics, McGraw Hill, 2/e, 2020.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Basics of Computer graphics and Fundamental of Multimedia		10 hours
1.1	Basics of Computer Graphics and applications	1
1.2	Refresh Cathode Ray Tubes	1

1.3	Random Scan Displays and systems	1
1.4	Raster scan displays and systems	1
1.5	Video Display devices- LED, OLED, Reflective displays	1
1.6	Touch Panel Technology	1
1.7	Introduction to Multimedia, Authoring and Tools	1
1.8	Popular File Formats	1
1.9	Fundamental Concepts and types of Video	1
1.10	Basics of Digital Audio and its types.	1
Module 2: Line and Shape Drawing Algorithms		8 hours
2.1	DDA Line drawing Algorithm	1
2.2	Bresenham's line drawing algorithm	1
2.3	Midpoint Circle generation algorithm	1
2.4	Bresenham's Circle generation algorithm	1
2.5	Illustration of line drawing and circle drawing algorithms	1
2.6	Ellipse-Generating Algorithms, Properties of Ellipses, Midpoint Ellipse Algorithm	1
2.7	Scan line polygon filling	1
2.8	Boundary filling and flood filling	1
Module 3: Geometric transformations		10 hours
3.1	Basic 2D transformations-Translation and Rotation	1
3.2	Basic 2D transformations- Scaling	1
3.3	Reflection and Shearing	1
3.4	Illustration of 2D Transformations	1
3.5	Composite transformations	1
3.6	General Pivot-Point Rotation	1
3.7	General Fixed-Point Scaling	1
3.8	Matrix representations and homogeneous coordinates	1
3.9	Basic 3D transformations	1
3.10	Illustration of basic 3D transformations	1

Module 4: Transformations and Clipping Algorithms		9 hours
4.1	Window to viewport transformation	1
4.2	Cohen Sutherland Line clipping algorithm	1
4.3	Midpoint subdivision Line clipping algorithm	1
4.4	Liang-Barsky Line Clipping	1
4.5	Nicholl-Lee-Nicholl Line Clipping	1
4.6	Sutherland Hodgeman Polygon clipping algorithm	1
4.7	Weiler Atherton Polygon clipping algorithm	1
4.8	Text Clipping and Exterior Clipping	1
4.9	Practice problems on Clipping algorithms	1
Module 5: Three dimensional graphics and Graphics Functions		8 hours
5.1	Three dimensional viewing pipeline, Projections-Parallel projections	1
5.2	Projections- Perspective projections	1
5.3	Visible surface detection algorithms- Back face detection.	1
5.4	Depth buffer algorithm	1
5.5	Scan line visible surface detection algorithm	1
5.6	A buffer algorithm, Ray-Casting Method	1
5.7	‘C’ Graphics Functions	1
5.8	Program to initialize the graph and draw a line and circle, program to initialize the graph and draw a rectangle, ellipses and arcs	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Compare the working principle of raster scan systems and random scan systems.
2. How much time is spent scanning across each row of pixels during screen refresh on a raster system with resolution of 1280*1024 and a refresh rate of 60 frames per second?

Course Outcome 2 (CO 2):

1. Rasterize the line using Bresenham's line drawing algorithm with end points (2,3) and (5,8) accepted from the user and implement it using any appropriate programming language.
2. Illustrate how the 4-connected boundary filling approach differs from 8-connected boundary filling and implement it using any appropriate programming language.

Course Outcome 3 (CO 3):

1. Rotate a triangle ABC 45 degree counter clockwise about the pivot point (10,3), where the position vector of the coordinates is given as A(4,1), B(5,2) and C(4,3).
2. Implement the above transformation using any appropriate programming language with user inputs.
3. Illustrate the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2, y2, z2). Give its composite matrix representation.

Course Outcome 4 (CO 4):

1. Given a clipping window A(20,20), B(60,20), C(60,40) and D(20,40). Using Cohen Sutherland algorithm, find the visible portion of the line segment joining the points P(40,80) and Q(120,30).
2. Implement Cohen Sutherland clipping algorithm using any appropriate programming language.

Course Outcome 5 (CO 5):

1. Explain scan line algorithm for detecting visible surfaces in an object.
2. Derive the matrix for performing perspective projection and parallel projection.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CSH41

Course Name: ADVANCED TOPICS IN COMPUTER GRAPHICS (HONOURS)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Out of raster scan system and random scan systems which type of system is beneficial for rendering architectural drawings? Why?
2. What do you understand by the aspect ratio and resolution of a display screen? Compute the width of an image if the image has a height of 2 inches and aspect ratio of 1.5.
3. Write the midpoint circle drawing algorithm?
4. Write the Boundary Filling Algorithm for filling a polygon using four connected approach.
5. A triangle ABC with coordinates A(0,0), B(6,5), C(6,0) is scaled with scaling factors Sx=2 and Sy=3 about the vertex C(0,0). Find the transformed coordinates.
6. Determine a sequence of basic transformations that is equivalent to x-direction shearing.
7. Find the window to viewport normalization transformation with window lower left corner at (1,1) and upper right corner at (2,6).

8. How does Cohen Sutherland algorithm determine whether a line is visible, invisible or a candidate for clipping based on the region codes assigned to the end points of the line?

9. Differentiate between the object space and image space method for the hidden surface removal of an image.

10. List the various C- Graphics Functions.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Explain the working principle of beam penetration method and shadow mask method with suitable illustrations (8)

    (b) Draw the architecture of raster scan display systems and explain its working principle. (6)

OR

12. (a) Explain the working principle of a Refresh CRT monitor with suitable diagrams. (8)

    (b) Describe random graphics system with suitable illustrations. (6)

13. (a) Differentiate between boundary fill and flood fill algorithms. (7)

    (b) Derive the initial decision parameter of Bresenham's line drawing algorithm and rasterize a line with endpoints (2,2) and (10,10). (7)

OR

14. (a) Write Midpoint circle drawing algorithm and identify the points in the circle with radius as 20 and center at (50,30) using the algorithm. (7)

    (b) Illustrate the working principle of scan line polygon filling algorithm. (7)

15. (a) Reflect a triangle ABC about the line 3x-4y+8=0, where the coordinates of the triangle are given as A(4,1), B(5,2) and C(4,3). (7)

    (b) A diamond shaped polygon is located at P(-1,0), Q(0,-2), R(1,0) and S(0,2). Find the transformation matrix which would rotate the triangle by 90 degree counter clockwise about the point Q. Using the transformation matrix, find the coordinates of the rotated polygon. (7)

OR

16. (a) Describe the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2,y2,z2). Give its composite matrix representation. (8)

    (b) Briefly explain Two dimensional transformation with example. (6)

17. (a) Illustrate Weiler – Atherton polygon clipping algorithm. (6)

    (b) Given a clipping window A(20,20), B (60,20), C(60, 40) and D(20,40). Using Cohen Sutherland algorithm, find the visible portion of the line segment joining the points P (40,80) and Q(120,30). (8)

OR

18. (a) Explain the steps involved in clipping a line using Mid point Subdivision algorithm. (7)

    (b) Explain Sutherland Hodgeman polygon clipping algorithm and specify its limitations. (7)

19. (a) Define parallel projection. Describe orthographic and oblique parallel projection. (7)

    (b) Using the A-buffer algorithm, explain how transparency is handled in visible surface detection. (7)

OR

20. (a) Write the pseudocode program to draw a circle and ellipses. (6)

    (b) By using depth buffer algorithm explain how visible surface can be detected. (8)

B24CSH42	COMPUTATIONAL FUNDAMENTALS FOR BIOINFORMATICS (Honours)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course introduces the fundamental concepts of molecular biology and the essential computational techniques used in bioinformatics. It covers topics such as sequence alignment, biological databases, phylogenetics, and pattern matching, with hands-on experience using R for biological data analysis. The course aims to equip students with the foundational skills required for analyzing and interpreting genomic and proteomic data.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand the Basics of Bioinformatics.(Cognitive Knowledge level: Understand)
CO 2	Use various biological databases and apply sequence alignment techniques. Use molecular phylogenetics to identify evolutionary relationships among various biological species.(Cognitive Knowledge level: Apply)
CO 3	Apply the concept of combinatorial pattern matching in bioinformatics.(Cognitive Knowledge level: Apply)
CO 4	Use R language and packages to solve bioinformatics problems,(Cognitive Knowledge level: Apply)
CO 5	Understand protein structure at various levels and utilize computational tools for visualization, prediction, and analysis of protein structures with applications in drug discovery and molecular biology.(Cognitive Knowledge level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	1	2							2
CO 2	3	3	2	3	3	1						2
CO 3	3	3	2	3	3							2
CO 4	3	3	2	2	3							3
CO 5	3	2	3	3	3	2	1	1				3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (9 hours)

Molecular Biology Primer:

Molecular Biology Primer: Genes, DNAs, RNAs, Proteins, Genomics, Sequencing techniques, Bioinformatics overview and scope. Sequence Alignment: Global and local sequence alignment-dynamic programming algorithms, edit distance, similarity, Needleman Wunsch Algorithm, Smith Waterman Algorithm.

MODULE 2 (9 hours)

Biological Databases and Data Formats:

Biological Databases and Data Formats: Genomic and Sequence Data Formats, GenBank, EMBL-Bank, and DDBJ, PROSITE, NCBI- Database Searching: BLAST, FASTA Phylogenetics: Phylogenetic Tree basics and Construction Methods, UPGMA, Neighbour joining, Parsimonous trees, Additive trees, Bootstrapping.

MODULE 3 (9 hours)

Combinatorial Pattern Matching:

Combinatorial Pattern Matching, Repeat finding, Keyword Trees, Suffix Trees, Heuristic similarity search algorithms, Approximate Pattern Matching.

MODULE 4 (9 hours)

R for Bioinformatics:

Variables, Data types, control flow constructs, String manipulation, Pattern Matching, arrays, lists and hashes, File handling, Programs to handle biological data and parse output files for interpretation, packages for sequence alignment, FASTA, BLAST (Bioconductor, msa, Biostrings etc.)

MODULE 5 (9 hours)

Structural Bioinformatics:

Protein structure basics: Primary, secondary, tertiary, and quaternary structures. Anatomy of DNA; A, B, Z-DNA, DNA bending. Structure prediction, Comparative protein modeling. Protein structure visualization tools (e.g., PyMOL, RasMol, UCSF Chimera). Protein structure databases: PDB, SCOP, CATH Protein structure prediction: Homology modeling, threading, ab initio methods. Structural alignment and comparison. Applications: Drug design, protein-ligand docking (overview), mutation analysis.

Text Books

1. N. C. Jones and P.A. Pevzner, An Introduction to Bioinformatics Algorithms, MIT Press, 2004.
2. Supratim Choudhuri, Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools, Academic Press 1/e, 2014.
3. Robert Gentleman, R Programming for Bioinformatics, CRC Press 1/e, 2009.
4. Philip E. Bourne and Helge Weissig, Structural Bioinformatics, Wiley-Liss 1/e, 2009.
5. Carl Branden & John Tooze, Introduction to Protein Structure, Taylor & Francis, 2/e, 1999.

Reference Books

1. T. K. Attwood and D. J. Parry-Smith, Introduction to Bioinformatics, Pearson Education, 1/e, 2003.
2. B. Junker and F. Schreiber, Analysis of Biological Networks, Wiley Publishers, 1/e, 2007.
3. Y. Sun and J. Han, Mining, Heterogeneous Information Networks - Principles & Methodologies, Morgan & Claypool Publishers, 1/e, 2012.
4. M. E. Dickison et al, Multilayer Social Networks, Cambridge University Press, 1/e, 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Molecular Biology Primer		9 hours
1.1	Genes, DNAs, RNAs, Proteins	1
1.2	Genomics, Sequencing techniques	1
1.3	Bioinformatics overview and scope	1
1.4	Global and local sequence alignment-dynamic programming algorithms	1

1.5	Global and local sequence alignment-dynamic programming algorithms	1
1.6	edit distance	1
1.7	similarity	1
1.8	Needleman Wunsch Algorithm,	1
1.9	Smith Waterman Algorithm	1
Module 2: Biological Databases and Data Formats		9 hours
2.1	Genomic and Sequence Data Formats	1
2.2	GenBank, EMBL-Bank, and DDBJ, PROSITE, NCBI	1
2.3	GenBank, EMBL-Bank, and DDBJ, PROSITE, NCBI	1
2.4	Database Searching: BLAST, FASTA	1
2.5	Phylogenetic Tree basics and Construction Methods	1
2.6	UPGMA	1
2.7	Neighbour joining	1
2.8	Parsimonous trees	1
2.9	Additive trees, Bootstrapping	1
Module 3: Combinatorial Pattern Matching		9 hours
3.1	Combinatorial Pattern Matching	1
3.2	Combinatorial Pattern Matching	1
3.3	Repeat finding	1
3.4	Keyword Trees	1
3.5	Suffix Trees	1
3.6	Heuristic similarity search algorithms	1
3.7	Heuristic similarity search algorithms	1
3.8	Approximate Pattern Matching	1
3.9	Approximate Pattern Matching	1
Module 4: R for Bioinformatics		9 hours
4.1	Variables, Data types	1
4.2	control flow constructs	1

4.3	String manipulation	1
4.4	Pattern Matching	1
4.5	arrays, lists and hashes	1
4.6	File handling	1
4.7	Programs to handle biological data and parse output files for interpretation	1
4.8	packages for sequence alignment	1
4.9	FASTA, BLAST (Bioconductor, msa, Biostrings etc.)	1
Module 5: Structural Bioinformatics		9 hours
5.1	Protein structure basics: Primary, secondary, tertiary, and quaternary structures	1
5.2	Anatomy of DNA; A, B, Z-DNA, DNA bending.	1
5.3	Structure prediction	1
5.4	Comparative protein modeling.	1
5.5	Protein structure visualization tools (e.g., PyMOL, RasMol, UCSF Chimera)	1
5.6	Protein structure databases: PDB, SCOP, CATH	1
5.7	Protein structure prediction: Homology modeling, threading, ab initio methods	1
5.8	Structural alignment and comparison	1
5.9	Applications: Drug design, protein-ligand docking (overview), mutation analysis.	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Describe the roles of DNA, RNA, and proteins in genetic information flow.
2. Explain the working of the Needleman-Wunsch algorithm with an example.

Course Outcome 2 (CO 2):

1. Explain the commonly used sequence data formats in bioinformatics. Give examples.
2. Explain the concept of additive trees in phylogenetic analysis.

Course Outcome 3 (CO 3):

1. Describe an algorithm to find repeats in DNA sequences. Why is repeat identification important in phylogenetic analysis?
2. You are given genomic data from five species. Outline a computational strategy using pattern matching techniques to construct a phylogenetic tree.

Course Outcome 4 (CO 4):

1. How can string manipulation techniques be used to implement pattern matching in biological sequences? Illustrate with an example.
2. Write a script to perform exact pattern matching of a given DNA motif within a sequence. How would you modify it for approximate matching?

Course Outcome 5 (CO 5):

1. Compare homology modeling, threading, and ab initio methods for protein structure prediction.
2. How can you retrieve a 3D protein structure from the Protein Data Bank (PDB) and visualize it?

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CSH42

Course Name: COMPUTATIONAL FUNDAMENTALS FOR BIOINFORMATICS (HONOURS)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Differentiate between DNA and RNA.
2. What does the Needleman-Wunsch algorithm aim to achieve in bioinformatics?
3. What is the role of GenBank in bioinformatics?
4. Define a phylogenetic tree. Why is it important?
5. What is a keyword tree? Mention one use in pattern matching.
6. Define approximate pattern matching. How does it differ from exact matching?
7. Differentiate between an array and a list in R.
8. What is the role of the Biostrings package in R?
9. Differentiate between tertiary and quaternary protein structures.
10. Why is structural alignment important in protein analysis?

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) Discuss various DNA/RNA sequencing techniques and their significance in genomics. (7)

    (b) Illustrate how edit distance and similarity scoring are used in comparing two sequences. (7)

OR

12. (a) Explain the scope and interdisciplinary nature of bioinformatics. (7)

    (b) Write a short note on the significance of sequence alignment in genome annotation. (7)

13. (a) Explain the structure and significance of GenBank, EMBL, and DDBJ databases. (7)

    (b) Discuss the working of BLAST and FASTA algorithms for sequence searching. (7)

OR

14. (a) Explain the concept of Parsimony and how it is used to construct phylogenetic trees. (7)

    (b) What are additive trees and how are they constructed? Provide an example. (7)

15. (a) Describe the process of repeat finding in biological sequences. Why is it relevant in genome analysis? (7)

    (b) Discuss any two heuristic similarity search algorithms. Highlight their advantages and limitations. (7)

OR

16. (a) Explain the concept of combinatorial pattern matching and its applications in genomics. (7)

    (b) Compare suffix trees and keyword trees in terms of structure, efficiency, and applications. (7)

17. (a) Describe string manipulation and pattern matching techniques in R with biological examples. (7)

    (b) Discuss the importance of file handling in bioinformatics data processing. Include a sample code for reading and parsing a sequence file. (7)

OR

18. (a) Describe the usage of Bioconductor and its packages (msa, Biostrings) in biological sequence analysis. (7)

(b) Write an R program to read a FASTA file and count the number of sequences. (7)

19. (a) Compare and contrast the functionalities of PyMOL, RasMol, and UCSF Chimera in protein visualization. (7)

    (b) Explain the methods used for protein structure prediction: homology modeling, threading, and ab initio. (7)

OR

20. (a) Explain the process and importance of protein-ligand docking in drug discovery. (7)

    (b) How does understanding protein structure help in studying disease-related mutations? Give examples. (7)

B24CSH43	PRINCIPLES OF PROGRAM ANALYSIS AND VERIFICATION (Honours)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This is the foundational course for awarding B. Tech. Honours in Computer Science and Engineering with specialization in Formal Methods. This course discusses the Foundational Concepts, Methods, Technologies and Tools to ensure reliability and correctness of software systems.

Prerequisites

Discrete Mathematics (B24MA2T03C)

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Explain the concepts and results about Lattices, Chains, Fixed Points, Galois Connections, Monotone and Distributive Frameworks, Hoare Triples, Weakest Preconditions, Loop Invariants and Verification Conditions to perform Analysis and Verification of programs. (Cognitive knowledge level: Understand)
CO 2	Illustrate methods for doing intraprocedural/interprocedural Data flow Analysis for a given Program Analysis problem. (Cognitive knowledge level: Analyse)
CO 3	Formulate an Abstract Interpretation framework for a given Data flow Analysis problem and perform the analysis using the tool WALA. (Cognitive knowledge level: Analyse)
CO 4	Use Kildall's Algorithm to perform Abstract Interpretation of Programs and compare the results obtained by the Algorithm on Monotone and Distributive Frameworks. (Cognitive knowledge level: Apply)
CO 5	Explain the concept of Loop Invariants and use them in Hoare Triple based Weakest Precondition analysis to verify the total correctness of a code segment and use of the tool VCC to specify and verify the correctness of a C Program. (Cognitive knowledge level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	2								1
CO 2	2	2	1	3								1
CO 3	2	2	2	2	2							1
CO 4	2	2	2	2								1
CO 5	2	2	2	2	2							1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Mathematical Foundations

Partially Ordered Set, Lattice, Complete Lattice, Construction of Complete Lattices, Chains, Fixed Points, Knaster-Tarski Fixed Point Theorem.

MODULE 2 (7 hours)

Introduction to Program Analysis

The WHILE language, Reaching Definition Analysis, Data Flow Analysis - Equational Approach and Constraint Based Approach, Abstract Interpretation, Algorithm to find the least solutions for the Data Flow Analysis problem.

MODULE 3 (12 hours)

Intraprocedural DataFlow Analysis

Available Expressions Analysis, Reaching Definitions Analysis, Live Variable Analysis, Derived Data Flow Information, Monotone and Distributive Frameworks, Equation Solving - Maximal Fixed Point and Meet Over all Paths solutions.
Interprocedural Data Flow Analysis - Structural Operational Semantics, Intraprocedural versus Interprocedural Analysis, Making Context Explicit, Call Strings as Context, Flow Sensitivity versus Flow Insensitivity, Implementing Interprocedural Data-flow Analysis using the Tool. WALA.

MODULE 4 (8 hours)

Abstract Interpretation

A Mundane Approach to Correctness, Approximations of Fixed Points, Galois Connections, Systematic Design of Galois Connections, Induced Operations, Kildall's Algorithm for Abstract Interpretation.

MODULE 5 (11 hours)

Program Verification

Why should we Specify and Verify Code, A framework for software verification - A core programming Language, Hoare Triples, Partial and Total Correctness, Program Variables and Logical Variables, Proof Calculus for Partial Correctness, Loop Invariants, Verifying code using the tool VCC (Verifier for Concurrent C).

Text Books

1. Flemming Nielson, Henne Nielson and Chris Kankin, Principles of Program Analysis, Springer (1998).
2. Michael Hutch and Mark Ryan, Logic in Computer Science - Modeling and Reasoning about Systems, Cambridge University Press, Second Edition.

Reference Books

1. Julian Dolby and Manu Sridharan, Core WALA Tutorial (PLDI 2010), available online at http://wala.sourceforge.net/files/PLDI_WALA_Tutorial.pdf
2. Ernie & Hillebrand, Mark & Tobies, Stephan (2012), Verifying C Programs: A VCC Tutorial.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No. of Lecture/ Tutorial Hours
	Total Hours	45 Hours
Module 1: Mathematical Foundations		7 hours
1.1	Partially Ordered Set	1
1.2	Lattice	1
1.3	Complete Lattice, Construction of Complete Lattices	1
1.4	Chains 3	1
1.5	Fixed Points	1
1.6	Knaster-Tarski Fixed Point Theorem	1

1.7	Proof of Knaster-Tarski Fixed Point Theorem	1
Module 2: Introduction to Program Analysis		7 hours
2.1	The WHILE language	1
2.2	Data Flow Analysis - Equational Approach	1
2.3	Constraint Based approach	1
2.4	Reaching Definition Analysis	1
2.5	Abstract Interpretation (Lecture 1)	1
2.6	Abstract Interpretation (Lecture 2)	1
2.7	Algorithm to find the least solutions for the Data Flow Analysis problem	1
Module 3: Data flow Analysis		12 hours
3.1	Available Expressions Analysis, Reaching Definitions Analysis	1
3.2	Live Variable Analysis	1
3.3	Derived Data Flow Information	1
3.4	Monotone and Distributive Frameworks	1
3.5	Equation Solving - MFP Solution	1
3.6	Equation Solving - MOP Solution	1
3.7	Structural Operational Semantics	1
3.8	Intraprocedural versus Interprocedural Analysis	1
3.9	Making Context Explicit	1
3.10	Call Strings as Context	1
3.11	Flow Sensitivity versus Flow Insensitivity	1
3.12	Implementing Interprocedural Dataflow Analysis using the Tool WALA	1
Module 4: (Abstract Interpretation		8 hours
4.1	A Mundane Approach to Correctness	1
4.2	Approximations of Fixed Points	1
4.3	Galois Connections	1
4.4	Systematic Design of Galois Connections (Lecture 1)	1

4.5	Systematic Design of Galois Connections (Lecture 2)	1
4.6	Induced Operations	1
4.7	Kildall's Algorithm for Abstract Interpretation (Lecture 1)	1
4.8	Kildall's Algorithm for Abstract Interpretation (Lecture 2)	1
Module 5: Program Verification		11 hours
5.1	Why should we Specify and Verify Code	1
5.2	A framework for software verification - A core programming Language	1
5.3	Hoare Triples (Lecture 1)	1
5.4	THoare Triples (Lecture 2)	1
5.5	Partial and Total Correctness	1
5.6	Program Variables and Logical Variables	1
5.7	Proof Calculus for Partial Correctness	1
5.8	Loop Invariants	1
5.9	Verifying C programs using the tool VCC (Lecture 1)	1
5.10	Verifying C programs using the tool VCC (Lecture 2)	1
5.11	Verifying C programs using the tool VCC (Lecture 3)	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Find a lattice to represent the data states of a given program and propose a sound abstract interpretation framework to do a given analysis on the program.
2. When is an abstract interpretation framework said to be sound? Illustrate with an example.
3. When is an abstract interpretation framework said to be precise? Illustrate with an example.

Course Outcome 2 (CO 2):

1. Illustrate how one can do Intraprocedural Available Expression Analysis on a program.
2. Illustrate how one can do Intraprocedural Reaching Definition Analysis on a program.
3. Illustrate how one can do Intraprocedural Live Variable Analysis on a program.

Course Outcome 3 (CO 3):

1. Illustrate how one can do Interprocedural Data Flow Analysis using the tool WALA

Course Outcome 4 (CO 4):

1. Illustrate the working of Kildall's algorithm to do Intraprocedural Available Expression Analysis on a program
2. Compare the results obtained by applying Kildall's algorithms for Abstract Interpretation in Monotone and Distributive Frameworks.

Course Outcome 5 (CO 5):

1. Illustrate the process of obtaining verification conditions (VCs) using weakest precondition analysis.
2. Explain the concepts of partials and total correctness of programs.
3. Using the tool VCC prove that a given code segment satisfies a given property

MODEL QUESTION PAPER

QP CODE: **Pages: 4**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24CSH43

Course Name: PRINCIPLES OF PROGRAM ANALYSIS AND VERIFICATION (HONOURS)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is a complete lattice? Give an example of a complete lattice.
2. Show that every chain is a lattice.
3. Write a program in while language to find the factorial of a number. Explain the statements of your program.
4. Consider a program that calculates x ^{y}through repeated multiplications. Draw the flow graph of the program.
5. What is Available Expression (AE) analysis? Give an application for AE analysis.
6. What is Live variable (LV) analysis? Give an application for LV analysis
7. Let P be a program analysis problem (like LV, AE, etc.), and (A, F_A, γ_{AC}) and (B, F_B, γ_{BC}) be two abstract interpretations such that A is more abstract than B. Let $\alpha : B \to A$ and $\gamma : A \to B$ be the abstraction and concretization functions between A and B. Then, what are the conditions required for α and γ to form a Galois Connection?
8. When is Kildall's algorithm for abstract interpretation guaranteed to terminate? Justify your answer.

9. Is it possible to verify total correctness of a program using Hoare Logic? If yes, how is it possible?

10. Define loop invariant. Show a simple loop with a loop invariant.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. (a) What is an infinite ascending chain in a lattice? Show an example lattice with an infinite ascending chain. Is it possible for a complete lattice to contain an infinite ascending chain? (7 marks)

    (b) State and prove Knaster-Tarski fixed point theorem. (7 marks)

OR

12. (a) Consider the lattice $(\mathbb{N}, \leq)$. Let $f : \mathbb{N} \to \mathbb{N}$ be a function defined as follows:

$$f(x) = \begin{cases} x+1, & \text{if } x < 100, \\ x-1, & \text{if } x > 100, \\ otherwise, & x = 100. \end{cases}$$

Then, show the following for f:

i. The set of all fixpoints.

ii. The set of all prefixpoints.

iii. The set of all postfixpoints.

(7 marks)

    (b) Let $(D, \leq)$ be a lattice with a least upper bound for each subset of (D). Then, prove that every subset of has a greatest lower bound. (7 marks)

13. (a) With a suitable example, explain the equational approach in Data Flow Analysis. (7 marks)

    (b) With a suitable example, explain how you obtain the collecting semantics of a program point. (7 marks)

OR

14. (a) With an example, explain the Constrained Based Approach in Data Flow Analysis. (7 marks)

    (b) Discuss the properties of an algorithm to solve the problem of computing the least solution to the program analysis problems in Data Flow Analysis. (7 marks)

15. (a) Using Intraprocedural Reaching Definition Analysis, find the assignments killed and generated by each of the blocks in the program

$$
\begin{array}{l}
[x := 5]^1; \\
[y := 1]^2; \\
\textbf{while } [x > 1]^3 \textbf{ do} \\
\quad \big([y := x * y]^4;\ [x := x - 1]^5\big)
\end{array}
$$

(7 marks)

(b) Analyse the following program using Intraprocedural Very Busy Expression analysis

$$
\begin{array}{l}
\textbf{if } [a > b]^1 \textbf{ then} \\
\quad \big([x := b - a]^2;\ [y := a - b]^3\big) \\
\textbf{else} \\
\quad \big([y := b - a]^4;\ [x := a - b]^5\big)
\end{array}
$$

(7 marks)

OR

16. (a) Find Maximal Fixed Point (MFP) solution for the program

$$
\begin{array}{l}
[x := a + b]^1; \\
[y := a * b]^2; \\
\textbf{while } [y > a + b]^3 \textbf{ do} \\
\quad \big([a := a + l]^4;\ [x := a + b]^5\big)
\end{array}
$$

(7 marks)

(b) With examples, explain the difference between flow sensitive and flow insensitive analysis. (7 marks)

17. (a) Prove that (L, α, γ, M) is an adjunction if and only if (L, α, γ, M) is a Galois connection. (7 marks)

(b) Prove that if $\alpha : L \to M$ is completely additive, then there exists $\gamma : M \to L$ such that (L, α, γ, M) is a Galois connection. Similarly, if $\gamma : M \to L$ is completely multiplicative, then there exists $\alpha : L \to M$ such that (L, α, γ, M) is a Galois connection. (7 marks)

OR

18. (a) Show that if $(L_i, \alpha_i, \gamma_i, M_i)$ are Galois connections and $\beta_i : V_i \to L_i$ are representation functions, then

$$((\alpha_1 \circ \beta_1) \twoheadrightarrow (\alpha_2 \circ \beta_2))(\Rightarrow) = \alpha_2 \circ ((\beta_1 \twoheadrightarrow \beta_2)(\Rightarrow)) \circ \gamma_1$$

(7 marks)

(b) Briefly explain Kildall's algorithm for abstract interpretation. (7 marks)

19. (a) Briefly explain the need of specification and verification of code. (7 marks)

(b) Argue that Hoare Logic is sound. When Hoare Logic is complete? Let APB be a Hoare triple such that Hoare Logic is complete for the program P. Then, is it always possible to check the validity of the Hoare Triple? If not, what is the difficulty? (7 marks)

OR

20. (a) With suitable examples, show the difference between partial and total correctness. (7 marks)

(b) With a suitable example, show how a basic program segment can be verified using the tool VCC. (7 marks)