MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING

SCHEME AND SYLLABUS

MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
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KNOWLEDGE IS POWER

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING

SCHEME

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 AND PROGRAMMING TECHNIQUES (A)	2-1-0-2	3	3
C	B24EE1T01	INTRODUCTION TO ELECTRICAL ENGINEERING	2-2-0-2	4	4
D	B24EE1T02	ELECTRONIC CIRCUITS I	2-1-0-2	3	3
E	B24ES1T03B	COMPUTER AIDED ENGINEERING GRAPHICS (B)	2-1-1-3	4	4
G	B24ES1L01A	PROGRAMMING LAB (A)	0-0-3-3	3	2
H	B24EE1L01	BASIC ELECTRICAL ENGINEERING LAB	0-0-3-3	3	2
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	22

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	B24PH1T01A	ENGINEERING PHYSICS (A)	2-1-0-2	3	3
C	B24CY1T01A	ENGINEERING CHEMISTRY (A)	2-1-0-2	3	3
D	B24ES1T05A	BASIC CIVIL AND MECHANICAL ENGINEERING (A)	2-2-0-2	4	4
E	B24EE1T03	ELECTRICAL MEASUREMENTS	2-1-0-2	3	3
F	B24ES1L04A	BASIC CIVIL AND MECHANICAL ENGINEERING WORKSHOP (A)	0-0-2-2	2	1
G	B24EE1L02	ELECTRONIC CIRCUITS LAB I	0-0-3-3	3	2
H	B24PC1L01A	ENGINEERING PHYSICS LAB (A) AND ENGINEERING CHEMISTRY LAB (A)	0-0-2-2	2	1
I	B24MC1T03	PROFESSIONAL COMMUNICATION AND ETHICS	2-0-1-3	3	P/F
J	B24MC1L02	IDEA LAB	0-0-3-3	3	P/F
			TOTAL	30	21

SEMESTER 3

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T03A	COMPLEX VARIABLES AND APPLICATIONS OF PDE	3-1-0-3	4	4
B	B24EE2T01	CIRCUITS AND NETWORKS	2-2-0-2	4	4
C	B24EE2T02	ELECTRICAL MACHINES I	2-2-0-2	4	4
D	B24EE2T03	DIGITAL ELECTRONICS	2-1-0-2	3	3
E	B24EE2T04	ELECTRONIC CIRCUITS II	2-1-0-2	3	3
G	B24EE2L03	ELECTRICAL MEASUREMENTS LAB	0-0-3-3	3	2
H	B24EE2L04	DIGITAL ELECTRONICS LAB	0-0-3-3	3	2
I	B24MC2T04	UNIVERSAL HUMAN VALUES 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	B24EEM3X	MINOR	3-1-0-3	4	4
			TOTAL*	32	22

SEMESTER 4

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T04A	STOCHASTIC PROCESSES AND NUMERICAL METHODS	3-1-0-3	4	4
B	B24EE2T05	SIGNALS AND SYSTEMS	2-2-0-2	4	3
C	B24EE2T06	POWER ELECTRONICS	3-1-0-3	4	4
D	B24EE2T07	ELECTROMAGNETIC THEORY	2-1-0-2	3	3
E	B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	3-0-0-3	3	3
F	B24EE2T08	MICROPROCESSORS AND MICROCONTROLLERS	2-2-0-2	4	4
G	B24EE2L05	ELECTRICAL MACHINES LAB I	0-0-3-3	3	2
H	B24EE2L06	ELECTRONIC CIRCUITS LAB II	0-0-3-3	3	2
M	B24EEM4X	MINOR	3-1-0-3	4	4
N	B24EEH4X	HONORS	2-2-0-2	4	4
			TOTAL*	36	25

*Total does not include the credits of honors and minor courses

SEMESTER 5

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24EE3T01	LINEAR CONTROL SYSTEM	2-2-0-2	4	4
B	B24EE3T02	POWER SYSTEM I	2-2-0-2	4	4
C	B24EE3T03	ELECTRICAL MACHINES II	2-2-0-2	4	4
D	B24EE3T04	INSTRUMENTATION SYSTEMS	3-1-0-3	4	4
E	B24HU3T05	ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT STRATEGIES	2-1-0-2	3	3
F	B24EE3P1X	PROGRAMME ELECTIVE I	2-1-0-2	3	3
G	B24EE3L07	MICROPROCESSOR AND MICROCONTROLLER LAB	0-0-3-3	3	2
H	B24EE3L08	POWER ELECTRONICS LAB	0-0-3-3	3	2
M	B24EEM5X	MINOR	3-1-0-3	4	4
N	B24EEH5X	HONORS	3-1-0-3	4	4
			TOTAL*	36	26

Note: Six programme electives are offered starting from Semester 5 as per the curriculum. This curriculum is designed to provide learners with the opportunity to gain proficiency in six different streams of Electrical and Electronics Engineering, including Control and Instrumentation, Power Electronics and Applications, Power System and High Voltage Engineering, Embedded Systems and VLSI, Electronics and Communication Systems, and Intelligent Computing Techniques, through program electives. Learners can choose any one of the streams in semester 5 and it is not compulsory to follow the same stream in the subsequent semesters. The department may offer Elective Courses to enable students to utilize this opportunity, depending on faculty availability.

PROGRAMME ELECTIVE I

COURSE NO.	COURSES
B24EE3P11	INDUSTRIAL INSTRUMENTATION AND AUTOMATION
B24EE3P12	RENEWABLE ENERGY SYSTEMS AND APPLICATIONS
B24EE3P13	HIGH VOLTAGE ENGINEERING
B24EE3P14	MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN
B24EE3P15	ELECTRONIC MATERIALS
B24EE3P16	COMPUTER ORGANIZATION AND ARCHITECTURE

SEMESTER 6

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24EE3T05	ADVANCED CONTROL SYSTEM	2-2-0-2	4	4
B	B24EE3T06	ELECTRIC DRIVES AND CONTROL	3-1-0-3	4	4
C	B24EE3T07	POWER SYSTEM II	2-2-0-2	4	4
D	B24EE3T08	OBJECT-ORIENTED PROGRAMMING	2-2-0-2	4	4
E	B24EE3P2X	PROGRAMME ELECTIVE II	2-1-0-2	3	3
F	B24EE3G1X	OPEN ELECTIVE I	2-1-0-2	3	3
G	B24EE3L09	ELECTRICAL MACHINES LAB II	0-0-3-3	3	2
H	B24EE3L10	CONTROL SYSTEM LAB	0-0-3-3	3	2
M	B24EEM6X	MINOR	3-1-0-3	4	4
N	B24EEH6X	HONORS	3-1-0-3	4	4
			TOTAL*	36	26

PROGRAMME ELECTIVE II

COURSE NO.	COURSES
B24EE3P21	BIOMEDICAL INSTRUMENTATION
B24EE3P22	SWITCHED-MODE POWER CONVERTERS
B24EE3P23	ENERGY MANAGEMENT AND AUDITING
B24EE3P24	SYSTEM DESIGN USING HDL
B24EE3P25	COMMUNICATION SYSTEMS
B24EE3P26	DATA STRUCTURES AND ALGORITHMS

OPEN ELECTIVE I

COURSE NO.	COURSES
B24EE3G11	ELECTRICAL SAFETY
B24EE3G12	RENEWABLE POWER GENERATION SYSTEMS
B24EE3G13	ELECTRICAL POWER UTILIZATION
B24EE3G14	ENERGY MANAGEMENT AND AUDITING
B24EE3G15	INDUSTRIAL AUTOMATION
B24EE3G16	ELECTRIC VEHICLE TECHNOLOGY

SEMESTER 7

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24EE4T01	ELECTRICAL SYSTEM DESIGN AND ESTIMATION	2-1-0-2	3	3
B	B24EE4P3X	PROGRAMME ELECTIVE III	2-1-0-2	3	3
C	B24EE4P4X	PROGRAMME ELECTIVE IV	2-1-0-2	3	3
D	B24EE4G2X	OPEN ELECTIVE II	2-1-0-2	3	3
E	B24HU4T04	DISASTER MANAGEMENT AND INDUSTRIAL SAFETY	2-1-0-2	3	3
G	B24EE4L11	POWER SYSTEM LAB	0-0-3-3	3	2
H	B24EE4L12	PROJECT PHASE I	0-0-6-6	6	3
J	B24EE4L13	SEMINAR	0-0-4-4	4	2
K	B24EE4T02	VIVA VOCE	0-0-0-0	-	1
M	B24EEM7X	MINOR	3-1-0-3	4	4
N	B24EEH7X	HONORS	3-1-0-3	4	4
			TOTAL*	36	23

PROGRAMME ELECTIVE III

COURSE NO.	COURSES
B24EE4P31	ROBOTICS AND AUTOMATION
B24EE4P32	ELECTRIC VEHICLE TECHNOLOGY
B24EE4P33	POWER QUALITY
B24EE4P34	INTERNET OF THINGS
B24EE4P35	SOLID STATE DEVICES
B24EE4P36	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

PROGRAMME ELECTIVE IV

COURSE NO.	COURSES
B24EE4P41	DIGITAL CONTROL SYSTEM
B24EE4P42	ENERGY STORAGE SYSTEMS FOR EV
B24EE4P43	COMPUTER AIDED POWER SYSTEM ANALYSIS
B24EE4P44	DIGITAL IC DESIGN
B24EE4P45	DIGITAL SIGNAL PROCESSING
B24EE4P46	COMPUTER NETWORKS

OPEN ELECTIVE II

COURSE NO.	COURSES
B24EE4G21	BIOMEDICAL INSTRUMENTATION
B24EE4G22	INTRODUCTION TO ENERGY STORAGE SYSTEMS
B24EE4G23	ILLUMINATION ENGINEERING
B24EE4G24	ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGIC SYSTEMS
B24EE4G25	ELECTRICAL SYSTEM DESIGN FOR BUILDING
B24EE4G26	SPECIAL MACHINES

SEMESTER 8

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A, B, C		INTERNSHIP & MOOC COURSES** (3 NUMBERS)			9
OR					
A	B24EE4P5X	PROGRAMME ELECTIVE V	2-1-0-2	3	3
B	B24EE4P6X	PROGRAMME ELECTIVE VI	2-1-0-2	3	3
C	B24EE4G3X	OPEN ELECTIVE III	2-1-0-2	3	3
AND					
H	B24EE4L14	PROJECT PHASE II	0-0-12-12	12	6
M	B24EEM8X	MINOR PROJECT***	0-0-3-3	3	6
N	B24EEH8X	HONORS PROJECT***	0-0-6-6	6	6
			TOTAL*	30	15

** Students can take MOOC courses either in Semester 7 or Semester 8 from the list of approved courses by the Board of Studies

***Minor/Honors Project can be done either in Semester 7 or Semester 8

PROGRAMME ELECTIVE V

COURSE NO.	COURSES
B24EE4P51	NON-LINEAR CONTROL THEORY
B24EE4P52	ADVANCED ELECTRIC DRIVES
B24EE4P53	POWER SYSTEMS OPERATION AND CONTROL
B24EE4P54	CMOS ANALOG CIRCUIT DESIGN
B24EE4P55	NANOELECTRONICS
B24EE4P56	DEEP LEARNING

PROGRAMME ELECTIVE VI

COURSE NO.	COURSES
B24EE4P61	PROCESS CONTROL AND INSTRUMENTATION
B24EE4P62	POWER CONVERTERS FOR POWER SYSTEM APPLICATIONS
B24EE4P63	SMART GRID TECHNOLOGIES
B24EE4P64	REAL-TIME OPERATING SYSTEMS
B24EE4P65	MICROELECTROMECHANICAL SYSTEMS
B24EE4P66	SOFT COMPUTING TECHNIQUES

OPEN ELECTIVE III

COURSE NO.	COURSES
B24EE4G31	INDUSTRIAL INSTRUMENTATION
B24EE4G32	SUSTAINABLE ENERGY SYSTEMS
B24EE4G33	HUMAN FACTORS ENGINEERING
B24EE4G34	ELECTRICITY MARKETS
B24EE4G35	INTERNET OF THINGS
B24EE4G36	SMART GRID ENGINEERING

PROGRAMME ELECTVE STREAMWISE LIST

STREAM 1 CONTROL AND INSTRUMENTATION	
ELECTIVE	**COURSES**
I	INDUSTRIAL INSTRUMENTATION AND AUTOMATION
II	BIOMEDICAL INSTRUMENTATION
III	ROBOTICS AND AUTOMATION
IV	DIGITAL CONTROL SYSTEM
V	NON-LINEAR CONTROL THEORY
VI	PROCESS CONTROL AND INSTRUMENTATION

STREAM 2 POWER ELECTRONICS AND APPLICATIONS	
ELECTIVE	**COURSES**
I	RENEWABLE ENERGY SYSTEMS AND APPLICATIONS
II	SWITCHED-MODE POWER CONVERTERS
III	ELECTRIC VEHICLE TECHNOLOGY
IV	ENERGY STORAGE SYSTEMS FOR EV
V	ADVANCED ELECTRIC DRIVES
VI	POWER CONVERTERS FOR POWER SYSTEM APPLICATIONS
STREAM 3 POWER SYSTEM AND HIGH VOLTAGE ENGINEERING	
ELECTIVE	**COURSES**
I	HIGH VOLTAGE ENGINEERING
II	ENERGY MANAGEMENT AND AUDITING
III	POWER QUALITY
IV	COMPUTER AIDED POWER SYSTEM ANALYSIS
V	POWER SYSTEMS OPERATION AND CONTROL
VI	SMART GRID TECHNOLOGIES
STREAM 4 EMBEDDED SYSTEMS AND VLSI	
ELECTIVE	**COURSES**
I	MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN
II	SYSTEM DESIGN USING HDL
III	INTERNET OF THINGS
IV	DIGITAL IC DESIGN
V	CMOS ANALOG CIRCUIT DESIGN
VI	REAL-TIME OPERATING SYSTEMS
STREAM 5 ELECTRONICS AND COMMUNICATION SYSTEMS	
ELECTIVE	**COURSES**
I	ELECTRONIC MATERIALS
II	COMMUNICATION SYSTEMS
III	SOLID-STATE DEVICES
IV	DIGITAL SIGNAL PROCESSING
V	NANOELECTRONICS
VI	MICROELECTROMECHANICAL SYSTEMS

STREAM 6 INTELLIGENT COMPUTING TECHNIQUES	
ELECTIVE	**COURSES**
I	COMPUTER ORGANIZATION AND ARCHITECTURE
II	DATA STRUCTURES AND ALGORITHMS
III	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
IV	COMPUTER NETWORKS
V	DEEP LEARNING
VI	SOFT COMPUTING TECHNIQUES

MINOR

BASKET 1		
SEMESTER	**COURSE CODE**	**COURSES**
3	B24EEM31	CIRCUIT THEORY
4	B24EEM41	LINEAR CONTROL SYSTEMS
5	B24EEM51	MODELING OF SYSTEMS
6	B24EEM61	INDUSTRIAL INSTRUMENTATION AND AUTOMATION
7	B24EEM71	ROBOTICS AND AUTOMATION
8	B24EEM81	PROJECT
BASKET 2		
SEMESTER	**COURSE CODE**	**COURSES**
3	B24EEM32	ELECTRIC CIRCUITS
4	B24EEM42	FUNDAMENTALS OF ELECTRICAL MACHINES
5	B24EEM52	SOLID STATE POWER CONVERSION
6	B24EEM62	POWER ELECTRONIC DRIVES
7	B24EEM72	HVDC TRANSMISSION
8	B24EEM82	PROJECT
BASKET 3		
SEMESTER	**COURSE CODE**	**COURSES**
3	B24EEM33	INTRODUCTION TO POWER ENGINEERING
4	B24EEM43	ENERGY STORAGE SYSTEMS
5	B24EEM53	POWER SYSTEM OPERATION AND CONTROL
6	B24EEM63	AUTOMATION OF POWER PLANTS
7	B24EEM73	DISTRIBUTED GENERATION AND SMART GRID
8	B24EEM83	PROJECT

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

HONORS

BASKET 1		
SEMESTER	**COURSE CODE**	**COURSES**
4	B24EEH41	NETWORK ANALYSIS AND SYNTHESIS
5	B24EEH51	SIMULATION OF ELECTRIC SYSTEMS
6	B24EEH61	ANALYSIS OF POWER ELECTRONIC CIRCUITS
7	B24EEH71	DYNAMICS OF POWER CONVERTERS
8	B24EEH81	PROJECT
BASKET 2		
SEMESTER	**COURSE CODE**	**COURSES**
4	B24EEH41	NETWORK ANALYSIS AND SYNTHESIS
5	B24EEH51	SIMULATION OF ELECTRIC SYSTEMS
6	B24EEH62	POWER SYSTEM DYNAMICS
7	B24EEH72	CONTROL AND DYNAMICS OF MICROGRID
8	B24EEH82	PROJECT
BASKET 3		
SEMESTER	**COURSE CODE**	**COURSES**
4	B24EEH41	NETWORK ANALYSIS AND SYNTHESIS
5	B24EEH51	SIMULATION OF ELECTRIC SYSTEMS
6	B24EEH63	GENERALIZED MACHINE THEORY
7	B24EEH73	FINITE ELEMENT APPLICATIONS IN ELECTRICAL ENGINEERING
8	B24EEH83	PROJECT

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

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B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING

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 AND PROGRAMMING TECHNIQUES (A)	2-1-0-2	3	3
C	B24EE1T01	INTRODUCTION TO ELECTRICAL ENGINEERING	2-2-0-2	4	4
D	B24EE1T02	ELECTRONIC CIRCUITS I	2-1-0-2	3	3
E	B24ES1T03B	COMPUTER AIDED ENGINEERING GRAPHICS (B)	2-1-1-3	4	4
G	B24ES1L01A	PROGRAMMING LAB (A)	0-0-3-3	3	2
H	B24EE1L01	BASIC ELECTRICAL ENGINEERING LAB	0-0-3-3	3	2
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	22

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.

Prerequisite

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 (9 hours)

Linear Algebra

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), Eigenvalues and eigenvectors. Diagonalization of matrices, orthogonal transformation, quadratic forms and their canonical forms.

(Textbook 2: Relevant topics from 7.3, 7.4, 7.5, 8.1, 8.3, 8.4)

MODULE 2 (9 hours)

Multivariable Calculus-Differentiation

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.

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

MODULE 3 (9 hours)

Multivariable Calculus-Integration

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).

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

MODULE 4 (9 hours)

Calculus of Vector Functions

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).

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

MODULE 5 (9 hours)

Vector Integral Theorems

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.

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

Text Books

1. H. Anton, I. Biven, S. Davis, *Calculus*, Wiley, 10th ed., 2015.

2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 10th ed., 2015.

Reference Books

1. G.B. Thomas and R.L. Finney, *Calculus and Analytic Geometry*, Pearson, 9th ed., Reprint,2002.

2. J. Stewart, *Essential Calculus*, Cengage, 2nd ed., 2017.

3. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 43rd., 2015.

4. Peter O Neil, *Advanced Engineering Mathematics*, Thomson, 7th ed., 2007.

5. 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	**Module 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	Eigenvalues and eigenvectors	2
1.4	Diagonalization of matrices	2
1.5	Orthogonal transformation, quadratic forms and their canonical forms	2
2	**Module 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	**Module 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	**Module 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	**Module 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, diagonalise 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 marks)

(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 marks)

OR

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

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

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 marks)

(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 marks)

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 marks)

(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 marks)

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 $y = 2\sqrt{x}$. (7 marks)

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

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 marks)

(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 marks)

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 marks)

(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 marks)

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 marks)

    (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 marks)

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 marks)

    (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 marks)

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 marks)

    (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 marks)

B24ES1T01A	PROBLEM SOLVING AND PROGRAMMING TECHNIQUES (A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

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

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1: C Fundamentals	**6**
1.1	Problem solving using Algorithms, Pseudocode and Flowcharts	1
1.2	C fundamentals: Character set, Constants, Identifiers	1
1.3	Keywords, Basic data types, Variables	1
1.4	Operators and its precedence, bitwise operators	1
1.5	Expressions, Statements, Input and Output statements	1
1.6	Structure of a C program– simple programs	1
	Module 2: Control Statements	**9**
2.1	Control statements: if, if-else, nested if	

2.2	Switch, while loop, do-while loop	1
2.3	For loop, break & continue statements, nested loops	1
2.4	Single dimensional arrays – defining an array, array initialization, accessing array elements	1
2.5	Two-dimensional arrays – defining a two-dimensional array	1
2.6	Programs for matrix processing	1
2.7	Programs for sequential search	1
2.8	Bubble sort	1
2.9	Enumerated data type	1
	Module 3: Strings and Functions	**8**
3.1	Strings: declaring a string variable, reading and displaying strings	1
3.2	String related library functions	1
3.3	Programs for string matching	1
3.4	Functions: Function definition, Function call	1
3.5	Function prototype, Parameter passing	1
3.6	Recursion	1
3.7	Passing array to function	1
3.8	Macros: Defining and calling macros	1
	Module 4: Structures	**8**
4.1	Structures: defining a structure variable, accessing members	1
4.2	Array of structures, passing structure to function	1
4.3	Union	1
4.4	Pointers: declaration, operations on pointers, pointer to a function	1
4.5	Accessing array elements using pointers, Processing strings using pointers	1
4.6	Pointer to pointer, Array of pointers	1
4.7	Pointer to function, Pointer to structure	1
4.8	Dynamic memory allocation	1
	Module 5: Files	**5**
5.1	Different types of files in C, Opening & Closing a file	1
5.2	Writing to and Reading from a file, Processing file	1
5.3	Library functions related to file – fseek(), ftell()	1
5.4	Library functions related to file – fread(), fwrite()	1
5.5	Storage Class associated with variables: automatic, static, external and register	1

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 marks)

OR

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

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

OR

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

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

OR

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

17. (a) Write a C program to: (7 marks)
        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 marks)

OR

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

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

OR

20. (a) Write a C program to count number of lines in a text file. (7 marks)
    (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 marks)

<table>
<tr><td rowspan="2">B24EE1T01</td><td rowspan="2">INTRODUCTION TO ELECTRICAL ENGINEERING</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>2</td><td>0</td><td>2</td><td>4</td><td>2024</td></tr>
</table>

Preamble

The course aims to equip the students with an understanding of the fundamental principles of electrical engineering. This will set a strong conceptual understanding of basic electrical laws and theorems with the art of technical problem solving. Upon successful completion of the course, the students will be empowered to analyze and comprehend the diverse electrical systems that surround us.

Prerequisites

Nil

Course Outcomes

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

CO 1	Apply fundamental concepts and circuit laws to solve electric circuits. (Cognitive Knowledge Level: Apply)
CO 2	Apply the circuit theorems of electrical engineering to solve DC circuits in steady-state. (Cognitive Knowledge Level: Apply)
CO 3	Understand the basic concepts of magnetism to develop and solve models of magnetic circuits and fundamental concepts of AC systems. (Cognitive Knowledge Level: Understand)
CO 4	Solve single-phase AC circuits by applying the fundamental laws of electrical engineering and analyze the same using circuit theorems. (Cognitive Knowledge Level: Apply)
CO 5	Analyze balanced and unbalanced 3-phase star-connected and delta-connected systems. (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	1		1	1		1		1	1
CO 2	3	3	2	1		1	1		1		1	1
CO 3	3	3	2	1		1	1		1		1	1
CO 4	3	3	2	1		1	1		1		1	1
CO 5	3	3	2	1		2	1		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	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 (10 hours)

DC Circuits

Independent voltage and current sources, passive components (circuit and dimension), Ohm's Law, Kirchhoff's Laws, series and parallel combinations, voltage and current division rule, Star-Delta/Delta-Star Conversions to reduce resistive networks, source transformation.

Analysis of DC Circuits

Mesh current analysis and nodal voltage analysis of circuits containing resistors and independent sources- solution of network equations by matrix representation.

MODULE 2 (8 hours)

Circuit Theorems

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, and Reciprocity theorem. Thevenin's and Norton's equivalent circuits (with independent sources only).

MODULE 3 (12 hours)

Electromagnetism

Magnetism - Terminologies, analogy of electrical and magnetic circuit, series and parallel magnetic circuits, force on current carrying conductors placed in a magnetic field - Fleming's left-hand rule, Faraday's Laws of electromagnetic induction, Lenz's Law, statically and dynamically induced EMF - self-inductance, mutual-inductance and coefficient of coupling.

AC Fundamentals

Generation of sinusoidal voltage and currents, average value, rms value, form and peak factors of trapezoidal and sinusoidal waveforms, Phasor representation of sinusoidal quantities - phase difference, addition and subtraction of sinusoids, Symbolic Representation: cartesian, polar and exponential forms.

MODULE 4 (8 hours)

Single Phase AC Circuits

AC circuits with pure resistance, pure inductance, pure capacitance, RL, RC, and RLC circuits - voltage-current phasor diagrams, active, reactive, apparent, complex power, and power factor.

Circuit Theorems in AC

Thevenin's Theorem, Norton's Theorem, and Maximum Power Transfer Theorem.

MODULE 5 (7 hours)

Analysis of Three-phase AC Circuits

Generation of 3-phase AC voltage, phase sequence, 3-phase star connected and delta connected systems - balanced and unbalanced 3-wire and 4-wire systems, power in three-phase balanced circuits - active power, reactive power, complex power, apparent power and power factor.

Text Books

1. K. S. Suresh Kumar, *Electric Circuits and Networks*, Pearson Education, 2nd ed., 2022.
2. B. L. Theraja, *Electrical Technology*, S. Chand Publication, Vol.1, 30th ed., 2020.
3. V. K. Mehta, *Basic Electrical Engineering*, S. Chand and Company Ltd, 8th ed., 2020.
4. Edward Hughes, *Electrical Technology*, Pearson Education, 11th ed., 2020.
5. J. A. Edminister, *Electric Circuit Theory*, McGraw-Hill , 2nd ed., 2022.

Reference Books

1. Del Toro V, *Electrical Engineering Fundamentals*, Pearson Education, 3rd ed., 2023.
2. T. K. Nagsarkar, M. S. Sukhija, *Basic Electrical Engineering*, Oxford Higher Education, 6th ed., 2022.
3. Hayt W. H., Kemmerly J. E., and Durbin S. M., *Engineering Circuit Analysis*, Tata McGraw-Hill, 10th ed., 2023.
4. Hughes, *Electrical and Electronic Technology*, Pearson Education, 12th ed., 2022.
5. V. N. Mittle and Arvind Mittal, *Basic Electrical Engineering*, McGraw Hill, 6th ed., 2022.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: DC Circuits and Analysis of DC Circuits	**10**
1.1	Independent voltage and current sources, passive components (circuit and dimension), Ohm's Law, Kirchhoff's Laws	1
1.2	Series and parallel combinations, voltage, and current division rule -Numerical problems	2
1.3	Star-Delta / Delta-Star Conversions to reduce resistive networks (derivation not required), source transformation-Numerical problems	2
1.4	Mesh current analysis and nodal voltage analysis of circuits containing resistors and independent sources	2
1.5	Numerical problems	1
1.6	Solution of network equations by matrix representation	2
	Module 2: Circuit Theorems	**8**
2.1	Superposition theorem, Numerical problems	2
2.2	Maximum Power Transfer theorem, and Reciprocity Theorem. Numerical problems	2
2.3	Thevenin's theorem and Norton's theorem	1
2.4	Determination of Thevenin's and Norton's equivalent circuits containing independent sources	3
	Module 3: Electromagnetism and AC Fundamentals	**12**
3.1	Magnetism- Terminologies, analogy of electrical and magnetic circuit, series and parallel magnetic circuits - Numerical problems	2
3.2	Force on current carrying conductors placed in a magnetic field - Fleming's left-hand rule	1
3.3	Faraday's Laws of electromagnetic induction, Lenz's Law, statically and dynamically induced EMF	2
3.4	Self-inductance, mutual-inductance, and coefficient of coupling- Numerical problems	2
3.5	Generation of sinusoidal voltage and currents	1
3.6	Average value, rms value, form and peak factors of trapezoidal and sinusoidal waveforms - Numerical problems	2
3.7	Phasor representation of sinusoidal quantities - phase difference, addition and subtraction of sinusoids	1
3.8	Symbolic Representation: cartesian, polar and exponential forms	1
	Module 4: Single phase AC Circuits and Circuit Theorems in AC	**8**

4.1	AC circuits with pure resistance, pure inductance, pure capacitance, RL, RC, and RLC circuits -corresponding voltage-current phasor diagrams	2
4.2	Active, reactive, apparent, complex power, and power factor	1
4.3	Numerical problems	3
4.4	Thevenin's theorem, Norton's theorem, and Maximum Power Transfer Theorem for AC circuits - Numerical problems	2
	Module 5: Analysis of Three-phase AC Circuits	**7**
5.1	Generation of 3-phase AC voltage, phase sequence	1
5.2	3-phase star connected and delta connected systems-balanced and unbalanced - 3-wire and 4-wire systems - Numerical problems	3
5.3	Power in three-phase balanced circuits- active power, reactive power, complex power, apparent power and power factor Numerical problem	3

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Solve problems based on the current division rule.
2. Solve problems with Mesh/Nodal analysis.
3. Solve problems on Star-Delta Transformation.

Course Outcome 2 (CO 2)

1. Solve DC circuits using the Superposition theorem.
2. Solve DC circuits using the Maximum Power Transfer/Reciprocity Theorem.
3. Determination of Thevenin's and Norton's equivalent circuits.

Course Outcome 3 (CO 3)

1. Problems on series/parallel magnetic circuits.
2. Problems on self-inductance, mutual-inductance, and coefficient of coupling.
3. Problems on rms and average values of periodic waveforms.

Course Outcome 4 (CO 4)

1. Problems on series RL and RC circuit.
2. Problems on series RLC circuit.
3. Solve AC circuits using Thevenin/Norton's Theorem.

Course Outcome 5 (CO 5)

1. Solve problems of balanced 3-phase star and delta connected system.
2. Solve problems of unbalanced 3-phase star and delta-connected system.
3. Determination of power in three-phase balanced circuits.

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: : B24EE1T01

Course Name: : INTRODUCTION TO ELECTRICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

PART A

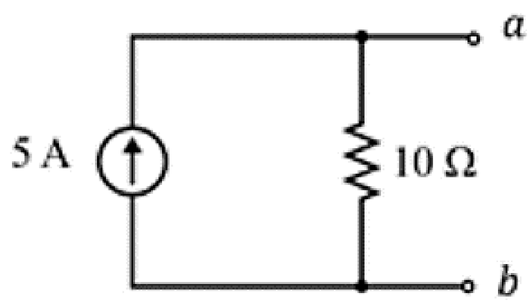
Answer all questions. Each question carries 3 marks.

1. State Kirchhoff's laws. Draw a circuit with one loop consisting of two resistances and two voltage sources, and write the voltage equation of the loop.

2. Three resistors, 20 Ω, 90 Ω, and 10 Ω, are star connected. Obtain the equivalent delta circuit.

3. State and explain the Reciprocity theorem using an example.

4. Find the value of the load resistance to be connected at a - b so that maximum power is transferred by the source. What is the maximum power delivered to the load?



5. Distinguish between self and mutual inductances. Derive an expression for the self-inductance of a coil.

6. Derive the form factor of a pure sinusoidal waveform.

7. A resistance of 10 Ω and an inductive reactance of 10Ω are connected in series. Calculate the value of impedance and draw the impedance triangle.
8. Explain active power, reactive power, and apparent power.
9. Draw a three-phase, four-wire system and mark the voltage between each wire. Assume that the voltage across a phase is 230 V.
10. Derive the relation between line and phase values of voltage and current for delta connected system.

PART B

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

11. (a) Determine the node voltages in the Figure 1. (10 marks)

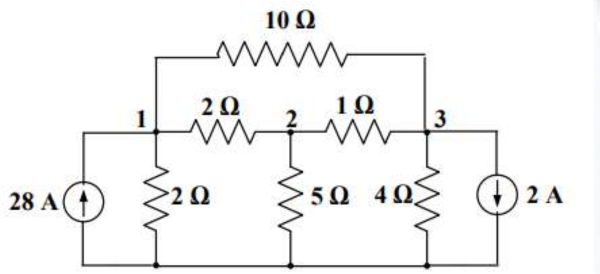


Figure 1

(b) Three lamps are connected in series across a 180 V supply and take a current of 2.5 A. If the resistance of two of the lamps is 30 Ω each, what is the resistance of the third lamp? (4 marks)

OR

12. (a) Using mesh analysis, find the voltage V_x of Figure 2. (10 marks)

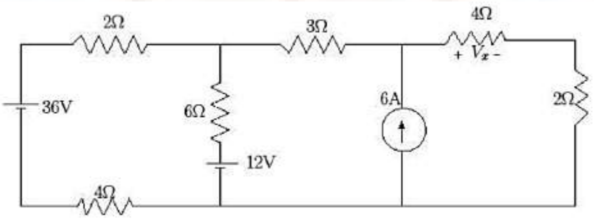


Figure 2

(b) Using star delta transformation, find the equivalent resistance between A and B in Figure 3. (4 marks)

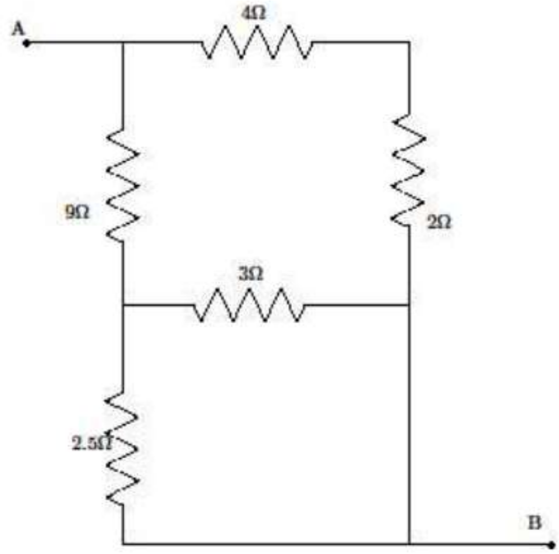


Figure 3

13. For the circuit given in Figure 4,

    (a) Determine the Thevenin's equivalent circuit across the terminals X and Y. (10 marks)

    (b) Determine the value of resistance to be connected across X and Y so that maximum power is transferred to it. Also, calculate the maximum power transferred. (4 marks)

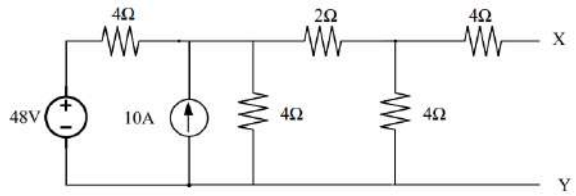


Figure 4

OR

14. For the circuit given in Figure 5, apply the superposition theorem to find the power dissipated in the 5 Ω. (14 marks)

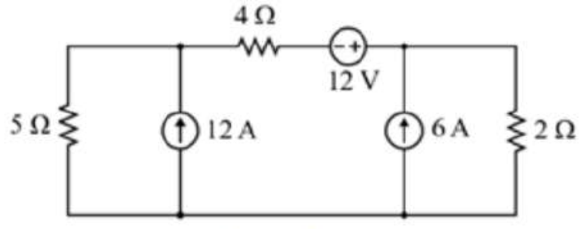


Figure 5

15. (a) A magnetic core is made up of a ring with a mean diameter of 7.96 cm and a cross-sectional area of 1 cm^2. The relative permeability of iron is 2000. A coil of

1500 turns is uniformly wound around the ring. Obtain the current required to produce a flux of 25 mWb? What current will be required to maintain the same flux, if an air gap of 2 mm is cut through the core. (10 marks)

(b) Write a short note on (4 marks)

i. Magneto motive force

ii. Reluctance

iii. Magnetic flux

iv. Permeability

OR

16. (a) Define the following terms with an example: a) Phase b) Phase difference. (4 marks)

(b) Explain in detail the dynamically and statically induced emfs. An air solenoid has 300 turns, its length is 25 cm, and cross-sectional area of 3 cm^2. Calculate the self-inductance. If the coil current of 10 A is completely interrupted in 0.04 s, calculate the induced emf in the coil. (10 marks)

17. (a) A current of 5 A flows through a non-inductive resistance in series with a choke coil when supplied at 250 V, 50 Hz. If the voltage across the resistance is 125 V and that across the coil is 200 V, calculate (i) Impedance, reactance, and resistance of the coil, (ii) Power absorbed by the coil, and (iii) Total power absorbed by the circuit. (10 marks)

(b) Explain the phasor diagram and impedance triangle of a series resistive inductive circuit excited by an AC source. (4 marks)

OR

18. In the circuit given in Figure 6,

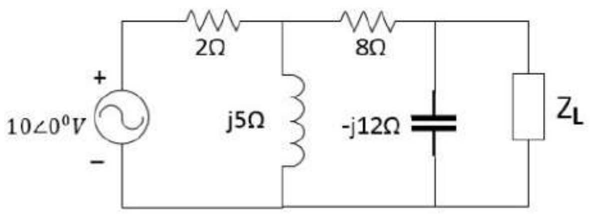


Figure 6

(a) Determine the value of the load impedance for maximum power transferred by the source to the load. (12 marks)

(b) Find the maximum power transferred. (2 marks)

19. A 3-phase, 3-wire, 240V system supplies a delta-connected load in which $Z_{AB} = 25 < 90^o\ \Omega$, $Z_{BC} = 15 < 30^o\ \Omega$ and $Z_{CA} = 20 < 0^o\ \Omega$. Determine the phase currents, line currents, and total power consumed by the load. (14 marks)

OR

20. A 3-phase, 400V, 4-wire system has a star connected load with $Z_A = 20\ \Omega$, $Z_B = 15 +$ j10 Ω and $Z_C =$ j5 Ω. Find the line currents, current through the neutral conductor, and the total power consumed by the load. (14 marks)

B24EE1T02	ELECTRONIC CIRCUITS I	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

Electronic Circuits I course aims to impart sound knowledge and basic concepts of electronic circuits. It gives information about the principle of operation of electronic devices and their practical applications. This course will enable the students to understand and analyse practical electronic circuits.

Prerequisites

Nil

Course Outcomes

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

CO 1	Understand the fundamental concepts of diodes, applications, and analysis. (Cognitive Knowledge Level: Understand)
CO 2	Describe the various transistor configurations and characteristics. (Cognitive Knowledge Level: Apply)
CO 3	Apply the basic biasing and stabilization techniques of transistors to develop practical circuits. (Cognitive Knowledge Level: Apply)
CO 4	Apply the h parameter model to find amplifier parameters and understand the frequency response of multi-stage amplifiers. (Cognitive Knowledge Level: Apply)
CO 5	Understand the principles of power amplifiers and various oscillators. (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	1		1	1	1	1	1	1		2
CO 2	3	2	2				1	1	1	1		2
CO 3	3	3	3	2				1	1	1		2
CO 4	3	3	3	2		1		1	1	1		2
CO 5	3	3	1		1	1	1	1	1	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 (7 hours)

Introduction to Semiconductor Devices

PN Junction diode - principle of operation, VI characteristics, principle of avalanche breakdown, zener diode, zener shunt regulator, Schottky diode.

Rectifiers

Half-wave rectifier, full-wave rectifier, full-wave bridge rectifier-design of half-wave and full-wave rectifiers with capacitor filters.

MODULE 2 (8 hours)

Wave Shaping Circuits

Clipping circuits and clamping circuits - applications - RC Integrator and Differentiator.

Transistor Circuits

Bipolar Junction Transistors (BJT), PNP and NPN structures, principle of operation, the relation between current gains in CE, CB, and CC, input and output characteristics of common base and common emitter configuration. Uni Junction Transistor (UJT), Junction Field Effect Transistor (JFET) - construction and working principle.

MODULE 3 (7 hours)

Transistor Stability

Operating point of BJT - factors affecting stability of Q point, DC biasing - biasing circuits - fixed bias, collector to base bias, voltage divider bias, role of emitter resistance in bias stabilization - stability factor derivation for voltage divider biasing, Numerical problems.

MODULE 4 (8 hours)

h-parameters

Modeling of BJT - h-parameter model of BJT in CE configuration, small signal low frequency, AC equivalent circuit of CE amplifier, calculation of amplifier gains and impedances using h-parameter equivalent circuit - Numerical problems.

Feedback in Amplifiers: Effect of positive and negative feedback.

Multistage Amplifiers

Direct coupled amplifiers, RC coupled amplifiers, frequency response of RC coupled - role of coupling capacitors and emitter bypass capacitor.

MODULE 5 (6 hours)

Power Amplifiers using BJT

Class A, Class B, Class AB, Class C, and Class D amplifiers (basic principles).

Oscillators

Oscillators: Bark Hausen's criterion - RC phase shift oscillator, LC oscillators (Hartley), Crystal oscillator (derivation not needed), BJT sweep generator, Astable multivibrator (working principle and applications only).

Text Books

1. Bell D. A., *Electronic Devices and Circuits*, Oxford University Press, 5th ed., 2007.
2. Boylestad R. L. and L. Nashelsky, *Electronic Devices, and Circuit Theory*, Pearson Education, 10th ed., 2009.
3. Floyd T.L., *Fundamentals of Analog Circuits*, Pearson Education, 2nd ed., 2012.

Reference Books

1. J. B. Gupta, *Electronic Devices and Circuits*, S.K. Kataria, 6th ed., 2016.
2. Millman J. and C. C. Halkias, *Integrated Electronics: Analog and Digital Circuits and Systems*, Tata McGraw-Hill, 2nd ed., 2010.
3. Malvino A. and D. J. Bates, *Electronic Principles*, Tata McGraw Hill, 7th ed., 2010.
4. Allen Mottershead, *Electronic Devices and Circuits: An Introduction*, Prentice Hall of India.
5. G.K. Mithal, *Electronic Devices and Circuits*, Khanna Publishers, 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Introduction to Semiconductor Devices	**7**
1.1	PN Junction diode, principle of operation, VI characteristics	1
1.2	Principle of avalanche breakdown - Zener diode	1
1.3	Zener shunt regulator, Schottky diode	1
1.4	Rectifiers - Half-wave rectifier, Full-wave rectifier	2
1.5	Full-wave bridge rectifier	1
1.6	Design of Half-wave and full-wave rectifiers with capacitor filters	1
	Module 2: Wave Shaping Circuits and Transistor Circuits	**8**
2.1	Clipping circuits	1
2.2	Clamping circuits - Applications- RC Integrator and Differentiator	2
2.3	Transistor circuits - Bipolar Junction Transistors	1
2.4	PNP and NPN structures, principle of operation	1
2.5	Relation between current gains in CE, CB, and CC	1
2.6	Input and output characteristics of common base and common emitter configuration	1
2.7	UJT and JFET - construction and working principle	1
	Module 3: Transistor Stability	**7**
3.1	Operating point of BJT - Factors affecting the stability of Q point	2
3.2	DC Biasing circuits - fixed bias, collector to base bias	1
3.3	Voltage divider bias, role of emitter resistance in bias stabilization	1
3.4	Stability factor derivation for Voltage Divider Biasing	1
3.5	Numerical problems – Biasing	2
	Module 4: h-parameters and Multistage Amplifiers	**8**
4.1	Introduction to h-parameters	1
4.2	Modeling of BJT- h-parameter model of BJT in CE configuration	1
4.3	Small signal low-frequency AC equivalent circuit of CE amplifier	1
4.4	Calculation of amplifier gains and impedances using the h-parameter equivalent circuit, Numerical problems	2
4.5	Feedback in Amplifiers - Effect of positive and negative feedback	1

4.6	Multistage amplifiers: Direct coupled amplifiers, RC coupled amplifiers, the frequency response of RC coupled amplifier, Role of coupling capacitors, and emitter bypass capacitor	2
	Module 5: Power Amplifiers using BJT and Oscillators	**6**
5.1	Power amplifiers using BJT: Class A, Class B, Class AB, Class C, and Class D amplifiers	2
5.2	Oscillators: Barkhausen's criterion - RC Phase Shift oscillator (principle and frequency of operation)	1
5.3	LC oscillators (Hartley), Crystal oscillator (derivation not needed)	1
5.4	BJT Sweep generator (working principle and applications only)	1
5.5	Astable multivibrator (working principle and applications only)	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Explain the principle of operation of the diode.
2. Draw the VI characteristics of diodes.
3. Explain the working of rectifiers.

Course Outcome 2 (CO 2)

1. Understand the working of clipping and clamping circuits.
2. Explain the different configurations of transistors.
3. Describe the operation of UJT and JFET.

Course Outcome 3 (CO 3)

1. Problems with the stability factor of voltage divider biasing.
2. Explain factors affecting stability of Q point.
3. Explain the various biasing circuits and compare them.

Course Outcome 4 (CO 4)

1. Problems on amplifier gains and impedances using h-parameter equivalent.
2. Compare positive and negative feedback in amplifiers
3. Explain the frequency response curve of the RC coupled amplifier.

Course Outcome 5 (CO 5)

1. What are the various classes of Power Amplifiers?
2. Explain the working principle of Oscillators.
3. Explain the working of the Sweep Generator and Astable Multivibrator.

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: B24EE1T02

Course Name: ELECTRONIC CIRCUITS I

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Differentiate between Avalanche and Zener breakdown.
2. Explain the principle of Schottky diode.
3. Design a suitable circuit to obtain the output level clipped at +3V and -4V for a 10V peak-to-peak sinusoidal input voltage.
4. With a neat diagram, explain the constructional features of n channel JFET.
5. What are the advantages of potential divider biasing?
6. State the functions of a transistor biasing circuit.
7. Draw and explain the frequency response characteristics of the RC coupled amplifier.
8. List out the advantages of negative feedback in amplifiers.
9. Explain the Barkhausen's criteria of oscillations.
10. Draw the circuit of crystal oscillator.

PART B

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

11. (a) Explain the working of a PN junction diode and draw the VI characteristics of the diode. (8 marks)

    (b) Explain the formation of potential barrier in a PN junction diode. (6 marks)

OR

12. (a) With a neat diagram, explain the working of a full wave bridge rectifier. (8 marks)

    (b) Narrate how the capacitor filter eliminates ripples from the output of a rectifier. (6 marks)

13. (a) Explain the working of an NPN transistor. Describe with suitable sketches the input and output characteristics of a common emitter NPN transistor. (10 marks)

    (b) Derive the relationship between common base current gain and common emitter current gain. (4 marks)

OR

14. (a) With a neat circuit diagram, explain the working of a negative voltage clamping circuit. (8 marks)

    (b) Explain the working of a Uni Junction Transistor. (6 marks)

15. (a) Define the stability factor and derive the equation for the stability factor for voltage divider biasing. (8 marks)

    (b) What factors are to be considered for selecting the operating point Q of an amplifier? (6 marks)

OR

16. Design a voltage divider bias circuit to operate from an 18 V supply in which bias conditions are to be V_{CE} =V_E = 6 V, I_C = 1.5 mA, and β = 90. Also, calculate the stability factor S. (14 marks)

17. (a) Derive the equation for voltage gain and current gain for a BJT using an approximate h-parameter model for common emitter configuration. (8 marks)

    (b) Given h-parameters of a transistor connected in CE configuration is hie =1000 Ω, $h - r_e$= 10×10^{-4}, h_{fe}= 50, h_{oe} = $100 \times 10 - 6$. If the load resistance R_L is 1 KΩ, find i) Input impedance, ii) Current gain, and iii) Voltage gain. (6 marks)

OR

18. (a) Draw the h parameter model of a transistor in CE configuration. Also, derive the expression for input impedance, current gain, and voltage gain. (8 marks)

    (b) Describe the gain and bandwidth of an RC-coupled amplifier. (6 marks)

19. (a) With a neat diagram, explain the working of a Hartley Oscillator. (8 marks)

    (b) Explain the working of Class A amplifier. (6 marks)

OR

20. (a) With a neat diagram, explain the working of the Astable multivibrator. (8 marks)

    (b) Explain the working of the Class C amplifier. (6 marks)

B24ES1T03B	COMPUTER AIDED ENGINEERING GRAPHICS (B)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	1	3	4	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 be from Part A having 20 marks and test 2 will be from Part B with 20 marks. Regarding Assignments/Class work, 15 marks will be awarded for Part A and remaining 25 marks should be based on class works/assignments from Part B (minimum 5 exercise).

End Semester Examination Pattern

ESE will be from Part A of 2-hour duration on A4 size answer booklet and will be for 50 marks.
The question paper shall contain two parts, in which Part I contains one question from each module, each carries 12 marks and Part II contains two questions from any of the three modules carrying 14 marks each. 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

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 (5 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.
Use of CAD tools to draw simple electrical components and circuits.Drawing of simple electrical line drawings, layouts etc..

MODULE 5 (9 hours)

Isometric Projection using CAD

Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Frustum of Pyramid, Frustum of Cone.
Simple isometric and Orthographic views of electrical components.

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., 54th ed., 2023.
2. John, K.C. *Engineering Graphics*, Prentice Hall India, 2nd ed., 2009.
3. K.N. Anilkumar, *Engineering Graphics*, Adhyuth Narayan, 8th ed., 2013.
4. P. I. Varghese, *Engineering Graphics*, VIP, 34th ed., 2023.

Reference Books

1. Agrawal, B. and Agrawal, C.M., *Engineering Drawing*, Tata McGraw Hill Publishers, 3rd ed., 2019.
2. Duff, J.M. and Ross, W.A., *Engineering Design and Visualisation*, Cengage Learning, 1st ed., 2008.
3. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., *Engineering Graphics with AutoCAD*, Prentice Hall India, 1st ed., 2010.

4. Luzaddff, W.J. and Duff, J.M., *Fundamentals of Engineering Drawing*, Prentice Hall India, 1st ed.,1992.

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	Introduction: 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	**5**
4.1	Introduction to Computer Aided Drawing: 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 and oops, Copy and Move objects, Rotate, Scale, Stretch Extend and Offset, Mirror and array, Apply Chamfers and Fillets, Edit polylines and spline, decurve, fit, thickness join and explode	1
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	1
4.5	Use of CAD tools to draw simple electrical components and circuits. Drawing of simple electrical line drawings, layouts etc.	1
	Module 5: Isometric Projection using CAD and Conversion of Pictorial Views using CAD	**9**
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	Simple isometric and orthographic views of electrical machines	1
5.4	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.
2. Draw simple electrical components and circuits using 2D software.

Course Outcome 5 (CO 5)

1. Draw Isometric views/projections of solids or combination of solids using modelling software.
2. Draw simple Isometric views/projections of electrical components using modelling software.
3. 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

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24ES1T03B

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 endpoint A of a line is 20 mm above HP and 10mm in front of VP. The other end of the line is 50 mm above HP and 15 mm behind VP. The distance between the end projectors is 70 mm. 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 25 mm and height 40 mm, 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 30 mm and height 50 mm. 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 40 mm and height 70 mm 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 30 mm and 10 mm. 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.

B24ES1L01A	PROGRAMMING LAB (A)	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 15 marks
Class Work/ Assessment Viva-Voce 15 marks
Viva-Voce/ Test 20 marks

End Semester Examination (ESE) Pattern

The following guidelines should be followed regarding the award of marks.

Algorithm 20 marks
Program 30 marks
Viva-Voce 30 marks
Output 20 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. 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	Define a structure for student with fields roll no, name and age. Create a pointer to this structure, assign values to the fields, and print the values using pointer.
25	Write a C program to concatenate two strings using pointers.
26	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.
27	Open a text file and count the number of characters, words and lines in it; and store the result in another file.
28	Find the substring from the given text file and replace it with another string.

Reference Books

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

B24EE1L01	BASIC ELECTRICAL ENGINEERING LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The basic electrical lab aims to equip students with practical experience and a comprehensive understanding of fundamental electrical engineering principles. This includes learning the safe use of electrical equipment, understanding circuit components, and applying theoretical knowledge to practical scenarios. Upon successful completion of the course, the students will be well-prepared to connect theoretical knowledge with practical application, fostering a deeper understanding of electrical engineering principles.

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, and perform basic electrical wiring. (Cognitive Knowledge Level: Understand)
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	Apply fundamental circuit theorems to various electrical circuits. (Cognitive Knowledge Level: Apply)
CO 4	Measure various circuit parameters and analyze the voltage-current relationship of RLC circuits, linear and non-linear loads. (Cognitive Knowledge Level: Apply)
CO 5	Develop team management skills and prepare laboratory reports that logically and scientifically communicate experimental information. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	3	1		3	1	1	3	3	3	3
CO 2	3	2	3	1		3	1	1	3	3	2	3
CO 3	3	3	3	3		2	2	1	3	3	2	3
CO 4	3	3	3	3		2	2	1	3	3	2	3
CO 5	3	1	1	1		3	2	3	3	3	3	3

Mark Distribution

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

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment Viva-Voce	20 marks
Viva-Voce/ Test	20 marks

End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding the award of marks

1. Preliminary work : 25 Marks
   (a) Circuit Diagram: 15 Marks
   (b) Theory and Procedure: 10 Marks
2. Implementing the work/Conducting the experiment : 30 Marks (usage of equipment and troubleshooting)
3. Result and Inference : 15 Marks
4. Viva Voce : 25 Marks
5. Record : 5 Marks

SYLLABUS

LIST OF EXPERIMENTS

1	a) Familiarization with electrical symbols, measuring instruments, lighting and wiring accessories, tools, and various wiring systems. b) Study the electric shock phenomenon, precautions, safety procedures, and earthing in electrical installations.
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, and selection and rating of fuse, MCB, ELCB 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.
7	a) Determination of V-I characteristics of the linear resistor and linear inductor, incandescent, and LED lamps. b) Verification of KCL and KVL for the given circuit theoretically and experimentally.

8	Verification of the Superposition theorem and Thevenin's theorem for the given circuit theoretically and experimentally.
9	Verification of Reciprocity's theorem and Maximum Power Transfer theorem for the given circuit theoretically and experimentally.
10	a) Measurement of self-inductance, the mutual inductance, and the coupling coefficient of two coils. b) Verification of the relation between phase and line quantities in a 3-phase balanced star and delta connected systems.
11	Analyze the RLC series and parallel AC circuits and verify them experimentally.
12	a) Determine the current and voltage response under illumination depending on the magnitude of the variable resistance. b) Visit the on-campus 150 kW solar power plant.

Reference Books

1. H. Cotton, *Advanced Electrical Technology*, Reem Publications, 5th ed., 2011.
2. K. S. Suresh Kumar, *Electrical Circuit and Networks*, Pearson Education, 2009.
3. E. W. Golding,*Electrical Measurements and Measuring Instruments*, Pitman, 3rd ed., 2011.

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	Develop a profound understanding of themselves and others, leading a fulfilling professional life by embracing a holistic approach to well being. (Cognitive Knowledge Level: Analyzes)
CO 3	Provide a solid foundation in leadership principles and team dynamics. (Cognitive Knowledge Level: Apply)
CO 4	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						3	1	2	2	2		2
CO 3									3			2
CO 4		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
100	50	50

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*, Wiley Publishing Ltd, 1st ed., 2015.
6. Larry James, *The First Book of Life Skills*, Embassy Books, 1st ed., 2016.
7. Shalini Verma, *Development of Life Skills and Professional Practice*, Sultan Chand (G/L) & Company, 1st ed., 2014.
8. Daniel Goleman, *Emotional Intelligence*, Bantam, 2006.
9. Remesh S., Vishnu R.G., *Life Skills for Engineers*, Ridhima Publications, 1st ed., 2016.
10. Butterfield Jeff, *Soft Skills for Everyone*, Cengage Learning India Pvt Ltd, 1st ed., 2011.
11. *Training in Interpersonal Skills: Tips for Managing People at Work*, Pearson Education, India; 6th ed., 2015.
12. *The Ace of Soft Skills: Attitude, Communication and Etiquette for Success*, Pearson Education, 1st ed., 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**
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**
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**
3.1	Leadership: Leadership traits, Styles of Leadership, VUCA Leadership, Transactional vs Transformational Leaders, managing diverse stakeholders, crisis management, Effective Leaders	1
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**
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?

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	Demonstrate expertise in ideating prototypes, models, and proof-of-concept iterations. (Cognitive Knowledge Level: Analyse)
CO 4	Analyze real-world challenges and develop a practical design thinking framework suitable for their professional endeavors. (Cognitive Knowledge Level: Create)

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	3
CO 3	2	2	2	1			1	1	1	1	1	2
CO 4	2	2	2	1			1	1	1		2	2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test (% Marks)	**Case Study Presentation (% Marks)**	
Remember	25		20
Understand	25		20
Apply	25		20
Analyse	25		20
Evaluate			
Create		100	20

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**
100	50	50

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test	25 marks
Case study Presentation	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 and Tamer M. Shahin, *Engineering Design Process*, Course Technology, 2010.
2. Clive L. Dym, Patrick Little and Elizabeth J Orwin, *Engineering Design-A Project based Introduction*, Wiley, 2014.
3. Don Norman, *The Design of Everyday Things*, Basic Books, 2nd ed„ 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, 2017.
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*, Harper Collins, 2019.
5. V. N. Mittle & Arvind Mittal, *Basic Electrical Engineering*, McGraw Hill, 2nd ed., 2006.

COURSE CONTENTS AND LECTURE SCHEDULE

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

2.2	Product concepts: establishing functions, task specifications	2
2.3	Solution Concept: conceptualization, evaluating alternatives	1
2.4	Embodiment design; Analysis and optimization; experiment; marketing	1
2.6	Human centred design process	1
	Module 3	**6**
3.1	Concepts Evaluation: Evaluating conceptual alternatives: Pugh's Evaluation matrix, decision matrix with examples	2
3.2	Prototypes, Models and Proofs of concepts	1
3.3	What is Prototype? Why Prototype? Building models and prototypes, Rapid Prototyping	1
3.4	Lean startup method for prototype development; Testing prototypes and models and proving concepts	2
	Module 4	**7**
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
4.2	Challenges in Design thinking	1
4.3	Design thinking case studies detailing the various aspects	5

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. Design the functional structure of a shopping cart.
4. Examine the changes that can be made in the design of a bag with constraints of cost, reliability issues, production methods and environmental factors.

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: 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.

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

OR

6. Summarize different stages of design thinking process using appropriate examples. (8 marks)

7. Illustrate different phases of extensive prescriptive model of design process. (8 marks)

OR

8. Identify the customer requirements with the help of refrigerator as example. (8 marks)

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

OR

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

11. 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 marks)

OR

12. 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 marks)

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 and Lifestyle Physical fitness, wellness and exercise programmes, First aid and Postures and 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	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

Mark Distribution

Total Marks	CIE Marks
50	50

Continuous Internal Evaluation Pattern

Attendance	10 marks
Regular Assessment	40 marks

Marks for the regular assessment can be based on the CO questions given at the end.

SYLLABUS

MODULE 1 (6 hours)

Yoga and 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 coordinative 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 everyday 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 Ajmer Singh.
2. *Light on Yoga* by B. K. S. Iyengar.
3. *Health and Physical Education*, NCERT (11th and 12th Classes).

Reference Books

1. *Physiological Aspects of Sports Training and Performance* by Jay Hoffman.
2. *Periodization Theory and Methodology of Training* by Tudor O. Bompa and G. Grisgery Haff.
3. *Essential of Strength Training and Conditioning* by Thomas Baechle E. R., Roger W. Earle.
4. *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**
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
1.2	Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana	1

1.3	Obesity: Procedure, Benefits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana	1
1.4	Back pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana	2
	Module 2	**6**
2.1	Meaning and importance of physical fitness and wellness, Components of physical fitness and health related fitness	1
2.2	Exercise for improving speed, strength, endurance, and flexibility and coordinative abilities	1
2.3	Exercises to prevent back pain, shoulder injury and knee pain	2
2.4	Fitness test battery for speed, strength, endurance, flexibility	1
2.5	Importance of weight training, Warming up and cooling down	1
	Module 3	**6**
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
3.2	Common injuries and their management: Wounds, Cuts, Sprain, Fracture and Dislocation	2
3.3	Cardio pulmonary resuscitation (CPR).	1
3.4	How to prevent muscle cramps and its management. How to carry an injured person	1
	Module 4	**6**
4.1	Posture and its importance. Common Postural Deformities-Knock Knee, Flat Foot, Round Shoulders	2
4.2	Lordosis, Kyphosis, Bow Legs and Scoliosis. Corrective Measures for Postural Deformities	2
4.3	Balanced diet, malnutrition and deficiency disease, Hydration	2

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 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. Prepare a report on this including your thoughts on the diet they take and its impact on their health.

MAR ATHANASIUS COLLEGE OF ENGINEERING
Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING

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	B24PH1T01A	ENGINEERING PHYSICS (A)	2-1-0-2	3	3
C	B24CY1T01A	ENGINEERING CHEMISTRY (A)	2-1-0-2	3	3
D	B24ES1T05A	BASIC CIVIL AND MECHANICAL ENGINEERING (A)	2-2-0-2	4	4
E	B24EE1T03	ELECTRICAL MEASUREMENTS	2-1-0-2	3	3
F	B24ES1L04A	BASIC CIVIL AND MECHANICAL ENGINEERING WORKSHOP (A)	0-0-2-2	2	1
G	B24EE1L02	ELECTRONIC CIRCUITS LAB I	0-0-3-3	3	2
H	B24PC1L01A	ENGINEERING PHYSICS LAB (A) AND ENGINEERING CHEMISTRY LAB (A)	0-0-2-2	2	1
I	B24MC1T03	PROFESSIONAL COMMUNICATION AND ETHICS	2-0-1-3	3	P/F
J	B24MC1L02	IDEA LAB	0-0-3-3	3	P/F
			TOTAL	30	21

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 (9 hours)

Ordinary Differential Equations

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.

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

MODULE 2 (9 hours)

Sequences and Series

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.

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

MODULE 3 (9 hours)

Fourier Series

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.

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

MODULE 4 (9 hours)

Fourier Transforms

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).

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

MODULE 5 (9 hours)

Laplace Transforms

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.

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

Text Books

1. H. Anton, I. Biven, and S. Davis, *Calculus*, Wiley, 10th ed., 2015.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 10th ed., 2016.

Reference Books

1. J. Stewart, *Essential Calculus*, Cengage, 2nd ed., 2017.
2. G. B. Thomas and R. L. Finney, *Calculus and Analytic geometry*, Pearson, Reprint, 9th ed., 2002.
3. Peter O. Neil, *Advanced Engineering Mathematics*, Thomson, 7th ed., 2007.
4. Louis C. Barret, and C. Ray Wylie, *Advanced Engineering Mathematics*, Tata McGraw Hill, 6th ed., 2003.
5. Veerarajan T,*Engineering Mathematics for first year*, Tata McGraw-Hill, 2008.
6. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 43 ed., 2015.
7. 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**
	Total Hours	45 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

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) $e^{-t} sin^2 t$ (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 marks)
    (b) By the method of variation of parameters solve $y'' + 4y = tan2x$. (7 marks)

OR

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

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 marks)
    (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 marks)

OR

14. (a) Determine whether the series $\sum_{k=1}^{\infty} \frac{1}{\sqrt{k+1}}$ is absolutely convergent or conditionally convergent. (7 marks)
    (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 marks)

15. (a) Expand into a Fourier series , $f(x) = e^{-x}, 0 < x < 2\pi$. (7 marks)
    (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 marks)

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 marks)
    (b) Find the half range cosine series for $f(x) = (x-1)^2$in $0 \leq x \leq 1$. (7 marks)

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

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 marks)
    (b) Find the Fourier sine transform of $f(x) = \begin{cases} k & , 0 < x < a \\ 0 & , x > a \end{cases}$ (7 marks)

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

OR

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

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

Nil

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 and 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. Aruldhas G., *Engineering Physics*, PHI Pvt. Ltd., 2015.
2. M. N. Avadhanulu, P. G. Kshirsagar, and TVS Arun Murthy, *A Textbook of Engineering Physics*, S.Chand & Co., Revised Edition, 2019.
3. Donald A. Neamen, *Semiconductor Physics and Devices - Basic Principles*, McGraw Hill, 4th ed., 2012.

Reference Books

1. Arthur Beiser, *Concepts of Modern Physics*, Tata McGraw Hill Publications, 6th ed., 2003.
2. D. K. Bhattacharya, and Poonam Tandon, *Engineering Physics*, Oxford University Press, 2015.
3. Md. N. Khan and S. Panigrahi *Principles of Engineering Physics 1 & 2*, Cambridge University Press, 2016.
4. 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	36 Hours
	Module 1: Laser and Fibre Optics	**7**
1.1	Optical processes - Absorption, Spontaneous emission and stimulated emission, - Einstein's relations	2
1.2	Principle of laser - conditions for sustained lasing - components of laser - Population inversion - energy source - Pumping, Metastable states - active medium, optical resonator	2
1.3	Construction and working of Ruby laser	1
1.4	Optic fiber-Principle of propagation of light, Numerical aperture – Derivation	1
1.5	Applications of fibers - Intensity modulated sensors	1
	Module 2: Quantum Mechanics	**7**
2.1	Introduction - Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only)	1
2.2	Wave function, its properties and physical interpretation	1

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
	Module 3: Semiconductor Physics I	**8**
3.1	Electrical Conduction in solids - Density of states function (no derivation), the Fermi-Dirac Probability function, Fermi energy and its physical significance	2
3.2	Charge carriers in semiconductors - Equilibrium distribution of electrons and holes, the n0 and p0 equations	3
3.3	Intrinsic carrier concentration ni, Intrinsic Fermi level position and its dependence on temperature	3
	Module 4: Semiconductor Physics II	**8**
4.1	Extrinsic semiconductors - P type semiconductor, N type semiconductor	2
4.2	Carrier concentration in N type semiconductor, Variation of fermi level with temperature, Variation of fermi level with donor concentration	3
4.3	Carrier concentration in P type semiconductor, Variation of fermi level with temperature, Variation of fermi level with acceptor concentration	3
	Module 5: Semiconductor Devices	**6**
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
5.2	Photonic devices (Qualitative treatment only) - Light Emitting Diode, Photo detectors (Junction and PIN photodiodes), Solar cells	3

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: 3**

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.

11. (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 marks)
    (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 marks)

OR

12. (a) Outline the construction and working of Ruby laser. (10 marks)
    (b) Calculate the N.A. of an optic fiber having core index of 1.54 and cladding index of 1.5 (4 marks)

13. (a) Derive time dependent Schrodinger equation. (10 marks)
    (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 marks)

OR

14. (a) Derive the expression for the energy eigenvalues for a particle confined within a box of width L. (10 marks)
    (b) Find the de-Broglie wavelength of an electron whose kinetic energy is 15eV. (4 marks)

15. (a) Derive the equations for the thermal equilibrium concentrations of electrons and holes in terms of the Fermi energy. (10 marks)
    (b) Calculate the density of states per unit volume with energies between 0 eV and 1 eV. (4 marks)

OR

16. (a) Derive the equation for the intrinsic carrier concentration. (10 marks)
    (b) Let T=300 K. Determine the probability that an energy level 3kT above the Fermi energy is occupied by an electron. (4 marks)

17. (a) Derive the fundamental relationship $n_0p_0 = n_i^2$. (10 marks)
    (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 marks)

OR

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

19. (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 marks)

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

OR

20. (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 marks)

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

<table>
<tr><td rowspan="2">B24CY1T01A</td><td rowspan="2">ENGINEERING CHEMISTRY (A)</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 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, 17th ed., 2015.
2. Shashi Chawla, *A Text Book of Engineering Chemistry*, Dhanpat Rai and Co.(P) Limited, 2017.
3. Muhammed Arif, Annette Fernandez, and 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, and Rino Laly Jose, *Text Book of Engineering Chemistry*, S. Chand and Company Pvt. Ltd., 2019.
7. B. L. Tembe, Kamaluddin, and M. S. Krishnan, *Engineering Chemistry* (NPTEL Web Book), 2018.

Reference Books

1. T. Pradeep, *NANO: The Essentials: Understanding Nanoscience and Nanotechnology*, McGraw-Hill, 2008.
2. B. Rogers, J. Adams, and S. Pennathur, *Nanotechnology: Understanding Small Systems*, CRC Press, 2014.
3. Donald L. Pavia, *Introduction to Spectroscopy*, Cengage Learning India Pvt. Ltd., 2015.
4. J. Goldstein, *Scanning Electron Microscopy and Microanalysis*, Springer, 2012.
5. H. H. Willard, L. L. Merritt, *Instrumental Methods of Analysis*, CBS Publishers, 7th ed., 2005.
6. Samuel Glasstone, *An Introduction to Electrochemistry*, East-West Press Pvt. Ltd., 2006.

7. Pietro Pedeferri, *Corrosion Science and Engineering*, Springer Link, 2018.
8. B. Sunden, *Hydrogen, Batteries and Fuel Cells*, Elsevier Inc., 2019.
9. B. Sorensen and G. Spazzafumo, *Hydrogen and Fuel Cells - Emerging Technologies and Applications*, Elsevier Ltd., 2018.
10. Raymond B. Seymour, and Charles E. Carraher, *Polymer Chemistry: An Introduction*, Marcel Dekker Inc; 4th ed., Revised,1996.
11. J. Janata, *Principles of Chemical Sensors*, Springer, New York, NY, 2009.
12. F-G. Banica, *Chemical Sensors and Biosensors: Fundamentals and Applications*, John Wiley and Sons, 2012.
13. M. Schwartz, *Smart Materials*, CRC Press, 2008.
14. Y. Zhao, and T. Ikeda, *Smart Light-Responsive Materials*, Wiley, 2009.
15. V. Khutoryanskiy, and T. Georgiou, *Temperature-Responsive Polymers: Chemistry, Properties and Applications*, Wiley, 2018.
16. P. W. Atkins, *Physical Chemistry*, Oxford University Press, 10th ed., 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1: Fundamentals of Nanomaterials	**7**
1.1	Introduction - Classification - Based on dimension and structural composition	1
1.2	Nanoscale materials – Introduction - Properties and applications of Quantum dots, Graphene and Carbon nanotubes (CNT) – General properties and applications of nanomaterials	3
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
	Module 2: Spectroscopic and Microscopic Techniques	**8**
2.1	Introduction - Types of spectrum - Electromagnetic spectrum - Molecular energy levels - Beer-Lambert's law – Numerical problems based on Beer-Lambert's law	3

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
2.3	Microscopic techniques - Scanning Electron Microscope (SEM) - Principle, instrumentation, working and applications	1
	Module 3: Introduction to Electrochemistry and Corrosion Science	**7**
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
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
3.3	Electroplating of Copper - Electroless plating of Copper – Anodizing of Aluminium	2
	Module 4: Energy Storage and Harvesting Technologies	**7**
4.1	Cells and batteries – Primary and secondary cells – Na-ion battery and Li-ion battery - Construction, working, advantages and applications	2
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
4.3	Supercapacitors - Classification - Construction and applications in hybrid vehicles	2
	Module 5: Advanced Materials and Devices for Engineering Applications	**7**
5.1	Conducting polymers – Introduction - Classification - Intrinsically and extrinsically conducting polymers - Conduction mechanism – Band theory - Polyaniline and polypyrrole - Synthesis, properties and applications	3
5.2	Molecular devices based on conducting polymers – Diodes, Field Effect Transistors, and Actuators - Introduction and applications - OLED – Construction, working and advantages	2
5.3	Smart materials - Thermo and light responsive materials - Introduction and examples - Sensors – Physical, chemical and biosensors – Introduction and applications	2

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 marks)

(b) Discuss the classification of nanomaterials based on dimension. (6 marks)

OR

12. (a) What are nanoscale materials? Give the properties and applications of quantum dots and graphene. (9 marks)

(b) Explain the sputtering method for the synthesis of nanomaterials. (5 marks)

13. (a) Explain the principle, instrumentation and working of SEM. (8 marks)

(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 marks)

OR

14. (a) Illustrate the vibrational modes of CO_2 and H_2O. Justify its IR activity. (9 marks)

(b) Explain the various energy levels associated with a molecule. (5 marks)

15. (a) How electroless plating of copper is carried out? Give the procedure and reactions. (8 marks)

(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 marks)

OR

16. (a) What is cathodic protection? Explain two methods. (9 marks)

(b) Write the Nernst equation for Daniel cell and explain the effect of temperature on emf. (5 marks)

17. (a) Discuss the construction, working and advantages of Li-ion battery. (9 marks)

(b) What is electrolysis of water? (5 marks)

OR

18. (a) With a neat diagram explain the construction and working of Hydrogen-Oxygen fuel cell. (8 marks)

(b) Explain the classification of supercapacitors. (6 marks)

19. (a) Discuss the construction and working of OLED with a diagram. (9 marks)

(b) Explain the synthesis, properties and applications of polyaniline. (5 marks)

OR

20. (a) Elaborate the classification and applications of conducting polymers. (8 marks)

(b) What are smart materials? Give examples for heat responsive materials. (6 marks)

B24ES1T05A	BASIC CIVIL AND MECHANICAL ENGINEERING (A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	2	0	2	4	2024

Preamble

The objective of this course is to provide insight and inculcate the essentials of the Civil and Mechanical Engineering discipline to the students of Electrical Engineering and to provide the students with an illustration of the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs.

Prerequisites

Nil

Course Outcomes

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

CO 1	Understand Civil Engineering history, disciplines, surveying, and apply sustainable building practices in real-world scenarios. (Cognitive Knowledge Level: Apply)
CO 2	Comprehend the Materials, energy systems, water management, and environment for green buildings. (Cognitive Knowledge Level: Understand)
CO 3	Solve engineering problems by analyzing forces, moments, and equilibrium in coplanar systems using free-body diagrams. (Cognitive Knowledge Level: Apply)
CO 4	Illustrate the workings of IC engines and hydraulic machines. (Cognitive Knowledge Level: Apply)
CO 5	Explain the basic principle of power transmission elements and material handling devices. (Cognitive Knowledge Level: Analyse)
CO 6	Describe the fundamentals of power plant engineering and air conditioning systems. (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		1	3	3	1				2
CO 2	2	1	2		1	2	3	2				2
CO 3	3	3		1								2
CO 4	3	1	1				1			1		1
CO 5	3	1	2			1				1		1
CO 6	2	1	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	15
Understand	40	40	35
Apply	40	40	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 for the end semester examination: Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and Part II carry 50 marks each. Part I contains 2 parts - Part A and Part B. Part A contains 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 a maximum 2 sub-divisions. The pattern for the end semester examination for Part II is the same as that of Part I. **The student should answer both Part I and Part 2 in separate answer booklets**.

SYLLABUS

MODULE 1 (7 hours)

Introduction to Civil Engineering

Relevance of Civil Engineering in the overall infrastructural development of the country. Brief introduction to major disciplines of Civil Engineering.

Construction Materials: Conventional construction materials - bricks, stones, cement, sand, timber and steel. Cement concrete: Constituent materials and properties. Other construction materials: Glass, Ceramics, Plastics, Composite materials, Thermal and acoustic insulating materials, Decorative panels, Water proofing materials.

Surveying: Basic Principles of surveying, instruments, methods, and measurements (brief discussion only).

Environment: Water Supply and Sanitary Systems, Urban Air Pollution Management, Solid Waste Management, Urban Flood Control (brief discussion only).

Earth Pitting Mechanisms: Increase in ground resistance and its consequences, Impact on equipment safety and reliability.

MODULE 2 (8 hours)

Types of Buildings: Components of a residential building and their functions.

Types of Structures: Load-bearing wall structures and Framed structures.

Building Area: Plinth area, built-up area, floor area, carpet area, and floor area ratio for a building as per KMBR.

Building Rules and Regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Green Buildings: Materials, energy systems, water management and environment for green buildings.

MODULE 3 (9 hours)

Introduction to Statics

Concept of Idealization, System of Forces, Principles of Superposition and Transmissibility, Resolution and Composition of Forces, Law of Parallelogram of Forces. Resultant of Concurrent and Non-concurrent Coplanar Force Systems. Moment of Forces, Couple, Varignon's Theorem, Free Body Diagram. Equations of Equilibrium, Equilibrium of Concurrent and Non-concurrent Coplanar Force Systems.

MODULE 4 (8 hours)

Internal Combustion Engines

Introduction, Terminologies, IC engine parts, Working of SI and CI engine, Two stroke and Four stroke engine, Fuel, Cooling and Lubrication systems, CRDI and MPFI engines. Concept of hybrid engines.

Hydraulic Machines

Classification of hydraulic turbines, Working of Pelton, Francis, and Kaplan turbines (Descriptions with figures only). Pumps: Classification and working of Centrifugal and Reciprocating pumps.

MODULE 5 (8 hours)

Power Transmission Elements

Classification and applications of mechanical drives, Velocity ratio of belt drive, Length of belt, Slip in belt, Power transmitted, simple problems. Gear drive: Types, Gear Ratio, Simple, compound, and epicyclic gear trains (simple descriptions only).

Material Handling

Objective, principle, and selection of material handling equipment, Types of conveyors, parts, and working of belt conveyors, screw conveyors and pneumatic conveyor- Hoisting machine, Elevators, Winches, and Cranes – Types – Concrete Pumps -Types, Working (Descriptions only).

MODULE 6 (8 hours)

Power Plant Engineering

Hydel power plants: Layout, classifications, and study of various components. Steam power plant: Layout, steam generators, study of various components. Gas turbine power plant and combined power plants, Layout. New generation power producing systems.

Air Conditioning

Units of Refrigeration, Refrigeration effect, Psychrometric properties, Psychrometric chart, Comfort conditions, window, split and centralized air condition system, Summer and Winter air-conditioning, Inverter Technology in Air conditioners, Solar Air conditioners.

Text Books

1. S. K. Duggal, *Building Materials*, New Age International Publishers, 4th ed., 2021.
2. B. C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, *Building Construction*, Laxmi Publications, 11th ed., 2016.
3. S. Timoshenko and D.H. Young, *Engineering Mechanics*, McGraw Hill Education, 5th ed., 2017.
4. I. B. Prasad, *Engineering Mechanics: Statics and Dynamics*, Khanna Publishers, 3rd ed., 2017.
5. J. Benjamin, *Basic Mechanical Engineering*, Pentex Books, 9th ed., 2018
6. P. Balachandran, *Basic Mechanical Engineering*, Owl Books, 1st ed., 2015.

Reference Books

1. M. S. Shetty and A. K. Jain, *Concrete Technology: Theory and Practice*, S. Chand & Company Pvt. Ltd., 9th ed., 2021.
2. R. Subramanian, *Surveying and Levelling*, Oxford University Press, 2nd ed., 2020.
3. Bindu B. Menon and G. Shivanand Rao, *Building Planning and Drawing*, Charotar Publishing House Pvt. Ltd., 1st ed., 2014.
4. S. K. Sharma, *Building Construction*, S. Chand & Company Pvt. Ltd., 3rd ed., 2016.
5. A. K. Tayal, *Engineering Mechanics*, Umesh Publications, 14th ed., 2019.
6. S. S. Bhavikatti, *Engineering Mechanics*, New Age International Publishers, 5th ed., 2018.
7. M. Clifford, K. Simmons, *An Introduction to Mechanical Engineering, Part I*, CRC Press.
8. K. P. Roy, S. K. H. Choudhary, N. Roy, *Elements of Mechanical Engineering.* Media Promoters & Publishers Pvt. Ltd., 7th ed., 2012.
9. S. Ray, *Introduction to material handling*, New Age International, 1st ed., 2008.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	**48 Hours**
1	**Module 1**	**7**
1.1	Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Brief introduction to major disciplines of Civil Engineering	1
1.2	Construction materials: Conventional construction materials - bricks, stones, cement, sand, timber and steel. Cement concrete: Constituent materials and properties. Other construction materials: Glass, Ceramics, Plastics, Composite materials, Thermal and acoustic insulating materials, Decorative panels, Water proofing materials	2
1.3	Surveying: Basic Principles of surveying, instruments, methods, and measurements (brief discussion only)	1
1.4	Environment: Water Supply and Sanitary Systems, Urban Air Pollution Management, Solid Waste Management, Urban Flood Control (brief discussion only)	2
1.5	Earth Pitting Mechanisms: Increase in ground resistance and its consequences, Impact on equipment safety and reliability	1
2	**Module 2**	**8**
2.1	Types of buildings: components of a residential building and their functions	1
2.2	Types of structures: Load-bearing wall structures and Framed structures	1
2.3	Building area: Plinth area, built-up area, floor area, carpet area, and floor area ratio for a building as per KMBR	2
2.4	Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only)	2
2.5	Green buildings: Materials, energy systems, water management and environment for green buildings	2
3	**Module 3**	**9**
3.1	Concept of Idealization, System of Forces, Principles of Superposition and Transmissibility	1
3.2	Resolution and Composition of Forces	1
3.3	Law of Parallelogram of Forces	1
3.4	Resultant of Concurrent and Non-concurrent Coplanar Force Systems	1
3.5	Moment of Forces, Couple	1
3.6	Varignon's Theorem, Free Body Diagram	2
3.7	Equations of Equilibrium, Equilibrium of Concurrent and Non-concurrent Coplanar Force Systems	2

4	**Module 4**	**8**
4.1	Introduction, Terminologies, IC engine parts	1
4.2	Working of four-stroke SI and CI engine, Working of two-stroke SI and CI engine	2
4.3	Fuel, Cooling and Lubrication systems, CRDI and MPFI engines, Concept of hybrid engines	2
4.4	Hydraulic Machines: Classification of hydraulic turbines, Working of Pelton, Francis, and Kaplan turbines (Descriptions with figures only)	2
4.5	Pumps: Classification and working of Centrifugal and Reciprocating pumps	1
5	**Module 5**	**8**
5.1	Power Transmission Elements: Classification and applications of mechanical drives, Velocity ratio of belt drive, Length of belt, Slip in belt, Power transmitted, simple problems	2
5.2	Gear drive: Types, Gear Ratio, Simple, compound, and epicyclic gear trains (simple descriptions only)	2
5.3	Material Handling: Objective, principle, and selection of material handling equipment, Types of conveyors, parts, and working of belt conveyors, screw conveyors, and pneumatic conveyors	2
5.4	Hoisting machine, Elevators, Winches, and Cranes – Types – Concrete Pumps -Types, Working (Descriptions only)	2
6	**Module 6**	**8**
6.1	Power Plant Engineering: Hydel power plants: Layout, classifications and study of various components. Steam power plant: Layout, steam generators, study of various components	2
6.2	Gas turbine power plant and combined power plants, Layout. New generation power producing systems	2
6.3	Air Conditioning: Units of Refrigeration, Refrigeration effect, Psychrometric properties, Psychrometric chart, Comfort conditions, window, split and centralized air condition system	2
6.4	Summer and Winter air-conditioning, Inverter Technology in Air conditioners, Solar Air conditioners	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Define the role of a civil engineer in society.
2. Address complex challenges in the built environment.

3. How do civil engineers contribute to the development of environmentally conscious infrastructure?

Course Outcome 2 (CO 2)

1. Examine the role of materials in green building construction
2. Evaluate the integration of energy systems in green buildings.
3. How do green building practices address water conservation, reuse, and efficient management of water resources?

Course Outcome 3 (CO 3)

1. Discuss the fundamental principles of forces and moments in static equilibrium.
2. How do engineers apply the principles of statics to solve physical problems?
3. Explore the applications of forces and moments in mechanical systems

Course Outcome 4 (CO 4)

1. Describe the working of a four-stroke diesel engine.
2. Why two stroke engines are less efficient than our stroke engine?
3. How hydraulic turbines are classified?

Course Outcome 5 (CO 5)

1. Derive an expression to determine the length of an open belt drive
2. Solve problem based on velocity ratio of a gear drive
3. What are the important components of a conveyer belt drive? Explain with figure.

Course Outcome 6 (CO 6)

1. With the aid of a neat sketch, explain the working of a thermal power plant.
2. List the advantage of a combined power plant over the steam power plant.
3. How the operation of a summer air conditioner differs from a winter air conditioner?

MODEL QUESTION PAPER

QP CODE: **Pages: 7**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24ES1T05A

Course Name: BASIC CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both PART I and PART II in separate answer booklets.

PART I: BASIC CIVIL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks.

1. How does Civil Engineering contribute to the comprehensive development of a country's infrastructure?
2. How does the increase in ground resistance due to earth pitting mechanisms?
3. Elaborate on how the Floor Area Ratio (FAR) is determined for a building.
4. Compare load-bearing masonry structures and framed structures.
5. Demonstrate the application of parallelogram law of forces in understanding force vectors.

PART B

Answer any one question from each module. Each question carries 10 marks.

6. Provide a concise overview of the basic principles, instruments, methods, and measurements involved in surveying.

(10 marks)

OR

7. How do water supply and sanitary systems, urban air pollution management, solid waste management, and urban flood control collectively contribute to environmental sustainability in urban areas? (10 marks)

8. How do green buildings incorporate sustainable practices in terms of materials, energy systems, water management, and overall environmental considerations? (10 marks)

OR

9. Explain the essential components of a residential building and elaborate on their functions within the functionality of the structure. (10 marks)

10. What are the laws to add two forces and several concurrent, coplanar forces? Explain in detail. (10 marks)

OR

11. Explain various force systems with neat sketches. (10 marks)

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks.

1. With the neat block diagram, explain the fuel system of a CI engine.
2. Illustrate the working of an epicyclic gear train.
3. Explain the principles of material handling.
4. Explain cooling and dehumidification processes.
5. Define: Specific humidity, relative humidity and dew point temperature.

PART B

Answer any one question from each module. Each question carries 10 marks.

6. Explain the working of a 4-stroke CI engine with the help of a neat diagram. (10 marks)

OR

7. With the aid of a neat sketch, describe the working of a Francis turbine. (10 marks)

8. (a) Discuss the factors to be considered while selecting a material handling equipment.

   (4 marks)

   (b) What are the different types of belt conveyers? Explain its important parts of a flat belt conveyer system. (6 marks)

OR

9. Two flat belt pulleys having a centre-to-centre distance of 137 cm have drive diameter of 72 cm and 36 cm. (10 marks)

   i. Determine the length of the belt if both pulleys will rotate in same direction.
   ii. Determine the angle of contact on the small and big pulley.
   iii. Calculate the belt length if the belt will be cross-connected to make the pulleys rotate in opposite directions.
   iv. Determine the angle of contact for opposite direction.

10. Explain the general layout of a hydroelectric power plant. (10 marks)

OR

11. (a) How summer air conditioners differ from winter air conditioners.

    (5 marks)

    (b) Explain the working of summer air conditioner with the air of a neat sketch.

    (5 marks)

B24EE1T03	ELECTRICAL MEASUREMENTS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

The course aims to build a solid foundation that empowers to analyze and comprehend the measurement of the circuit parameters and magnetic quantities. It provides the basic knowledge about the construction, principles, and applications of analog and digital measuring instruments. Upon successful completion of the course students will be thorough with various measuring techniques that are required for an electrical engineer.

Prerequisites

Nil

Course Outcomes

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

CO 1	Identify and analyze the factors affecting the performance of the measuring system and select appropriate instruments for the measurement of voltage and current in DC measurements. (Cognitive knowledge level: Apply)
CO 2	Understand the measurement of power and energy in poly-phase systems. (Cognitive knowledge level: Understand)
CO 3	Design electrical bridges to measure resistance, inductance, capacitance, and frequency. (Cognitive knowledge level: Apply)
CO 4	Understand the principle of operation of CRO and apply the methods to measure magnetic and electric parameters. (Cognitive knowledge level: Apply)
CO 5	Understand the importance and working of digital instruments. (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	2		2	1	1	1	1	1	2
CO 2	3	2	2	2		2	1	1	1	1	1	2
CO 3	3	3	3	2	1	2	1	1	1	1	1	2
CO 4	3		2	2	1	2	1	1	1	1	1	2
CO 5	3		2	2	3	2	2	1	1	1	1	2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (% Marks)	**Test 2 (% Marks)**	
Remember	30	40	30
Understand	40	40	50
Apply	30	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)

Measurement Systems

Measurement standards, static and dynamic characteristics of instruments, errors in instruments, need for calibration, classification of instruments, secondary instruments, indicating, integrating and recording, operating forces, essentials of indicating instruments - deflecting, damping, controlling torques - Numerical problems.

Measurement of Current and Voltage

Moving coil and moving iron instrument- constructional details and operation, ammeter shunts, voltmeter multipliers - Numerical problems.

MODULE 2 (10 hours)

Measurement of Power and Energy

Dynamometer type wattmeter - construction and working, low power factor wattmeter, power in polyphase systems, measurement of power in three phases balanced and unbalanced systems, measurement of reactive volt-amperes, Induction type single phase energy meters- construction, theory and operation, errors, compensation and adjustments, direct and phantom loading.

Instrument Transformers

Principle of working, ratio and phase angle errors, extension of range.

MODULE 3 (6 hours)

Measurement of Resistance, Inductance, and Capacitance

Ammeter-voltmeter method, Kelvin's double bridge, Wheatstone bridge, loss of charge method, measurement of earth resistance, Maxwell inductance bridge, Schering bridge, Wien bridge - Numerical problems. General principle of slide wire potentiometer and Crompton potentiometer.

MODULE 4 (6 hours)

Magnetic Measurements

Measurement of flux/flux density, determination of BH curve and hysteresis loop - step-by-step method, method of reversals, permeability measurement, ballistic galvanometer and flux meter - construction and principle of operation.

Oscilloscopes

Principle of operation of general purpose CRO - basics of vertical and horizontal deflection system, XY mode - Lissajous Pattern.

MODULE 5 (7 hours)

Digital Meters

Advantages and disadvantages of digital instruments, resolution, accuracy, and error in digital instruments. Digital voltmeters and frequency meters using electronic counters, digital multimeters, clamp-on meters, Time of Day meter (TOD), smart metering (description only), and Phasor Measurement Unit (PMU) (description only). Power quality analyzer, digital insulation resistance tester, proximity sensor, introduction to virtual instrumentation systems - Simulation software LabVIEW (description only).

Text Books

1. A. K. Sawhney, *A course in Electrical and Electronic Measurements and Instrumentation*, Dhanpat Rai, 19th ed., 2015.

2. J. B. Gupta, *A course in Electrical & Electronic Measurement and Instrumentation*, S.K Kataria & Sons, 14th ed., 2014.

3. H. S. Kalsi, *Electronic Instrumentation*, Tata McGraw Hill, 3rd ed., 2017.

4. E.O Doebelin and D.N Manik, *Doebelin's Measurements Systems: Application and Design*, McGraw Hill Education, 6th ed., 2017.

Reference Books

1. E. W. Golding, *Electrical Measurements & Measuring Instruments*, Pitman 3rd ed., 2011

2. William D. Cooper and Albert D. Helfrick, *Modern Electronic Instrumentation and Measurement Techniques*, Prentice Hall India Learning 1st ed., 1992.

3. Melville B. Stout, *Basic Electrical Measurements*, Prentice Hall Inc., 2nd ed., 1961.

4. David A. Bell, *Electronic Instrumentation and Measurements*, Oxford University Press, 3rd ed. 2013.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1	**7**
1.1	Measurement standards, static and dynamic characteristics of instruments	1
1.2	Errors in instruments, need for calibration	1
1.3	Classification of instruments, secondary instruments, indicating, integrating, and recording	1
1.4	operating forces, essentials of indicating instruments - deflecting, damping, controlling torques - Numerical problems	1
1.5	Moving coil instrument- constructional details, principle of operation, and numerical Problems	1
1.6	Moving iron instrument- constructional details, the principle of operation, and numerical Problems	1
1.7	Ammeter shunts, voltmeter multipliers - Numerical problems	1
	Module 2	**10**
2.1	Dynamometer-type wattmeter - construction and working.	1
2.2	Low power factor wattmeter, power in polyphase systems	1
2.3	Measurement of power in three phases, balanced and unbalanced systems, measurement of reactive volt-amperes	2
2.4	Induction type single-phase energy meters- construction, theory and operation, errors, compensation, and adjustments	2
2.5	Direct and Phantom Loading	1
2.6	Single phase transformer- principle and working	1
2.7	Instrument transformers – current and potential transformers- principle of working -ratio and phase angle errors. Extension of range	2
	Module 3	**6**
3.1	Measurement of resistance- Ammeter voltmeter method, Kelvin's double bridge, Wheatstone bridge	1
3.2	loss of charge method, measurement of earth resistance	1
3.3	Measurement of inductance and capacitance: Maxwell inductance bridge, Schering bridge, Numerical problems	1
3.4	Wien bridge - Numerical problems	1
3.5	General principle of slide wire potentiometer and Crompton potentiometer	2
	Module 4	**6**
4.1	Measurement of flux/flux density, determination of BH curve and hysteresis loop - step-by-step method, method of reversals	2

4.2	Ballistic galvanometer -construction and principle of operation	1
4.3	Flux meter - construction and the principle of operation	3
4.4	Oscilloscopes - Principle of operation of general purpose CRO - basics of vertical and horizontal deflection system, XY mode - Lissajous Pattern	2
	Module 5	**7**
5.1	Digital Meters: Advantages and disadvantages of digital instruments, resolution, accuracy, and error in digital instruments	1
5.2	Digital voltmeters and frequency meters using electronic counters	1
5.3	Digital multimeters, clamp-on meters, Time of Day meter (TOD), smart metering (description only), and Phasor Measurement Unit (PMU) (description only)	2
5.4	Power quality analyzer, digital insulation resistance tester, proximity sensor	2
5.5	Introduction to Virtual Instrumentation Systems - Simulation software LabVIEW (description only)	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Explain classification and characteristics of measuring systems.
2. Explain the construction and working of indicating Instruments.
3. Problems related to indicating Instruments.

Course Outcome 2 (CO 2)

1. Describe the principle of operation and construction of energy meters.
2. Describe the principle of operation and construction of the wattmeter.
3. Illustrate the principle and working of Instrument Transformers.

Course Outcome 3 (CO 3)

1. Explain the operation of basic AC/DC bridges.
2. Problems related to the measurement of inductance, capacitance, and frequency.

3. Explain the principle of operation of DC potentiometers.

Course Outcome 4 (CO 4)

1. Explain the principle of operation of the fluxmeter and ballistic galvanometer.
2. Describe the procedure for plotting the BH curve and Hysteresis loop of a magnetic specimen.
3. Block diagram and working principle of CRO.

Course Outcome 5 (CO 5)

1. Explain the Basics of Digital Instruments.
2. Block diagram of DMM, PMU, and TOD.
3. Illustrate the principle of the Power Quality Analyzer, Proximity Sensor, and Digital Insulation Resistance Tester.

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: : B24EE1T03

Course Name: : ELECTRICAL MEASUREMENTS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define the following terms in measurement: i) accuracy, ii) resolution, and iii) precision.
2. The weight of 5 kg is used as the control weight in a gravity-controlled instrument. Find its distance from the spindle if the deflecting torque for a deflection of 600 is $1.13X10^{-3}$.
3. With a neat circuit diagram, show how power can be measured in a 3-phase circuit using two-watt meters in unbalanced load conditions.
4. Explain the working principle of a potential transformer with the help of neat diagrams.
5. Explain how insulation resistance can be measured using the loss of charge method.
6. With neat diagrams, outline the principle of slide wire potentiometer.
7. Show how a Ballistic Galvanometer can be used to determine the flux density in a magnetic specimen.
8. Using the diagram, label the parts of Cathode Ray Tube.
9. Explain the working of a Phasor Measurement Unit (PMU).
10. Illustrate the principle of the Power Quality Analyzer.

PART B

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

11. (a) What are the different torques needed for the proper operation of an indicating instrument? (6 marks)

    (b) Explain the construction and principle of operation of a PMMC instrument in a neat diagram. Derive the expression for deflection. (8 marks)

OR

12. (a) Explain three mechanisms for producing damping torque in electrical measuring instruments with neat diagrams. (7 marks)

    (b) Demonstrate how the range of the instrument can be extended in PMMC ammeter and voltmeter.

    (7 marks)

13. (a) Illustrate with a neat diagram the construction and working of an electrodynamometer wattmeter.

    (8 marks)

    (b) Develop the expression for the torque of a single-phase induction-type energy meter. (6 marks)

OR

14. (a) Demonstrate how the expression for ratio and phase angle error in a current transformer can be derived with the help of a phasor diagram (10 marks)

    (b) Explain phantom loading and its advantages. (4 marks)

15. (a) With necessary diagram, demonstrate how the Kelvin's double bridge can be used for the measurement of low resistances. (6 marks)

    (b) Explain how unknown self-inductance is measured using Maxwell's Inductance bridge with a neat circuit diagram. Derive the expression for unknown self-inductance. Draw the phasor diagram.

    (8 marks)

OR

16. (a) With necessary diagram and phasor, explain how unknown capacitance is measured using the Schering Bridge.

    (8 marks)

    (b) The arm of a four-arm bridge ABCD supplied with a sinusoidal voltage has the following values. Arm AB a resistance of 250 Ω in parallel with a capacitance of 2 μF, Arm BC 425 Ω ,Arm CD 999 Ω, Arm DA a resistance R2 in series with a 2.5 μF capacitance. Find the value of R2 and find the frequency at which the bridge will balance. (6 marks)

17. (a) Explain the measurement of flux in a ring specimen using Flux meter (8 marks)

(b) What are Lissajous patterns? How are they used for the measurement of frequency and phase angle?

(6 marks)

OR

18. (a) Define the function of each block of a Cathode Ray Oscilloscope using the necessary diagrams.

(10 marks)

(b) Illustrate with figures the step by step method used for the determination of BH curve of a magnetic material (4 marks)

19. (a) With neat figures, explain the working principle of frequency meters using electronic counters.

(b) Show how the rotational speed is measured using Proximity sensors. (6 marks)

OR

20. (a) Explain the basic principle and working of the Digital Insulation Resistance Tester. (6 marks)

(b) Summarize the working of (i)Digital Multi Meter (ii) Clamp-on meter (8 marks)

B24ES1L04A	BASIC CIVIL AND MECHANICAL ENGINEERING WORKSHOP (A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	2	2	1	2024

Preamble

This course equips students with practical knowledge in both Civil and Mechanical Engineering, linking theoretical studies to real-world applications and problem-solving. It provides hands-on training in essential tools, materials, and processes, preparing students to manage and execute engineering projects in a collaborative learning environment.

Prerequisite

Nil

Course Outcomes

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

CO 1	Identify and choose key plumbing components and building materials for real-world scenarios. (Cognitive Knowledge Level: Apply)
CO 2	Apply the principles of setting out in construction by successfully setting out a single-room building according to a given building plan, utilizing tape for accurate measurements. (Cognitive Knowledge Level: Apply)
CO 3	Apply the triangle law of forces to solve practical engineering problems involving the equilibrium of forces. (Cognitive Knowledge Level: Apply)
CO 4	Master carpentry joints and tools, smithy forging techniques, and foundry molding and casting processes. (Cognitive Knowledge Level: Apply)
CO 5	Gain proficiency in fitting, welding, conventional machining, and advanced methods like CNC machining and 3D printing. (Cognitive Knowledge Level: Apply)
CO 6	Understand the operation and application of centrifugal, self-priming, and reciprocating pumps, as well as Pelton, Francis, and Kaplan turbines. (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	2	2				2	1		3	1		2
CO 2	3	3	2		2	1			3	1		3
CO 3	3	3	2		2	1			3	1		3
CO 4	1	1	1						2	1	1	2
CO 5	1	1	1						2	1	1	2
CO 6	1	1	1						2	1	1	2

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
End semester examination (Internally by college)	30 marks

End Semester Examination Pattern

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

SYLLABUS

LIST OF EXPERIMENTS

PART I

CIVIL WORKSHOP
(Any 05 experiments are mandatory)

1	Plumbing: Introduction to plumbing and sanitary fittings.
2	Building Materials: Familiarization of various building materials- bricks, wood, steel and concrete with demonstration of its testing for fitness.
3	Calculate the area of a built-up space and a small parcel of land using standard measuring tape and digital distance measuring device.
4	Compute the area and/or volume of various building elements - door and window, quantity of bricks required to construct a wall of a building, quantity of steel bars used in windows (to create an awareness of measurements and units).
5	Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape only.
6	Verification of triangle law of forces.

PART II

MECHANICAL WORKSHOP

(Five models from exercises 1 to 5 are mandatory. Additionally, the study and demonstration of the remaining exercises are also required.)

1	Carpentry: Study of Carpentry tools, Carpentry joints practices: T-Lap joint, Cross lap joint / Cross halving joint, Dove tail halving joint, Mortice & Tenon Joint.
2	Smithy: Study of different tools & forged models in Smithy shop, Forging Practices: Square prism, Hexagonal headed bolt, octagonal prism.
3	Foundry: Study of Foundry tools, Molding practices: Bench molding, Floor molding, Core making, Casting.
4	Fitting: Study of fitting tools in a workshop, Fitting shop joints practices: Square Joint, V-Joint, Male and Female fitting.
5	Welding: Study of welding tools, equipment's and methods, Welding practices: Arc Welding, MIG Welding, Oxy-Acetylene Gas Welding.
6	Conventional Machines: Study and demonstration of conventional machines like Shaping and Slotting machine, Lathe, Milling machine, Grinding machines & Radial drilling machine.
7	Advanced Manufacturing Methods: Study and demonstration of CNC machines and 3D printing.
8	Study and demonstration of pumps: Centrifugal, Self-priming and Reciprocating pumps. Study and demonstration of hydraulic turbines: Pelton, Francis and Kaplan Turbine.

Reference Books

1. S. C. Rangwala, *Water Supply and Sanitary Engineering*, Charotar Publishing House Pvt. Ltd., 28th ed., 2019.
2. A.K. Jain, Basic Construction Materials, Khanna Publishers, 1st ed., 2019.
3. S.K. Duggal, *Building Materials*, New Age International Publishers, 4th Edition, 2021.
4. M.S. Shetty and A.K. Jain, *Concrete Technology: Theory and Practice*, S. Chand & Company Pvt. Ltd., 9th ed., 2021.
5. B.C. Punmia, *Surveying*, Vol. 1, Laxmi Publications, 17th ed., 2021.
6. S.K. Garg, *Building Construction*, Khanna Publishers, 32nd ed., 2020.
7. W. A. J. Chapman, *Workshop Technology - Parts 1 & 2*, CBS Publishers & Distributors Pvt. Ltd., 4th ed., 2007.
8. A. O'Bren, (Editor), *Welding Handbook*, Vol. 1, 2, 3. American Welding Society, 9th ed., 2001.
9. 9. J. Anderson, *Shop Theory*, Tata McGraw Hill, 6th ed. 2017.
10. J. H. Douglass, *Wood Working with Machines*, Illinois, McKnight & McKnight Pub. Co., 1995.
11. P.L. Jain, *Principles of Foundry Technology*, Tata McGraw Hill, 5th ed. 2017.
12. S.K. Hajra Choudhury, *Elements of Workshop Technology*, Vol 2, Media Promoters & Publishers, 2010.

B24EE1L02	ELECTRONIC CIRCUITS LAB I	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The electronic circuits lab aims to equip the students with the basics of implementation of electronic circuits. It covers the design and implementation of wave shaping circuits and transistor-based circuits. This course builds a solid foundation that empowers to analyze and comprehend the application of electronic circuits.

Prerequisite

Electronic Circuits I

Course Outcomes

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

CO 1	Identify and test various electronic components and fabricate single-sided PCB. (Cognitive Knowledge Level: Understand)
CO 2	Design and test differentiator, integrator, clipping, clamping, and rectifier circuits. (Cognitive Knowledge Level: Apply)
CO 3	Design and set up voltage regulator, transistor-based amplifier, oscillator, and multivibrator circuits. (Cognitive Knowledge Level: Apply)
CO 4	Design and simulate simple circuits using PSpice with OrCAD Capture. (Cognitive Knowledge Level: Apply)
CO 5	Develop team management skills and prepare laboratory reports that logically and scientifically communicate experimental information. (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	2		1	1	1	3	1	2	2
CO 2	3	2	3	2		1	1	1	3	1	2	2
CO 3	3	3	3	2		1	1	1	3	1	2	2
CO 4	3	3	3	2	3	1	1	1	3	1	2	2
CO 5	3	1	1	2		3	2	3	3	3	3	3

Mark Distribution

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

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment Viva-Voce	20 marks
Viva-Voce/ Test	20 marks

End Semester Examination (ESE) Pattern

The following guidelines should be followed regarding the award of marks

1. Preliminary work : 25 Marks
   (a) Circuit Diagram: 15 Marks
   (b) Theory and Procedure: 10 Marks
2. Implementing the work/Conducting the experiment : 30 Marks (usage of equipment and troubleshooting)
3. Result and Inference : 15 Marks
4. Viva Voce : 25 Marks
5. Record : 5 Marks

SYLLABUS

LIST OF EXPERIMENTS

1	a) Familiarization/Identification of electronic components, testing instruments, and commonly used tools. b) Study Functionality, type, size, color coding, package, symbol, cost [Active, Passive components], Multimeter, Function generator, Power supply, and DSO.
2	a) Study the types of Printed circuit boards (PCB) (single-sided double-sided, PTH), Processing methods. b) Design and fabricate a single-sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.
3	a) Design and realize the integrator and differentiator circuits. b) Design and set up different types of clipping and clamping circuits.
4	a) Design and test half wave rectifier circuit with and without filter and plot the regulation characteristics. b) Design and test full wave rectifier circuit (center tapped and bridge circuit) with and without filter delivering 200 mA at 9V dc and plot the regulation characteristics.
5	a) Design and set up a transistor series regulated power supply and plot the regulation characteristics. b) Design and set up transistor sweep generator.
6	Design and set up an RC-coupled amplifier using BJT in CE configuration. Plot the frequency response characteristics and measure the gain and bandwidth.

7	a) Design and set up an RC phase shift oscillator for a frequency of 1 kHz. b) Design and set up an LC Oscillator and determine the inductance value used.
8	Design and set up an Astable Multivibrator for a frequency of 1 kHz.
9	Design and set up a Monostable Multivibrator for a frequency of 1kHz.
10	Study PSpice Software and simulate simple circuits using PSpice with OrCAD Capture.

Reference Books

1. Chinmoy Saha, Arindham Halder and Debarati Ganguly, *Basic Electronics - Principles and Applications*, Cambridge University Press, 1st ed., 2018.
2. Michael Dsouza and Dsouza Michael, *PCB Design: Printed Circuit Board*, Kindle Edition, 1st ed., 2017.
3. Bell D. A., *Electronic Devices and Circuits*, Prentice Hall of India, 11th ed., 2015.
4. Malvino A. and D. J. Bates, *Electronic Principles*, Tata McGraw Hill, 7th ed., 2017.
5. Boylestad R. L. and L. Nashelsky, *Electronic Devices and Circuit Theory*, Pearson Education India, 11th ed., 2015.
6. Floyd T.L., *Fundamentals of Analog Circuits*, Pearson Education, 2nd ed., 2012.
7. Anant Agarwal, Jeffrey Lang, *Foundations of Analog Electronic Circuits*, Morgan Kaufmann Publishers, 1st ed., 2005.

B24PC1L01A	ENGINEERING PHYSICS LAB (A) AND 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, and 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, and Sabu Thomas, *Colloidal metal Oxide Nanoparticles: Synthesis, Characterization and Applications*, Elsevier Science, 2019.

B24MC1T03	PROFESSIONAL COMMUNICATION AND ETHICS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	0	1	3	P/F	2024

Preamble

This course aims to provide the students with the vital skills needed to excel in listening, reading, writing, and speaking. Whether conveying technical ideas or non-technical information, mastering these communication elements is crucial for aspiring professionals. The goal is to equip students with the ability to comprehend and successfully articulate ideas while also honing their persuasive communication skills. The course also aims to create in students awareness on ethics and human values.

Prerequisite

Nil

Course Outcomes

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

CO 1	Expand vocabulary and linguistic proficiency pertinent to the field of engineering (Cognitive Knowledge Level: Apply)
CO 2	Examine, comprehend, and succinctly describe a range of textual material. (Cognitive Knowledge Level: Apply)
CO 3	Produce clear, technically sound documents and presentations that follow all required conventions. (Cognitive Knowledge Level: Apply)
CO 4	Manifest acute ethical awareness and effectively apply ethical principles in practical engineering scenarios. (Cognitive Knowledge Level: Apply)
CO 5	Analyze and address global ethical issues, showcasing an understanding of their roles as ethical leaders and contributors to technological 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						2	1	2	3	1	2	
CO 2						3	1	3	3	2	2	
CO 3						3	1	3	3	3	3	
CO 4	3	3	2	2	2	2	2	3	2	2	2	2
CO 5	2	2	2	2	2	2	2	3	2	2	2	3

Assessment Pattern

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

Mark Distribution

Total Marks	CIE Marks	ESE Marks
100	50	50

Continuous Internal Evaluation Pattern

Attendance	10 marks
Regular Assessment	15 marks
Series Test (one test, conducted for 50 marks and reduced to 25)	25 marks

Regular assessment

Project report presentation and technical presentation through PPT	4 marks
Listening test	2 marks
Group discussion/mock job interview	4 marks
Resume submission	2 marks
Assignment/Case study	3 marks

End Semester Examination Pattern

Total Marks: 50, Time: 2 hours. There will be two parts; Part A and Part B. Part A contain 4 questions carrying 5 marks each. Part B contains one question from each module in two sets of which students should answer one from each set. Each question can have a maximum of 2 sub-divisions and carry 15 marks each.

SYLLABUS

MODULE 1 (9 hours)

Communication Process

Modes, Verbal and Non-Verbal Communication, Verbal Aptitude- Misspelled Words, synonyms, paraphrasing, sentence completion using appropriate words, subject-verb agreement, Reading-Strategies for Effective Reading, types, Listening-Active and Passive Listening, Barriers, Taking notes while listening Activity- Worksheets, Exercises, Synthesizing and deriving conclusions from technical articles videos, and podcasts

MODULE 2 (9 hours)

Professional Discipline

Public Speaking- Technical Talks- Formal and Informal Letters- Emails- Resume Preparation, Video Profile- GD Vs Debate-Dynamics of Professional Presentation (Individual and Group)- Format of Report, Proposal and Minutes.
Activity- Public Speaking, Podcast preparation, Resume preparation, Video profile creation, Company profiling, Group discussion, Technical Proposal, Structured Flow Analysis using AI.

MODULE 3 (9 hours)

Fundamentals of Ethical Engineering

Introduction to Human Values - Morals, Ethics, and Integrity - Academic and Work Ethics - Service Learning and Civic Virtue - Respect, Peaceful Living, Caring, and Sharing - Values of Honesty, Courage, Cooperation, Commitment, Empathy, and Self-Confidence - Senses of Engineering Ethics - Moral Autonomy and Ethical Theories - Moral Issues and Dilemmas in Engineering.

MODULE 4 (9 hours)

Professional Responsibility in a Global Context

Engineering as Social Experimentation - Responsible Experimentation and Codes of Ethics - Customs, Religion, and their Role in Engineering Ethics - Collegiality, Loyalty, and Conflict Management - Confidentiality, Conflicts of Interest, and Occupational Crime - Rights and Responsibilities in Engineering - Global Ethical Issues: Multinational Corporations, Environmental Ethics, Business Ethics, and Computer Ethics - Engineers as Leaders, Expert Witnesses, and Contributors to Technological Development.

Text Books

1. Ashraf Rizvi, *Effective Technical Communication*, McGraw Hill Education, 2nd ed., 2017.
2. Meenakshi Raman and Sangeetha Sharma, *Technical Communication: Principles and Practice*, Oxford University Press, 2nd ed., 2011.
3. M. Govindarajan, S. Natarajan and V. S. Senthil Kumar, *Engineering Ethics*, Prentice-Hall of India, 2012.
4. R S Naagarazan, *A textbook on professional ethics and human values*, New Age International, 2006.

Reference Books

1. *English for Engineers and Technologists*, (Combined edition, Vol.1 and 2), Orient Blackswan, 2010.
2. Stephen P. Robbins and Phillip L.Hunsaker, *Training in Interpersonal Skills: Tips for Managing People at Work*, Pearson Education, India, 6th ed., 2015.
3. Mike W Martin and Roland Schinzinger, *Ethics in Engineering*, Tata McGraw Hill, 4th ed., 2014.
4. Charles D Fleddermann, *Engineering Ethics*, Pearson Education/ Prentice Hall of India, 2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, *Engineering Ethics-Concepts and Cases*, Wadsworth Thompson Learning, United states, 2005.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	**Topic**	**No of Lecture/Tutorial Hours**
	Total Hours	36 Hours
	Module 1: Communication Process	**9**
1.1	Modes, Verbal and Non-Verbal Communication	1
1.2	Verbal Aptitude- Misspelled Words, synonyms, paraphrasing	1
1.3	Sentence completion using appropriate words, subject verb agreement	1
1.4	Reading-Strategies for Effective Reading, types	1

1.5	Listening-Active and Passive Listening, Barriers, Taking notes while listening	1
1.6	Activity- Public Speaking, Podcast preparation, Resume preparation, Video profile creation, Company profiling, Group discussion, Technical Proposal	4
	Module 2: Professional Discipline	**9**
2.1	Public Speaking- Technical Talks- Formal and Informal Letters	1
2.2	Emails- Resume Preparation, Video Profile, GD Vs Debate	1
2.3	Dynamics of Professional Presentation (Individual and Group)	1
2.4	Format of Report, Proposal and Minutes	1
2.3	Activity- Public Speaking, Podcast preparation, Resume preparation, Video profile creation, Company profiling, Group discussion, Technical Proposal	5
	Module 3: Fundamentals of Ethical Engineering	**9**
3.1	Introduction to Human Values - Morals, Ethics, and Integrity	1
3.2	Academic and Work Ethics - Service Learning and Civic Virtue - Respect, Peaceful Living, Caring, and Sharing	2
3.3	Values of Honesty, Courage, Cooperation, Commitment, Empathy, and Self-Confidence	2
3.4	Senses of Engineering Ethics - Moral Autonomy and Ethical Theories	2
3.5	Moral Issues and Dilemmas in Engineering	2
	Module 4: Professional Responsibility in a Global Context	**9**
4.1	Engineering as Social Experimentation - Responsible Experimentation and Codes of Ethics	1
4.2	HCustoms, Religion, and their Role in Engineering Ethics - Collegiality, Loyalty, and Conflict Management	2
4.3	Confidentiality, Conflicts of Interest, and Occupational Crime	1
4.4	Rights and Responsibilities in Engineering - Global Ethical Issues	1
4.5	Multinational Corporations, Environmental Ethics, Business Ethics, and Computer Ethics	2
4.6	Multinational Corporations, Environmental Engineers as Leaders, Expert Witnesses, and Contributors to Technological Development	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Analyze how different modes of communication impact the overall message.
2. Identify and use appropriate verbal communication skills in various contexts.
3. Identify different types of reading and apply suitable strategies accordingly.
4. Recognize and overcome barriers to effective listening.

Course Outcome 2 (CO 2)

1. Demonstrate confidence and competence in public speaking.
2. Compose well-structured written communications.
3. Participate effectively in group discussions and debates, showcasing critical thinking and communication skills.

Course Outcome 3 (CO 3)

1. Understand the format and structure of professional reports and proposals.
2. Summarize and organize information effectively in meeting minutes.
3. Adapt presentation style based on the context and audience.

Course Outcome 4 (CO 4)

1. Explain the role of professional ethics in technological development.
2. Explain the need for environmental ethics in engineering projects.
3. How civic virtue and integrity contribute to application of ethical principles?

Course Outcome 5 (CO 5)

1. Explain how ethical issues in the workplace affect the development of a company.
2. Show how occupational crimes are resolved by keeping the rights of employees.
3. Explain the necessity of code of conduct for digital ethics.

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: B24MC1T03

Course Name: PROFESSIONAL COMMUNICATION AND ETHICS

Max. Marks: 50 Duration:2 hours

PART A

Answer all questions. Each question carries 5 marks.

1. Find out which pair of words 'can be filled-up in the blanks in the sentence in the same sequence to make the sentence grammatically correct and meaningfully complete.
   (a) He was ...... not to ...... done the exercise himself.
   a) expected, be b) required, being c) needed, get d) supposed, have.
   (b) A committee has been………….to………….the transformation of the city into an international finance center.
   a) Constituted, convert b) appointed, oversee c) inducted, change d) converged, evaluate.
2. Highlight the differences between a group discussion (GD) and a debate.
3. Briefly explain morals, values, and ethics.
4. Provide an explanation on conflicts of interest with an example.

PART B

Answer any one question from each set. Each question carries 15 marks.

5. (a) "In today's world, being a good listener is more important than being a good Speaker." Enumerate. (7 marks)

(b) Help your friend by suggesting and explaining methods to improve his/her reading skills.

(8 marks)

OR

6. (a) Compare and contrast the formats of a proposal and a report. (7 marks)

   (b) Discuss the challenges and benefits of delivering a presentation in a group setting. (8 marks)

7. (a) Exemplify a comprehensive review of integrity and respect for others. (8 marks)

   (b) Explain how caring and sharing differ or exhibit similarities. (7 marks)

OR

8. (a) Explain in detail about professional rights and employee rights. (8 marks)

   (b) Explain the necessity of code of conduct for digital ethics. (7 marks)

B24MC1L02	IDEA LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	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

Nil

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 Microcontroller 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
100	50	50

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. Veeranna D.K. *Workshop/Manufacturing Practices(with Lab Manual)|AICTE Prescribed Textbook (English)*, Khanna Book Publishing.
2. Dr. SabrieSoloman, *3D Printing and Design*, Khanna Book, ISBN: 978-9386173768.
3. Chris Hackett, *The Big Book of Maker Skills: Tools and Techniques for Building Great Tech Projects*, Weldon Owen, 2018, ISBN-13: 978-1681884325.
4. Sean Michael Ragan, *The Total Inventors Manual (Popular Science): Transform Your Idea into a Top Selling Product*, Weldon Owen, 2017, ISBN-13:978-1681881584.
5. Charles Platt, *Make: Tools: How They Work and How to Use Them*, Shroff/Maker Media, 2018, ISBN-13: 978- 352137374.
6. Paul Horowitz and Winfield Hill, *The Art of Electronics*, Cambridge University Press, 3rd ed., ISBN: 9780521809269.
7. Paul Sherz and Simon Monk, *Practical Electronics for Inventors* McGraw Hill, 4th ed., ISBN-13: 978-1259587542.
8. Charles Platt, *Encyclopedia of Electronic Components* (Volume 1, 2 and 3), Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 9789352133703.
9. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer, *Building Scientific Apparatus*, Cambridge University Press, 4th ed., ISBN-13: 978-0521878586.
10. Simon Monk, *Programming Arduino: Getting Started with Sketches*, McGraw Hill, 2nd ed., ISBN-13: 978-1259641633.
11. Simon Monk and Duncan Amos, *Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards*, McGraw Hill Education, ISBN-13: 978-1260019193.
12. Scott Chacon and Ben Straub, *Pro GIT*, 2nd ed., Apress, 2014, ISBN-13: 9781484200773.
13. Venuvinod, P. K. and Ma W., *Rapid Prototyping – Laser Based and Other Technologies*, Kluwer.
14. Ian Gibson, David W. Rosen, and 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, 5th ed., 2002.

MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER 3

SYLLABUS

SEMESTER 3

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T03A	COMPLEX VARIABLES AND APPLICATIONS OF PDE	3-1-0-3	4	4
B	B24EE2T01	CIRCUITS AND NETWORKS	2-2-0-2	4	4
C	B24EE2T02	ELECTRICAL MACHINES I	2-2-0-2	4	4
D	B24EE2T03	DIGITAL ELECTRONICS	2-1-0-2	3	3
E	B24EE2T04	ELECTRONIC CIRCUITS II	2-1-0-2	3	3
G	B24EE2L03	ELECTRICAL MEASUREMENTS LAB	0-0-3-3	3	2
H	B24EE2L04	DIGITAL ELECTRONICS LAB	0-0-3-3	3	2
I	B24MC2T04	UNIVERSAL HUMAN VALUES 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	B24EEM3X	MINOR	3-1-0-3	4	4
			TOTAL*	32	22

*Total does not include the credits of minor courses

MINOR

BASKET 1	
COURSE CODE	**COURSE**
B24EEM31	CIRCUIT THEORY
BASKET 2	
COURSE CODE	**COURSE**
B24EEM32	ELECTRIC CIRCUITS
BASKET 3	
COURSE CODE	**COURSE**
B24EEM33	INTRODUCTION TO POWER ENGINEERING

B24MA2T03A	COMPLEX VARIABLES AND APPLICATIONS OF PDE	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. To understand the basic theory of functions a complex variable residue integration and conformal transformation.

Prerequisites

A basic course in partial differentiation and complex numbers.

Course Outcomes

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

CO 1	Solve non linear and linear partial differential equations. (Cognitive Knowledge Level: Apply)
CO 2	Solve one-dimensional wave equation and heat equation using partial differential equations. (Cognitive Knowledge Level: Apply)
CO 3	Make use of Cauchy-Riemann equations to understand complex functions, its continuity and differentiability. (Cognitive Knowledge Level: Apply)
CO 4	Evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula. (Cognitive Knowledge Level: Apply)
CO 5	Develop power series expansion of an analytic function. (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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

Partial Differential Equations

Partial differential equations, formation of partial differential equations - elimination of arbitrary constants - elimination of arbitrary functions, solutions of a partial differential equations - equations solvable by direct integration, linear equations of the first order - Lagrange's linear equation, non-linear equations of the first order - Charpit's method, solution of equation by method of separation of variables.

MODULE 2 (9 hours)

Applications of Partial Differential Equations

One-dimensional wave equation- vibrations of a stretched string, solution of the wave equation using the method of separation of variables, D'Alembert's solution of the wave equation. One-dimensional heat equation, solution of the heat equation.

MODULE 3 (9 hours)

Complex Variable – Differentiation

Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugate, conformal mappings − mappings $w = z^2, w = e^z$ linear fractional transformation $w = \frac{1}{z}$, fixed points.

MODULE 4 (9 hours)

Complex Variable - Integration

Complex integration, line integrals in the complex plane, basic properties, first evaluation method - indefinite integration and substitution of limit, second evaluation method - use of a representation of a path, contour integrals, Cauchy integral theorem on simply connected domain, Cauchy Integral formula.

MODULE 5 (9 hours)

Complex Variable - Residue Integration

Taylor's and Maclaurin series. Laurent's series (without proof), zeros of analytic functions, singularities, poles, removable singularities, essential singularities, and residues.

Text Books

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th ed., 2018.

2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 10th ed., 2016.

Reference Books

1. Peter V. O'Neil, *Advanced Engineering Mathematics*, Cengage, 7th ed., 2012.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Partial Differential Equations	**9**
1.1	Partial differential equations, Formation of partial differential equations – elimination of arbitrary constants - elimination of arbitrary functions, solutions of a partial differential equation, equations solvable by direct integration	3
1.2	Linear equations of the first order - Lagrange's linear equation, non-linear equations of the first order - Charpit's method	4
1.3	Boundary value problems, method of separation of variables	2
	Module 2: Applications of Partial Differential Equations	**9**
2.1	One dimensional wave equation - vibration of a stretched string	1
2.2	Solution of wave equation using method of separation of variables, Fourier series solution of boundary value problems involving wave equation, D'Alembert's solution of the wave equation	3
2.3	One dimensional heat equation	1
2.4	Solution of the heat equation, using method of separation of variables, Fourier series solutions of boundary value problems involving heat equation	4
	Module 3: Complex Variable – Differentiation	**9**
3.1	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations	4
3.2	Harmonic functions, finding harmonic conjugate	2
3.3	Conformal mappings - mappings of w= z^2, w = e^z, w=$1/z$	3

	Module 4: Complex Variable – Integration	**9**
4.1	Complex integration, line integrals in the complex plane, basic properties, first evaluation method, second evaluation method, use of representation of a path	4
4.2	Contour integrals, Cauchy integral theorem (without proof) on simply connected domain. Cauchy Integral formula (without proof)	2
4.3	Cauchy Integral formula	2
4.4	Cauchy Integral formula for derivatives of an analytic function	1
	Module 5: Complex Variable – Residue Integration	**9**
5.1	Taylor series and Maclaurin series	2
5.2	Laurent's series(without proof)	3
5.3	Zeros of analytic functions, singularities, poles, removable singularities, essential singularities	2
5.4	Residues	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Form the partial differential equation given $z = f(x + it) + g(x - it)$, where $i = \sqrt{-1}$.
2. Solve $\frac{\partial^2 z}{\partial y^2} = \sin(xy)$.
3. Solve $(y - z)p + (x - y)q = (z - x)$.
4. Solve $2zx - px^2 - 2qxy + pq = 0$.
5. Solve $\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}$ where $u(0, y) = 8e^{-3y}$ by the method of seperation of variables.

Course Outcome 2 (CO 2)

1. Write all possible solutions of one-dimensional wave equation.
2. Find the steady state temperature distribution in a rod of length 10 cm with ends kept at 20^0C and 80^0C.
3. A string is stretched between the fixed points $(0, 0)$and $(l, 0)$ and released at rest from the initial deflection given by $f(x) = \begin{cases} \frac{2k}{l}x \ , & \text{when } 0 < x < \frac{l}{2} \\ \frac{2k}{l}(l - x) \ , & \text{when } \frac{l}{2} < x < l \end{cases}$
4. A rod of length l with insulated sides is initially at a uniform temperature u_0. Its ends are suddenly cooled to 0°C and are kept at that temperature. Find the temperature function $u(x, t)$.

Course Outcome 3 (CO 3)

1. Find the real and imaginary parts of the function $5z^2 - 12z + 3 + 2i$.
2. Check whether the function $\frac{x+iy}{x^2+y^2}$ is analytic.
3. Determine the analytic function whose real part is $e^{2x}\left(x\cos 2y - y\sin 2y\right)$.
4. Find the fixed points of $(a+ib)z^2$.
5. Find the image of $1 \leq |z| \leq 2$, $\frac{\pi}{6} \leq \theta \leq \frac{\pi}{3}$ under the mapping $w = z^2$.

Course Outcome 4 (CO 4)

1. Evaluate $\int_0^{1+i}(x - iy)\, dz$ along the straight line path from 0 to $1+i$.
2. Find the value of $\int_C \frac{z^2+1}{z^2-1}\, dz$ where C is $|z - 4 - 2i| = 6.5$.
3. Evaluate $\oint_C \frac{sinz}{z+4iz}\, dz$ where C is $|z| = 1$ in counter clockwise direction.
4. Integrate $\oint_C \frac{sinh2z}{(z-\frac{1}{2})^4}\, dz$ in counterclockwise direction around the unit circle.
5. Evaluate $\oint_C \frac{\cos\pi z^2+\sin\pi z^2}{(z-1)(z-2)} dz$ where C is $|z| = 3$ using Cauchy's integral formula.

Course Outcome 5 (CO 5)

1. Find the Maclaurin series expansion of $\frac{z+2}{1-z^2}$.
2. Find all singular points and residue of the function *cosec* z.
3. Find the Laurents series of $\frac{-2z+3}{z^2-3z+2}$ valid in (i) $1 \leq |z| \leq 2$ (ii) $|z| \geq 2$.
4. Find the poles and residues of the function $\frac{1}{z^4-1}$.
5. Expand $f(z) = \frac{z+1}{z-1}$ as a Taylor series about $z = -1$.

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: B24MA2T03A

Course Name: : COMPLEX VARIABLES AND APPLICATIONS OF PDE (CE,ME,EE,EC)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Find the partial differential equation of all spheres of fixed radius having their centres in the xy-plane.
2. Solve $\frac{\partial^2 z}{\partial x \partial y} = \frac{x}{y} + a$.
3. Find the steady state temperature distribution in a rod of length 10 cm with ends are kept at 20^0C and 80^0C.
4. A tightly stretched elastic string of length l fixed at end points is initially at its rest position. If each of its points is displaced by giving a velocity, find its initial conditions and boundary conditions.
5. Test the continuity at $z = 0$ of $f(z) = \begin{cases} \frac{Re(z)}{1-|z|} \text{ , } z = 0 \\ 0 \text{ , } z \neq 0 \end{cases}$
6. Show that an analytic function with constant real part is constant.
7. Evaluate $\oint_{-\pi i}^{\pi i} cosz \, dz$.
8. Find the Maclaurin series of $\frac{1}{1+z^2}$.
9. Find the zeros and their order of the function $f(z) = (1 - z^4)^2$.
10. Find the residue at poles for the function $f(z) = \frac{sinhz}{z^4}$.

PART B

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

11. (a) Form the partial differential equation by eliminating the arbitrary functions from $z = yf(x) + xg(y)$. (7 marks)

    (b) Solve $(y + zx)p - (x + yz)q = x^2 - y^2$. (7 marks)

OR

12. (a) Solve $q + xp = p^2$. (7 marks)

    (b) Using method of separation of variables, solve $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} = 0$. (7 marks)

13. (a) A string is stretched between the fixed points $(0, 0)$and $(l, 0)$ and released at rest from the initial deflection given by

    $$f(x) = \begin{cases} \frac{2k}{l}x \ , & \text{when } 0 < x < \frac{l}{2} \\ \frac{2k}{l}(l - x) \ , & \text{when } \frac{l}{2} < x < l \end{cases}$$ (7 marks)

    (b) A rod of length l with insulated sides is initially at a uniform temperature u_0. Its ends are suddenly cooled to 0°C and are kept at that temperature. Find the temperature function $u(x, t)$. (7 marks)

OR

14. (a) A tightly stretched homogeneous string of length l with its fixed ends at $x = 0$ and $x = l$ executes transverse vibrations. Motion starts with zero initial velocity by displacing the string into the form $f(x) = k(x - x^2)$. Find the deflection $u(x, t)$ at any time t. (7 marks)

    (b) Derive the solutions of one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ using variable seperable method. (7 marks)

15. (a) Check whether $f(z) = iz\overline{z}$ is analytic. (7 marks)

    (b) Find the image of $x > 1, \ y > 0$ under the transformation $w = 1/z$. (7 marks)

OR

16. (a) Show that$u = x^3 - 3xy^2 - 5y$ is harmonic. Also find the corresponding harmonic conjugate function. (7 marks)

    (b) Find the image of $|z| \leq 2, \ \frac{\pi}{6} < Argz < \frac{\pi}{3}$ under the mapping $w = z^2$. (7 marks)

17. (a) Evaluate$\oint_C (z + \frac{1}{z})dz$ where C is the unit circle traversed counterclockwise. (7 marks)

    (b) Evaluate$\oint_C \frac{5z+7}{z^2+2z-3} \, dz$ where C is taken counterclockwise around the circle (i) $|z - 2| = 2$ (ii) $|z + i| = 1$. (7 marks)

OR

18. (a) Integrate counterclockwise around the unit circle $\oint_C \frac{sin2z}{z^4}\,dz$. (7 marks)
    (b) Evaluate $\int(z^2+3z)dz$ along the circle $|z| = 2$ from $(2,0)$ to $(0,2)$ in counter clockwise direction. (7 marks)

19. (a) Expand $f(z) = \frac{z}{(z+1)(z+2)}$ as a Laurent's series about $z = -2$ in $0 < |z+2| < 1$. (7 marks)
    (b) Determine and classify the singular points for $f(z) = \frac{\sin z}{(z-\pi)^2}$ and $g(z) = e^{\frac{-1}{z}}$. (7 marks)

OR

20. (a) Find the poles and residues of the function $\frac{1}{z^4-1}$. (7 marks)
    (b) Expand $f(z) = \frac{z-1}{z^2}$ as a Taylor series about $z_0 = 1$. (7 marks)

B24EE2T01	CIRCUITS AND NETWORKS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	2	0	2	4	2024

Preamble

This course aims to equip students with a comprehensive understanding of circuit analysis, focusing on both time-domain and frequency-domain methods, as well as the application of Laplace transforms in solving complex electrical circuits. The course covers key topics such as DC and AC circuit analysis, resonance, coupled circuits, three-phase systems, and two-port networks, alongside practical tools like MATLAB and PSpice for simulation. Upon completion, students will be capable of analyzing and solving complex electrical circuits and applying network analysis methods to real-world electrical engineering problems.

Prerequisites

Introduction to Electrical Engineering, Ordinary Differential Equations and Transforms.

Course Outcomes

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

CO 1	Solve electric circuits under various switching conditions to determine transient and steady-state behavior in the time domain. (Cognitive Knowledge Level: Apply)
CO 2	Apply and solve first and second-order DC circuits using Laplace transforms, considering various initial conditions and damping effects. (Cognitive Knowledge Level: Apply)
CO 3	Solve AC circuits and coupled circuits with sinusoidal excitation using Laplace transforms and s-domain analysis. (Cognitive Knowledge Level: Apply)
CO 4	Analyse resonance in RLC circuits and solve unbalanced three-phase systems using appropriate methods. (Cognitive Knowledge Level: Apply)
CO 5	Evaluate parameters of two-port networks and use transformations to solve network 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	3	3	3	2	2	2	2		2	1	2	3
CO 2	3	3	2	2	2	1	2		2	1	1	2
CO 3	3	3	3	2	2	1	2		2	1	1	2
CO 4	3	3	3	2	2	1	2		2	1	1	2
CO 5	3	3	3	2	2	2	2		1	1	1	2

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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

Time Domain Analysis of First and Second-Order Circuits

Behavior of R, L, C under switching conditions, time domain analysis of simple RL, RC, RLC series and parallel networks with excitation and initial conditions - transient and steady-state response - time constant - underdamped, critically damped, overdamped and undamped RLC network.
Use simulation software like MATLAB/PSpice to simulate RLC circuits (Assignment/Tutorial only).

MODULE 2 (9 hours)

DC Circuit Analysis in the Frequency Domain

Laplace transform of basic functions, properties - linearity, time shifting, frequency shifting, time scaling, time reversal, differentiation, integration, multiplication, convolution theorems - initial and final value theorem, solution of ordinary differential equation using Laplace transforms, inverse Laplace transform - partial fraction method.
S-domain analysis of circuits - Solution of simple RL, RC, and RLC DC networks using Laplace transforms, transformed equivalent of resistance, inductance, and capacitance - concept of the transformed circuit in s-domain - nodal analysis and mesh analysis of the transformed circuit.

MODULE 3 (10 hours)

AC Circuit Analysis in the Frequency Domain

Solution of RL, RC, and RLC circuits with sinusoidal excitation using Laplace Transforms, transformed circuits in s-domain - solution using mesh and nodal analysis.
Coupled circuits - Conductively coupled circuits and mutual impedance - mutual inductance, dot polarity convention, coefficient of coupling - series and parallel coupled circuits, analysis of coupled circuits in s-domain.

MODULE 4 (8 hours)

Resonance in an RLC Circuit

Resonance in series RLC circuits - impedance, phase angle, current, voltage, bandwidth, quality factor. Parallel resonance circuits (Concept only), resonant frequency for a tank circuit.

Unbalanced 3-Phase Systems

Three-phase networks - Unbalanced three-phase three-wire star and delta-connected load, four-wire unbalanced star-connected load, star-delta method of solving unbalanced load, neutral shift.

MODULE 5 (9 hours)

Two-port Networks

One-port network, two-port networks - Characterization in terms of impedance (Z), admittance (Y), hybrid (h) and transmission (T) parameters - conditions for symmetry and reciprocity of two-port networks, interconnection of two-port networks - series, parallel, and cascade, T-π representations and transformation.

Text Books

1. Hayt W. H., Kemmerly J. E., and Durbin S. M., *Engineering Circuit Analysis*, Tata McGraw Hill, 10th ed., 2023.
2. K. S. Suresh Kumar, *Electric Circuit Analysis*, Pearson Publications, 2nd ed., 2020.
3. Alexander and Sadiku, *Fundamentals of Electric Circuits*, McGraw-Hill, 6th ed., 2021.
4. Allan H. Robbins, Wilhelm C. Miller, *Circuit Analysis: Theory and Practice*, Cengage Learning, 5th ed., 2016.

Reference Books

1. Joseph A. Edminister and Mahmood Nahvi, *Theory and Problems in Electric circuits*, McGraw Hill, 5th ed., 2010.
2. A. Sudhakar, Shyammohan S Palli, *Circuits and Networks*, McGraw Hill, 4th ed., 2019.
3. Van Valkenberg, *Network Analysis*, Prentice Hall India Learning Pvt. Ltd., 3rd ed., 2018.
4. Chakrabarti, *Circuit Theory Analysis and Synthesis*, DhanpatRai and Co., 7th ed., 2021.
5. R. Gupta, *Network Analysis and Synthesis*, S. Chand and Company Ltd, 2nd ed., 2020.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Time domain Analysis of First and Second-Order Circuits	**9**
1.1	Behaviour of R, L, C under switching conditions	1
1.2	Time domain analysis of simple RL series and parallel networks with excitation and initial conditions	1
1.3	Time domain analysis of simple RC series and parallel networks with excitation and initial conditions	1
1.4	Time domain analysis of simple RLC series and parallel networks with excitation and initial conditions	2
1.5	Transient and steady-state response - time constant	1
1.6	Underdamped and critically damped RLC network	1
1.7	Overdamped and undamped RLC network	2
	Module 2: DC Circuit Analysis in the Frequency Domain	**9**
2.1	Laplace transform of basic functions, properties - linearity, time shifting, frequency shifting, time scaling, time reversal	1
2.2	Differentiation, integration, multiplication, and convolution theorems - initial and final value theorem	1
2.3	Solution of ordinary differential equation using Laplace transforms, inverse Laplace transform - partial fraction method for inverse Laplace transforms of functions	1
2.4	Solution of simple RL DC networks using Laplace transforms	1
2.5	Solution of simple RC DC networks using Laplace transforms	1
2.6	Solution of simple RLC DC networks using Laplace transforms	1
2.7	Transformed equivalent of resistance, inductance, and capacitance - concept of the transformed circuit in s-domain	1
2.8	Node analysis and mesh analysis of the transformed circuit	2
	Module 3: AC Circuit Analysis in the Frequency Domain	**10**
3.1	Solution of RL circuits with sinusoidal excitation using Laplace transforms	1
3.2	Solution of RC circuits with sinusoidal excitation using Laplace transforms	1
3.3	Solution of RLC circuits with sinusoidal excitation using Laplace transforms	1
3.4	Transformed circuits in s-domain	1
3.5	Solution using mesh and nodal analysis	1
3.6	Conductively coupled circuits and mutual Impedance	1

3.7	Mutual inductance, dot polarity convention	1
3.8	Coefficient of coupling - series and parallel coupled circuits	1
3.9	Analysis of coupled circuits in s-domain	2
	Module 4: Resonance in an RLC Circuit and Unbalanced 3-Phase Systems	**8**
4.1	Resonance in series RLC circuits - impedance, phase angle, current, voltage, bandwidth, quality factor	2
4.2	Parallel resonance circuits (Concept only), resonant frequency for a tank circuit	2
4.3	Unbalanced three-phase three-wire star connected load	1
4.4	Unbalanced three-phase three-wire delta connected load	1
4.5	Four-wire unbalanced star-connected load, star-delta method of solving unbalanced load, neutral shift	2
	Module 5: Two-port Networks	**9**
5.1	One-port network, two-port networks	1
5.2	Characterization in terms of impedance (Z) and admittance (Y) parameters	2
5.3	Characterization in terms of hybrid (h) and transmission (T) parameters	2
5.4	Conditions for symmetry and reciprocity of two-port networks	1
5.5	Interconnection of two-port networks series and parallel networks	1
5.6	Interconnection of two-port networks cascade networks	1
5.7	T-π representations and transformation	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Describe the transient and steady-state behaviour of resistors, inductors, and capacitors in various circuit configurations when subjected to switching conditions.
2. Solve for the time-domain responses of simple RL, RC, and RLC circuits using differential equations and initial conditions.
3. Derive the transient and steady-state response expressions in RL, RC and RLC circuits.
4. Classify RLC circuits as underdamped, critically damped, overdamped, or undamped based on their natural frequency and damping factor.

Course Outcome 2 (CO 2)

1. Evaluate the Laplace transform of basic functions and the properties of Laplace transforms.
2. Solve ordinary differential equations using Laplace transforms.
3. Find inverse Laplace transforms using the partial fraction method.
4. Use Laplace transforms to solve simple RL, RC, and RLC DC circuits in the s-domain.
5. Identify and calculate the transformed equivalent of resistance, inductance, and capacitance in the s-domain.
6. Apply node analysis and mesh analysis techniques to solve DC circuits in the transformed circuit in the s-domain.

Course Outcome 3 (CO 3)

1. Problems with steady state and transient analysis of RL, RC, and RLC series circuits with sinusoidal excitation.
2. Problems with node and mesh analysis of transformed circuits in the s-domain.
3. Problems on the solution of transformed circuits, including mutually coupled circuits in the s-domain.

Course Outcome 4 (CO 4)

1. Problems with unbalanced Y and Δ configurations.
2. Evaluation of neutral shift voltage in unbalanced systems.
3. Problems with series resonance circuits and evaluate the parameters such as quality factor, and bandwidth.
4. Develop the impedance/admittance *vs* frequency plot for the given RLC network.

Course Outcome 5 (CO 5)

1. Problems in finding Z, Y, h, and T parameters of simple two-port networks.
2. Problems with T-Δ transformation in two-port networks.
3. Derive the condition for symmetry and reciprocity of a two-port network.
4. Show that the overall transmission parameter matrix for the cascaded two-port network is simply the matrix product of transmission parameters for each individual two-port network in cascade.

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: : B24EE2T01

Course Name: CIRCUITS AND NETWORKS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. A series RL circuit with $R = 20\,\Omega$ and $L = 10\,H$ has a constant voltage, $V = 40\,V$ applied through a switch S at $t = 0$. Solve for the current equation in the network.

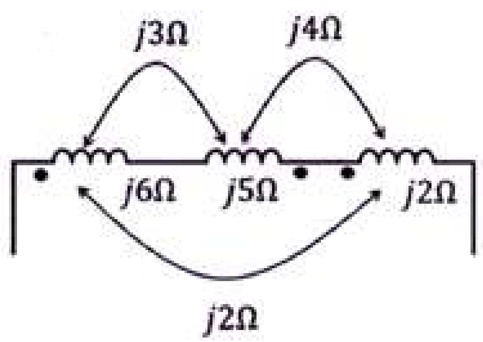
2. Evaluate the time constant of a series RC circuit with $R = 10\,\Omega$ and $C = 1\,F$.

3. Determine the s-domain equivalent circuit of an inductor with an initial I_o current

4. State initial value theorem in Laplace transforms.

5. Obtain the sinusoidal response of an RL series circuit with initial conditions equal to zero.

6. Obtain the equivalent inductive reactance.



7. Line currents through a 3-phase 4-wire unbalanced star-connected load are $I_A = 9.24 < 0^0$ A, $I_B = 21 < -100^0$ A and $I_C = 15.4 < 110^0$ A. Find the current through the neutral wire.

8. Explain the condition for resonance and Quality factor in series RLC circuit.

9. Two identical sections of transmission lines with $A = 2, B = 3, C = 1, D = 2$ parameters are cascaded. Calculate the transmission parameters of the resultant network.

10. A two-port network is described by the equation, $V_1 = 4I_1 + 2I_2$ and $V_2 = 2I_1 + I_2$. A load impedance of 3 Ω is connected to port 2. Calculate the value of input impedance.

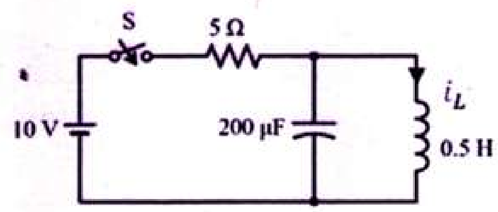
PART B

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

11. In the network shown in the figure below, initially, the switch S is closed and a steady state is obtained. At $t = 0$, switch s is opened.

    (a) Determine the current I_L(t) through the inductor. (10 marks)

    (b) Determine the voltage across the capacitor and draw the final steady-state circuit. (4 marks)



OR

12. (a) Derive the expression of current in an underdamped RLC series network with dc excitation. (10 marks)

    (b) A series RC circuit is connected to a DC source of 10 V at time t = 0. Find the voltage across the capacitor at t = 1 sec, if the time constant of the circuit is 2 seconds. (4 marks)

13. (a) State and prove the time shifting theorem with Laplace transforms (5 marks)

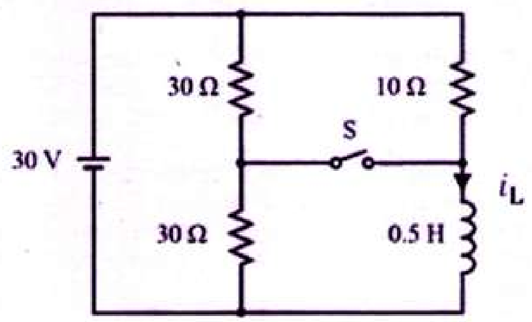
    (b) Find the current equation in an series RLC DC circuit. (9 marks)

OR

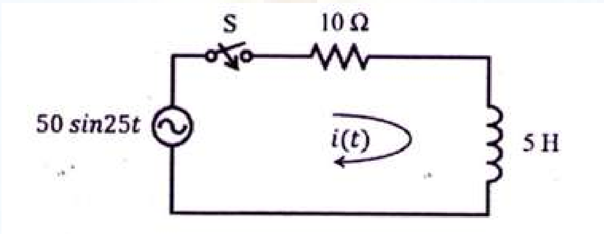
14. In the circuit given below, obtain I_L(t) when

    (a) Switch S is initially open and closed at t = 0. (8 marks)

    (b) Switch S is initially closed and opened at t = 0. (6 marks)



15. (a) Using Laplace transform technique, determine the current I(s) in the network given below when the switch is closed at t = 0. Assume the inductor is initially relaxed. (4 marks)



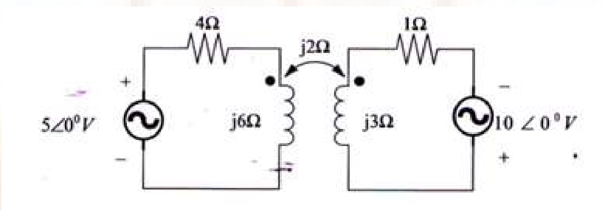
(b) Explain Dot rule and the coefficient of coupling in coupled circuits. (10 marks)

OR

16. For the circuit given below

(a) Find the steady state current through the 1 Ω and 4 Ω resistors. (8 marks)

(b) Obtain the conductively coupled equivalent circuit. (6 marks)



17. A 400V, three-phase balanced supply feeds a delta-connected load having phase impedances $Z_{RY} = 40 < 30^0$, $Z_{YB} = 50 < 0^0$ and $Z_{BR} = 40 < -30^0$. Determine the following:

(a) Phase currents and line currents (10 marks)

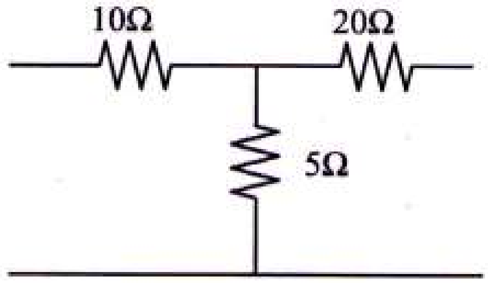
(b) Active and reactive power delivered to the load. (4 marks)

OR

18. (a) Explain neutral shift in a three-phase unbalanced star-connected load. (4 marks)

(b) A 440 V, 50 Hz, 3 phase supply of phase sequence ABC is supplied to a star connected load with branch impedances Z_A= 10 Ω , Z_B= -j5 Ω, Z_C= -j5 Ω. Calculate line currents and voltage across each phase impedance. The phase sequence is ABC. (8 marks)

19. (a) Determine the h parameters of the following network (8 marks)



(b) Derive the condition for symmetry and reciprocity of a two-port network in terms of transmission parameters (6 marks)

OR

20. (a) Show that the Y parameters of two parallel connected two port networks is equal to the sum of their individual Y parameters. (6 marks)

(b) A two-port network is represented by the following network equations. $V_1 = 4I_1 + 2I_2$ and $V_2 = 2I_1 + I_2$. Determine the equivalent π network. (8 marks)

B24EE2T02	ELECTRICAL MACHINES I	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	2	0	2	4	2024

Preamble

The course provides fundamental knowledge of electromechanical energy conversion, focusing on the principles, construction, operation, and performance analysis of DC machines and transformers. The course explores the working principles, characteristics, and real-world applications of DC generators, DC motors, and transformers, including their efficiency, losses, and testing methods. By the end of the course, students will be able to analyse, troubleshoot, and optimize the performance of DC machines and transformers, apply appropriate testing methods, and understand their applications.

Prerequisite

Introduction to Electrical Engineering

Course Outcomes

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

CO 1	Illustrate the constructional details of DC machines and explain the working principle of DC generators and classify them. (Cognitive knowledge Level: Understand)
CO 2	Analyse the performance of DC generators under different load conditions and interpret the conditions for voltage build-up. (Cognitive knowledge Level: Apply)
CO 3	Describe the principle of operation of DC motors, test DC machines to assess its performance, and select appropriate motor types for different applications. (Cognitive knowledge Level: Apply)
CO 4	Construct the phasor diagram and equivalent circuit of single-phase transformers and investigate the conditions for parallel operation of transformers. (Cognitive knowledge Level: Apply)
CO 5	Explain the theory of autotransformers, and analyse three-phase transformer connections with their vector groupings for effective power system integration. (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	3	2	1	2			1			2
CO 2	3	3	3	2		2	1		1			3
CO 3	3	3	3	2		2			1		2	3
CO 4	3	3	3	2		2		1	1	1		3
CO 5	3	3	3	2		2		1	2	1		3

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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (8 hours)

Introduction to DC Machines

Constructional details of DC machines, armature winding - single layer - double layer - lap and wave windings, equalizer rings, dummy coils - developed simplex winding diagram - double layer - progressive only (winding diagram not for evaluation).
DC generator - principle of operation, EMF equation, classification of DC generator, numerical problems.

MODULE 2 (10 hours)

Characteristics of DC Generators

Armature reaction - demagnetising and cross-magnetising ampere turn, commutation - compensating windings, interpoles. DC shunt generator - voltage build-up, no-load characteristics (OCC) - critical field resistance - critical speed, numerical problems, load characteristics of DC shunt and compound generators. Power flow diagram - losses and efficiency - maximum efficiency, parallel operation - load sharing, numerical problems.

MODULE 3 (10 hours)

DC Motors

DC motor - principle of operation - back emf, classification of DC motors, numerical problems. Torque equation, performance characteristics, numerical problems. Starting of DC motors, starters - 3-point and 4-point starters (principle only). Speed control of DC motors - field control, armature control, numerical problems. Power flow diagram - losses and efficiency, numerical problems. Testing of DC motors - Swinburne's test, Hopkinson's test, Retardation test, numerical problems, DC motor applications.

MODULE 4 (10 hours)

Single-Phase Transformers

Single-phase transformers - constructional details, principle of operation, EMF equation. Ideal and practical transformer - phasor diagram, no load and on load operations, equivalent circuit, voltage regulation, numerical problems. Transformer losses and efficiency, condition for maximum efficiency, kVA rating, numerical problems. Testing of transformers - polarity test, open circuit test, short circuit test, Sumpner's test - separation of losses, parallel operation of single-phase transformers, numerical problems.

MODULE 5 (8 hours)

Autotransformers and Three-Phase Transformers

Autotransformer - principle of operation, rating of autotransformers. Three-phase transformer - construction, different connections of 3-phase transformers - $Y-Y, \Delta-\Delta, Y-\Delta, \Delta-Y$, numerical problems. Vector groupings - need for vector grouping - Yy0, Dd0, Yy6, Dd6, Yd1, Yd11, Dy1, Dy11. Parallel operation of three-phase transformers - essential and desirable conditions. Power transformer and distribution transformer - all-day efficiency, numerical problems.

Text Books

1. V. K. Mehta and Rohit Mehta , *Principles of Electrical Machines*, S. Chand Publication, 2006.
2. K. Murugesh Kumar, *DC Machines & Transformers*, Vikas Publishing House, 2nd ed., 2008.
3. J. B. Gupta, *Theory & Performance of Electrical Machines*, S. K. Kataria, 15th ed., 2022.
4. Vinod Kumar and K. S. Suresh Kumar, *Electric Machines*, McGraw-Hill Education, 2018.

Reference Books

1. P. S. Bimbhra, *Electrical Machinery*, Khanna Publishers, 7th ed., 2021.
2. D. P. Kothari & I J Nagrath, *Electric Machines*, Tata McGraw Hill, 5th ed., 2017.
3. Stephen L. Herman, *Electrical Transformers and Rotating Machines*, Cengage Learning, 4th ed., 2016.
4. A. E. Fitzgerald, Charles Kingsley Jr., and Stephen D. Umans *Electric Machinery*, McGraw Hill, 7th ed., 2013.
5. A. E. Clayton & N. N. Hancock, *The Performance and design of Direct Current Machines*, CBS Publishers & Distributors, New Delhi, 2018.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	46 Hours
	Module 1: Introduction to DC Machines	**8**
1.1	Constructional details of DC machines	1
1.2	Armature winding- single layer - double layer - lap and wave windings, equalizer rings, dummy coils	1
1.3	Developed simplex winding diagram-double layer - progressive only	2
1.4	DC generator - principle of operation, EMF equation - numerical problems	2
1.5	Classification of DC generator - numerical problems	2
	Module 2: Characteristics of DC Generators	**10**
2.1	Armature reaction - demagnetising and cross magnetising ampere turns	1
2.2	Commutation - compensating windings, interpoles	1
2.3	DC Shunt Generator - no-load characteristics (OCC) - voltage build-up - critical field resistance - critical speed - numerical problems	2
2.4	Load characteristics of DC shunt and compound generators	2
2.5	Power flow diagram - losses and efficiency - maximum efficiency - numerical problems	2
2.6	Parallel operation - load sharing - numerical problems	2
	Module 3: DC Motors	**10**
3.1	DC motor - principle of operation - back emf	1
3.2	Classification of DC motors - numerical problems	1
3.3	Torque equation - numerical problems	1
3.4	Performance characteristics of DC shunt and series motors	1
3.5	Starting of DC motors - starters – 3-point and 4-point starters	1
3.6	Speed control of DC motors - field control, armature control - numerical problems	1
3.7	Power flow diagram - losses and efficiency - numerical problems	2
3.8	Testing of DC motors - Swinburne's test - numerical problems	1
3.9	Hopkinson's Test - Retardation test - DC motor applications	1
	Module 4: Single-Phase Transformers	**10**
4.1	Single-phase transformers - constructional details - principle of operation	1
4.2	EMF equation - numerical Problems	1

4.3	Ideal and practical transformer - phasor diagram, no-load and on-load operations	1
4.4	Equivalent circuit, voltage regulation - numerical problems	2
4.5	Transformer losses and efficiency, condition for maximum efficiency - numerical Problems - kVA rating.	2
4.6	Testing of transformers - polarity test, open circuit test, short circuit test - numerical problems	1
4.7	Sumpner's test - separation of losses	1
4.8	Parallel operation of single-phase transformers - numerical problems	1
	Module 5: Autotransformers and Three-phase Transformer	**8**
5.1	Autotransformer - saving of copper -rating of autotransformers	1
5.2	Three phase transformer - construction - different connections of 3-phase transformers - $Y-Y, \Delta-\Delta, Y-\Delta, \Delta-Y$	1
5.3	Numerical problems on $Y-Y, \Delta-\Delta, Y-\Delta, \Delta-Y$	1
5.4	Difference between power transformer and Distribution transformer - all-day efficiency - numerical problems	2
5.5	Vector groupings - Need for Vector Grouping - Yy0, Dd0, Yy6, Dd6, Yd1, Yd11, Dy1, Dy11	2
5.5	Parallel operation of three-phase transformers - essential and desirable conditions	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Describe the functions of individual parts of DC machines.
2. Develop simplex lap and wave windings for different pole configurations.
3. Explain different types of DC generators.
4. Derive the EMF equation of a DC machine.

Course Outcome 2 (CO 2)

1. Draw the open circuit and load characteristics of DC generators
2. Explain the conditions for voltage build up in DC generators.
3. Explain armature reaction in DC machines and solutions to overcome its effects.
4. Explain Commutation and ways to improve it.

5. Analyse parallel operation of DC generators.

Course Outcome 3 (CO 3)

1. Derive the torque equation of a DC motor.
2. Why starters are used in DC motors?
3. Explain the types of speed control in DC motor.
4. Explain regenerative braking in a DC motor.
5. What are the losses associated with DC motor?
6. Select a suitable type of DC motor for specific applications.

Course Outcome 4 (CO 4)

1. Derive the EMF equation of a single-phase transformer.
2. Derive the condition for maximum efficiency in a transformer.
3. What are the necessary condition for parallel operation of a single-phase a transformer?
4. Explain no-load and short circuit tests on a single-phase transformer.
5. Explain Sumpner's test on transformers.
6. Draw the equivalent circuit of single-phase transformer referred to the LV side.

Course Outcome 5 (CO 5)

1. Explain the theory of autotransformer.
2. Explain the different connections of 3-phase transformers.
3. Draw the Vector Groupings of a three-phase transformer.
4. What are the necessary conditions for parallel operation of three-phase transformers?
5. Compare power transformer and distribution transformer.
6. What is All Day Efficiency?

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: : B24EE2T02

Course Name: : Electrical Machines I

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Compare Lap and Wave windings.
2. List down the classification of DC Generators.
3. A 4-pole generator has a wave wound armature with 722 conductors and delivers 100 A on full load. If the brush lead is 8°, calculate the armature demagnetizing and cross-magnetizing ampere turns per pole.
4. Explain the methods to improve commutation.
5. Explain the need for starters.
6. List down the speed control techniques of the DC Shunt motor.
7. Draw the phasor diagram of a single phase transformer with capacitive load.
8. In a 50 kVA transformer, the iron loss is 500 W and full-load copper loss is 800 W. Find the efficiency at quarter load and 0.8 pf lag.
9. Explain the essential and desirable conditions for the parallel operation of three-phase transformers.
10. An autotransformer supplies a load of 2.5 kW at 110 V at a unity power factor. If the applied primary voltage is 220 V, calculate the power transferred to the load inductively and conductively.

PART B

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

11. (a) Explain in detail the constructional details of a 4 pole DC machine. (8 marks)

    (b) A 20 kW, 250 V DC shunt generator has armature and field resistances of 0.1 Ω and 125 Ω respectively. Calculate the total armature power developed when running (i) as a generator delivering 20 kW output (ii) as a motor taking 20 kW input. (6 marks)

OR

12. A compound generator is to supply a load of 250 lamps, each rated at 100 W, 250 V. The armature, series field and shunt field windings have resistance of 0.06 Ω, 0.04 Ω, 50 Ω respectively. Determine the generated emf when the machine is connected in i) long shunt ii) short shunt Take drop per brush as 1 V. Draw the circuit connections in each case. (14 marks)

13. A 100 kW, 460 V shunt generator was run as a motor on no-load at its rated voltage and speed. The total current taken was 9.8 A including a shunt current of 2.7 A. The resistance of the armature circuit (including compoles) at normal working temperature was 0.11 Ω. Calculate the efficiency at (i) full-load (ii) half full-load. (14 marks)

OR

14. The O.C.C of a separately excited d.c. generator driven at 400 r.p.m. is as follows.

Field Current (A)	2	3	4	5	6	7	8	9
E.M.F (V)	110	155	186	212	230	246	260	271

The machine is connected as a shunt generator and driven at 400 r.p.m. Find,

i. The emf to which the machine will excite when the field circuit resistance is 34 Ω.

ii. The critical value of shunt field resistance. Also, infer what happens if the field resistance value exceeds the critical value.

iii. The critical speed when the field circuit resistance is 34 Ω. (14 marks)

15. (a) A 220 V DC shunt motor runs at 1000 rpm while taking a current of 25 A. The resistance of armature is 0.2 Ω and that of shunt field circuit is 110 Ω. Calculate the speed when the load is increased so that the motor takes a load current of 50 A. During this increase in load, armature reaction weakens the field by 2 %. The average drop per brush is 1 V. Determine torque developed in both cases. (10 marks)

    (b) Explain any two braking techniques of DC Motor. (4 marks)

OR

16. (a) A 200 V shunt motor has an armature resistance of 0.1 Ω and field resistance 240 Ω and rotational loss 236 W. On full load the line current is 9.8 A with the motor running at 1450 rpm.

    Calculate

    i. Mechanical power
    ii. Output power
    iii. Load torque
    iv. Full load efficiency (8marks)

    (b) A 500 V DC shunt motor takes a current of 4 A on no-load. The armature resistance including that of brush is 0.2 Ω and field current is 1 A. Estimate the output power and efficiency when input current is at 20 A. (6 marks)

17. A 20 kVA 250/2500 V 50 Hz single phase transformer gave the following test results.

OC TEST	220 V	1.4 A	150 W
SC TEST	120 V	8 A	320 W

Find the required parameters and hence draw the equivalent circuit of the transformer referred to LV side. Also predetermine the efficiency at 75 % rated load and regulation at half load, 0.8 pf lead. (14 marks)

OR

18. Explain the need for parallel operation of Single Phase Transformers. Derive the expression for load shared between 2 transformers. Also draw the circuit diagram to Back-to Back Test in 2 identical transformers. Explain how regulation can be determined from the same. (14 marks)

19. Derive an expression to justify the saving of copper in auto transformer with respect to an ordinary two winding transformer with the same rating. Also find the currents in different parts of the winding for a step down auto transformer from 440 V to 300 V supplying 30 Ω load. (14 marks)

OR

20. Explain group 1, 3, and 4 vector groupings of three-phase transformers with phasor and winding connection diagrams. (14 marks)

B24EE2T03	DIGITAL ELECTRONICS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

This course aims to equip students with essential knowledge and practical skills in the design, analysis, and implementation of digital electronic systems. The course ensures a comprehensive understanding of the logic design of combinational and sequential circuits, state machines, and a hardware description language is introduced to model and simulate digital circuits. Students will gain analytical and practical expertise to understand and design digital electronic systems, making them well-prepared for both academic research and industry applications in digital electronics.

Prerequisites

Electronic Circuits I

Course Outcomes

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

CO 1	Understand various number systems, codes, and logic gates and perform binary arithmetic operations. (Cognitive Knowledge Level: Understand)
CO 2	Apply Boolean laws and theorems, utilize K-map for the minimization of Boolean expressions, and design digital circuits. (Cognitive Knowledge Level: Apply)
CO 3	Design and implement various combinational logic circuits for practical applications. (Cognitive Knowledge Level: Apply)
CO 4	Design and analyse various types of registers, asynchronous counters, and synchronous counters for sequential operations. (Cognitive Knowledge Level: Apply)
CO 5	Understand the operation of various ADC/DAC circuits, the concepts of Verilog HDL, and design State machines for various 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	3	1	1		2						2
CO 2	3	3	2	2	2	2						2
CO 3	3	3	2	2	2	2	3	3	2	1	1	2
CO 4	3	2	3	2	2	2	3	3	2	1	1	2
CO 5	3	3	3	2	2	2	3	3				2

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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (7 hours)

Number Systems, Codes and Logic Gates

Number systems and codes: Decimal, binary, octal and hexadecimal conversions - ASCII code, excess-3 code, gray code, BCD, error detection codes-parity method. Binary addition and subtraction - representation of signed numbers, 1's and 2's complement arithmetic, floating-point representation.
Logic gates, realization of NAND and NOR as universal gates.

MODULE 2 (8 hours)

Boolean Algebra

Boolean Laws and De Morgan's theorems, conversion of AOI logic to NAND/NOR logic-Sum of Products(SOP) method, Product of Sum(POS) method - K-map representation and simplification - pairs, quads, octets, don't care conditions.

MODULE 3 (7 hours)

Combinational Circuits

Adders - half adder and full adder, subtractors - half subtractor and full subtractor, 4 bit parallel binary adder/subtractor, carry look-ahead adders.
Comparators, parity generators and checkers, encoders, decoders, BCD to seven segment decoder, code converters, multiplexers, demultiplexers.

MODULE 4 (8 hours)

Sequential Circuits

Flip-Flops: SR, JK, D and T flip-flops, JK master slave flip-flop, conversion of flip-flops, preset and clear pins. Shift Registers: SISO, SIPO, PISO, PIPO.
Asynchronous counters: Up/Down counters - modulus of a counter - design of Mod-N counters, Ring counter, Johnson counter. Synchronous counters - design of synchronous counters.

MODULE 5 (6 hours)

D/A and A/D converters and State Machines

Digital to Analog converter(DAC): specifications, weighted resistor type and R-2R ladder type DAC. Analog to Digital Converter(ADC): specifications, flash type and successive approximation type ADC.
State Machines: State transition diagram, Moore and Mealy Machines.
Introduction to Verilog programming: Gate flow and data flow modelling of all the logic gates, half adder and full adder.

Text Books

1. Floyd T. L, *Digital Fundamentals*, Pearson Education, 11th ed., 2017.
2. Bhupesh Bhatia and M. V. Subramanyam, *Basics of Digital Electronics*,Tata McGraw-Hill Education, 8th ed., 2020.
3. Mano M. M, *Logic and Computer Design Fundamentals*, Pearson Education, 5th ed., 2016.
4. A. Anand Kumar, *Fundamental of Digital Electronics*, Prentice Hall, 5th ed., 2016.
5. S. Salivahanan, *Digital Circuits and Design*, Oxford University Press, 6th ed., 2018.

Reference Books

1. Donald P. Leach, Albert Paul Malvino, *Digital Principles and Applications*, McGraw Hill, 8th ed., 2016.
2. Tocci R. J. and N. S. Widmer, *Digital Systems, Principles and Applications*, Pearson Education, 11th ed., 2008.
3. John F. Wakerly, *Digital Design: Principles and Practices*, Pearson Education, 4th ed., 2005.
4. Taub & Schilling, *Digital Integrated Electronics*, McGraw Hill, 7th ed., 2017.
5. C. H. Roth and L. L. Kimney, *Fundamentals of Logic Design*, Cengage Learning, 7th ed., 2013.
6. Roy Chaudari,*Linear Integrated Circuits*, New Age International Publications, 5th ed., 2018.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1: Number Systems, Codes and Logic Gates	**7**
1.1	Decimal, binary, octal and hexadecimal conversions	2
1.2	ASCII code, excess-3 code, gray code, BCD, error detection codes - Parity method.	1
1.3	Binary addition and subtraction - representation of signed numbers	1
1.4	1's and 2's complement arithmetic	1
1.5	Floating-point representation	1
1.6	Logic gates, realization of NAND and NOR as universal gates	1
	Module 2: Boolean Algebra	**8**
2.1	Boolean Laws and De Morgan's theorems	2
2.2	Conversion of AOI logic to NAND/NOR logic	2
2.3	Sum of Products method	1
2.4	Product of Sum method	1
2.5	K map representation and simplification - pairs, quads, octets, don't care conditions	2
	Module 3: Combinational Circuits	**7**
3.1	Adders - half adder and full adder	1
3.2	Subtractors - half subtractor and full subtractor, 4-bit parallel binary adder/subtractor	1
3.3	Carry Look-ahead adders	1
3.4	Comparators, parity generators and checkers	1
3.5	Encoders, decoders, BCD to seven segment decoder, code converters	1
3.6	Multiplexers	1
3.7	Demultiplexers	1
	Module 4: Sequential Circuits	**8**
4.1	Flip-Flops: SR, JK, D and T flip-flops, JK master-slave Flip-flop	1
4.2	Conversion of flip-flops, preset and clear pins	1
4.3	Shift Registers : SISO, SIPO, PISO, PIPO	2
4.4	Asynchronous counters: Up/Down counters - modulus of a counter	1
4.5	Design of Mod-N counters - Ring counter, Johnson Counter	1
4.6	Synchronous counters, design of synchronous counters	2
	Module 5: D/A and A/D converters and state machines	**6**

5.1	Digital to Analog converter: Specifications, weighted resistor type and R-2R Ladder type DAC	1
5.2	Analog to Digital Converter: specifications, flash type, and successive approximation type ADC	1
5.3	State Machines: State transition diagram, Moore and Mealy Machines	2
5.4	Introduction to Verilog programming: gate flow and data flow modelling of all the logic gates, half adder and full adder	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Convert one number system to another form - binary, decimal, octal, and hexadecimal.
2. Explain error detection using the parity method.
3. Perform binary arithmetic using 1's complement and 2's complement method.

Course Outcome 2 (CO 2)

1. Reduce the boolean expression using Boolean laws.
2. Develop logic circuits using Universal gates.
3. Convert an SOP form to a POS form and vice-versa.
4. Simplify boolean expression using K-map.

Course Outcome 3 (CO 3)

1. Design of i) half adder ii) full adder iii) full subtractor using gate.
2. Discuss how the look-ahead carry adder speeds up the addition process.
3. Explain the use of the enable input in a decoder.
4. Explain odd parity generator and even parity generator.
5. Differentiate between multiplexers and de-multiplexers.

Course Outcome 4 (CO 4)

1. Explain different types of flip-flops and its application areas.
2. Describe a level triggered flip flop and compare it with an edge triggered flipflop.
3. Design of mod-N asynchronous counter using J-K flipflop.
4. Distinguish Ring counter from Johnson counter.
5. Explain various types of shift register.

Course Outcome 5 (CO 5)

1. Determine the number of output voltages that can be produced by an 8 bit ADC.
2. Write the advantage of the R-2R ladder DAC over the weighted resistor type DAC.
3. Differentiate between Moore and Mealy machine.
4. Explain the function of the Mealy machine.
5. Write the implementation code of simple circuits using Verilog.

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: : B24EE2T03

Course Name: : DIGITAL ELECTRONICS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Find the binary code and gray code of the number 3A816.
2. Implement NOT circuit using a two input EX-OR gate.
3. Using the Boolean laws and rules, simplify the logic expression $Z = (A+B)(\bar{A}+B)$.
4. Convert the following function into standard POS and express as maxterms $Y(A, B, C) = (A + B)(\bar{B} + C)(A + C)$.
5. Implement $Y(A, B, C) = \Sigma m(0, 1, 2, 6, 7)$ using 4:1 MUX.
6. Design a 2 bit magnitude comparator using logic gates.
7. Derive the characteristic equation of a J-K flip-flop.
8. Determine the number of flip-flops needed to construct a register capable of storing (i) a 6 bit binary number (ii) hexadecimal numbers upto F (iii) octal numbers upto 10.
9. Draw the circuit diagram of a 4-bit weighted resistor type digital to analog converter. Write an expression for its output.
10. Write the structural model of three input AND gate in Verilog HDL.

PART B

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

11. (a) Perform -25 + 14 using 1's compliment and 2's compliment method. (7 marks)
    (b) Draw the Truth table and explain the operation of Universal Gates. (7 marks)

OR

12. (a) Convert the following (9 marks)
    i. $(1001011)_{gray} = ()_2$
    ii. $(10110110.0011)_2 = ()_{BCD}$
    iii. $(5762)_8 = ()_{16}$
    iv. $(76)_{10} = ()_{gray}$
    v. Attach the proper even parity bit to 10100100 and odd parity bit to 11111000.
    (b) Convert the decimal number 3.248 x 104 to a single-precision floating-point binary number. (5 marks)

13. (a) Reduce the expression $Y = \Sigma m(0, 1, 2, 3, 5, 7, 8, 9, 10, 12, 13)$, show the implementation using NAND gates. (8 marks)
    (b) Show that a full adder can be constructed with two half adders and an OR gate. (6 marks)

OR

14. (a) If $\bar{A}B + C\bar{D} = 0$, then prove that $AB + \bar{C}(\bar{A} + \bar{D}) = AB + BD + \bar{B}\bar{D} + \bar{A}\bar{C}D$ (4 marks)
    (b) Explain the difference between ripple adder and carry look ahead adder with implementation details. (10 marks)

15. (a) Design two bit comparator using decoder. (8 marks)
    (b) Draw the implementation circuit of a 1 : 8 Demultiplexer using two 1 : 4 demultiplexers. (8 marks)

OR

16. Write down the truth table for a BCD-to-seven segment decoder. Deduce the Boolean expression for each output. (14 marks)

17. (a) Draw the logic circuit diagram of a 4-bit ring counter which employs D flip-flop. Write down its count sequence table.. (5 marks)
    (b) Design a mod-10 asynchronous up-counter using J-K flip-flops. Draw the timing diagram and relevant excitation table. (9 marks)

OR

18. (a) Design a counter to produce the following binary sequence. Use J-K flip-flops. 1, 4, 3, 5, 7, 6, 2, 1, ... (9 marks)

    (b) Draw the circuit and timing diagrams of a 3 bit SISO shift register. (5 marks)

19. (a) Write the Verilog code for a half adder. (7 marks)

    (b) Explain R-2R ladder type of DAC. (7 marks)

OR

20. (a) Explain the working of successive approximation ADC with the help of an example.
    (8 marks)

    (b) Differentiate Moore and Mealy state machines. (6 marks)

<table>
<tr><td rowspan="2">B24EE2T04</td><td rowspan="2">ELECTRONIC CIRCUITS II</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 aims to impart sound knowledge and basic concepts of operational amplifiers. It gives information about the working principle and applications of analog electronic devices. This course will enable the students to develop the skill to design circuits using operational amplifiers and other linear ICs for various applications.

Prerequisites

Electronic Circuits I

Course Outcomes

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

CO 1	Understand the working principle of MOSFET and basic concepts of TTL and CMOS logic families. (Cognitive Knowledge Level: Understand)
CO 2	Understand the fundamentals of operational amplifiers and design Op-Amp circuits for various applications. (Cognitive Knowledge Level: Apply)
CO 3	Analyse the working principle of Op-Amp oscillators, multivibrators, and various filters. (Cognitive Knowledge Level: Apply)
CO 4	Analyse the working of 555 timer, VCO and PLL ICs and its applications. (Cognitive Knowledge Level: Apply)
CO 5	Understand the working principle of various voltage regulators. (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	1	2	1	1	1	1		1		1
CO 2	3	2	2	2	2	2	1	1	1	1	1	1
CO 3	3	2	3	2	1	2	1	1		1		1
CO 4	3	2	2	2	1	2	1	1		1		1
CO 5	3	2	1	2	1	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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (8 hours)

MOSFET and MOSFET Amplifier

MOSFET: Structure - enhancement, and depletion types, the principle of operation, and characteristics. MOSFET as an amplifier, biasing of discrete MOSFET amplifier, small signal equivalent circuit, small signal voltage and current gain, input and output impedance of CS configuration.

TTL and CMOS Logic Families

Concepts of sourcing, sinking, fan-in, fan-out, internal diagram of TTL NAND gate and CMOS NOR gate.

MODULE 2 (8 hours)

Differential Amplifiers

Differential amplifier configurations using BJT - differential and common mode gains.

Operational Amplifiers

Block Diagram of Op-Amp, Characteristics of Op-Amp - gain, bandwidth, slew rate, CMRR, offset voltage, offset current, comparison of ideal and practical Op-Amp IC 741, open loop and closed loop configurations, concept of virtual ground.
Applications of Op-Amps - Inverting and non-inverting amplifier circuits, summing amplifier, subtractor, integrator, differentiator - practical integrator and differentiator circuits, comparator.
Use simulation software like MATLAB/PSpice to simulate basic Op-Amp circuits (Assignment/Tutorial only).

MODULE 3 (7 hours)

Op-Amp Oscillators and Multivibrators

Phase shift and Wien-bridge oscillators, triangular and sawtooth waveform generators, astable and monostable multivibrators.

Active Filters

Comparison with passive filters, first and second order low pass, high pass, band pass and band reject active filters, state variable filters.

MODULE 4 (7 hours)

Timer and VCO

Timer IC 555 - functional diagram, astable and monostable operations, voltage-controlled oscillator (VCO) (basic concepts), and VCO IC LM 566 - applications.

Phase Locked Loop

Operation, closed-loop analysis, lock and capture range, basic building blocks, PLL IC 565, applications of PLL.

MODULE 5 (6 hours)

Voltage Regulators

Fixed and adjustable voltage regulators, 78XX/79XX fixed voltage series regulators - connection of positive and negative voltage regulators - specifications, LM317 - adjustable voltage regulator, IC 723 - general purpose regulator - functional block diagram - low voltage and high voltage configurations, current boosting, current limiting, short circuit, and fold-back protection, limitations of IC 723, switching regulator (concept only).

Text Books

1. Roy D. C. and S. B. Jain, *Linear Integrated Circuits*, New Age International, 6th ed., 2021.
2. DFranco S, *Design with Operational Amplifiers and Analog Integrated Circuits*, Tata McGraw Hill, Vol.1, 3rd ed., 2017.
3. Gayakwad R. A, *Op-Amps and Linear Integrated Circuits*, Pearson, 4th ed., 2015.
4. Botkar K. R., *Integrated Circuits*, Khanna Publishers, 10th ed., 2008
5. Robert L.Boylestad and Louis Nashelsky, *Electronic Devices and Circuit Theory*, Pearson Education India, 11th ed., 2015

Reference Books

1. C.G. Clayton, *Operational Amplifiers*, Butterworth & Company Publ. Ltd. Elsevier, 5th ed., 2003
2. David A. Bell, *Operational Amplifiers & Linear ICs*, Oxford University Press, 3rd ed., 2011
3. R.F. Coughlin & Fredrick Driscoll, *Operational Amplifiers & Linear Integrated Circuits*, PHI, 6th ed., 2000

4. Sedra A. S. and K. C. Smith, *Microelectronic Circuits*, Oxford University Press, 7th ed., 2014.

5. Thomas L Floyd, David M Buchla, *Fundamentals of Analog Circuits*, Pearson, 2nd ed., 2001.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1: MOSFET and MOSFET Amplifier, TTL and CMOS Logic Families	**8**
1.1	MOSFET Structure - enhancement, and depletion types	1
1.2	Principle of operation, and characteristics	1
1.3	MOSFET as an amplifier	1
1.4	Biasing of discrete MOSFET amplifier	1
1.5	Small signal equivalent circuit	1
1.6	Small signal voltage and current gain, input and output impedance of CS configuration	1
1.7	Concepts of sourcing, sinking, fan-in, fan-out	1
1.8	Internal diagram of TTL NAND gate and CMOS NOR gate	1
	Module 2: Differential Amplifiers, Operational Amplifiers	**8**
2.1	Differential amplifier configurations using BJT - differential and common mode gains. Block Diagram of Op-Amp	1
2.2	Characteristics of Op-Amps - gain, bandwidth, slew rate, CMRR, offset voltage, offset current	1
2.3	Comparison of ideal and practical Op-Amp IC 741	1
2.4	Open-loop and closed-loop configurations	1
2.5	Applications of Op-Amps - Inverting amplifier	1
2.6	Non-inverting amplifier circuits, summing amplifier	1
2.7	Subtractor, integrator, differentiator	1
2.8	Practical integrator and differentiator circuits, comparator	1
	Module 3: Op-Amp Oscillators and Multivibrators, Active Filters	**7**
3.1	Phase shift and Wien-bridge oscillators	1
3.2	Triangular and sawtooth waveform generators	1
3.3	Astable multivibrators	1
3.4	Monostable multivibrators	1
3.5	Comparison with passive filters, first and second order low pass filters	1
3.6	High pass, band pass and band reject filters	1
3.7	Active filters, state variable filters	1
	Module 4: Timer and VCO, Phase Locked Loop	**7**

4.1	Timer IC 555 - functional diagram	1
4.2	Astable and monostable operations	1
4.3	Voltage-controlled oscillator (basic concepts)	1
4.4	VCO IC LM 566 - applications	1
4.5	PLL Operation, closed-loop analysis	1
4.6	Lock and capture range, basic building blocks	1
4.7	PLL IC 565, applications of PLL	1
	Module 5: Voltage Regulators	**6**
5.1	Fixed and adjustable voltage regulators	1
5.2	78XX/79XX fixed voltage series regulators - connection of positive and negative voltage regulators - specifications	1
5.3	LM317 - adjustable voltage regulator	1
5.4	IC 723 - general purpose regulator - functional block diagram	1
5.5	Current boosting, current limiting, short circuit, and fold-back protection, limitations of IC 723	1
5.6	Switching regulator (concept only)	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Explain enhancement type MOSFET.
2. Analyse small signal equivalent circuit of MOSFET amplifier.
3. Illustrate TTL NAND gate.

Course Outcome 2 (CO 2)

1. Explain the working of BJT differential amplifiers.
2. Limitations of Ideal Op-Amp Differentiator.
3. Problems based on closed-loop applications.

Course Outcome 3 (CO 3)

1. Explain the Wien-bridge oscillator.
2. Explain working of an Astable multivibrator.
3. Problems on monostable multivibrator.

Course Outcome 4 (CO 4)

1. What is the need of voltage controlled Oscillator?
2. Analyse the functional diagram of IC 555.
3. What is the function of low pass filter in PLL?

Course Outcome 5 (CO 5)

1. Outline the principle of fixed voltage regulators.
2. Draw the block diagram of IC 723.
3. Illustrate how a switching regulator differ from a linear regulator?

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: : B24EE2T04

Course Name: : ELECTRONIC CIRCUITS II

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Illustrate the construction of Enhancement MOSFET.
2. Explain the concept of fan-in and fan-out.
3. Illustrate the virtual ground concept in Op-Amp.
4. List any 6 characteristics of an ideal operational amplifier.
5. Explain the working principle of Wien-bridge oscillator.
6. Compare active and passive filters.
7. Draw the circuit of monostable multivibrator using IC 555.
8. What is the function of low pass filter in PLL?
9. Explain how current boosting is achieved using IC 723.
10. Derive the relation between line and phase values of voltage and current for delta connected system.

PART B

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

11. Draw the circuit of a common source amplifier using MOSFET. Derive the expressions for voltage gain and input resistance from small signal equivalent circuit. (14 marks)

OR

12. Explain the working of TTL NAND gate with the help of a neat diagram. (14 marks)

13. (a) Explain i) CMRR ii) Slew rate of an Op Amp.

    (4 marks)

    (b) Draw the circuit diagram and derive the voltage gain equation of Inverting amplifier. Design a Inverting amplifier with gain of 6.

    (10 marks)

OR

14. Develop a circuit diagram for practical integrator and draw its frequency response waveform. (14 marks)

15. Derive the equation for frequency of oscillation (f_o) of a Wein Bridge oscillator. Design a Wein Bridge oscillator for $f_o = 1$ kHz. (14 marks)

OR

16. Design a circuit to generate 1 kHz triangular wave with 5 V peak. (14 marks)

17. With the help of an internal functional diagram, explain the working of the monostable multivibrator using 555 timer. Derive the equation for pulse width. (14 marks)

OR

18. Explain the operation of Phase Locked Loop. What is lock range and capture range?

    (14 marks)

19. Explain how short circuit, fold back protection and current boosting are done using IC 723 voltage regulator. (14 marks)

OR

20. What are some common applications for the LM317? How the regulated output voltage of an LM317 can be set? (14 marks)

B24EE2L03	ELECTRICAL MEASUREMENTS LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The Electrical Measurements Lab is designed to equip students with the knowledge and skills to effectively use various measuring instruments and transducers for assessing physical parameters. The course is designed to build a solid foundation that empowers to analyse and comprehend the measurement of circuit parameters, magnetic quantities and calibration of various meters at different power factors. By successfully completing the course, students will gain the ability to bridge theoretical concepts with practical applications, enhancing their comprehension of electrical measurement principles.

Prerequisite

Introduction to Electrical Engineering, Electrical Measurements

Course Outcomes

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

CO 1	Determine power in single-phase and three-phase circuits using various methods. (Cognitive Knowledge Level: Apply)
CO 2	Analyse the magnetic properties of various electrical devices and evaluate energy consumption across different loads. (Cognitive Knowledge Level: Apply)
CO 3	Calibrate different meters using direct and phantom loading methods across various power factors in electrical systems. (Cognitive Knowledge Level: Apply)
CO 4	Evaluate electrical parameters using AC and DC bridges and to analyse the performance of electronic devices for an instrumentation system. (Cognitive Knowledge Level: Apply)
CO 5	Develop team management skills and prepare laboratory reports that logically and scientifically communicate experimental information. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	1	1	1	3	2	1	2	2	3	3
CO 2	3	3	1	1	1	3	1	1	2	2	2	3
CO 3	3	3	1	3	1	3	3	3	2	2	2	3
CO 4	3	3	1	3	1	3	2	1	2	2	2	3
CO 5	3	3	1	1	2	3	2	3	2	2	3	3

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
Performance	10 marks
Viva-Voce	5 marks
Lab Record	5 marks
Internal Exam	20 marks

End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding the award of marks

1. Preliminary work : 25 Marks
   (a) Circuit Diagram: 15 Marks
   (b) Theory and Procedure: 10 Marks
2. Implementing the work/Conducting the experiment : 30 Marks (usage of equipment and troubleshooting)
3. Result and Inference : 15 Marks
4. Viva Voce : 30 Marks

Students having a certified Lab Record are only eligible to appear for the End Semester Examination.

SYLLABUS

LIST OF EXPERIMENTS

1	Three phase power measurement using one wattmeter and two-wattmeter methods, and determination of active, reactive and apparent power drawn.
2	a) Extension of instrument range by using instrument transformers(CT and PT). b) Measurement of energy using TOD meter(R and RL load).
3	a) Determination of the B-H curve of a magnetic specimen. b) Familiarization of the fluxmeter. c) Verification of loading effect in ammeters and voltmeters with current measurement using clamp-on meter.
4	Calibration of 1-phase energy meter at various power factors using direct loading.
5	Calibration of 1-phase energy meter at various power factors using phantom loading.
6	Calibration of ammeter converted to voltmeter, using Slide-wire potentiometer.
7	Calibration of 3-phase, 4 wire energy meter using standard wattmeter.
8	Calibration of wattmeter using Crompton potentiometer.
9	a) Measurement of resistance using i) Wheatstone's bridge and ii) voltmeter-ammeter method. b) Measurement of capacitance using an AC bridge.
10	Calculate and verify the Z and Y parameters of a two-port network.
11	Plot the V-I characteristics of solar PV system.
12	Experimental evaluation of power quality analysis using power quality analyser.

Reference Books

1. H. Cotton, A. K. Sawhney, *A course in Electrical and Electronic Measurements & Instrumentation*, Dhanpat Rai, 19th ed., 2015.

2. J. B. Gupta, *A course in Electrical & Electronic Measurement & Instrumentation*, S. K. Kataria & Sons, 14th ed., 2014.

3. E. W. Golding, *Electrical Measurements and Measuring Instruments*, Pitman, 3rd ed., 2011.

<table>
<tr><td rowspan="2">B24EE2L04</td><td rowspan="2">DIGITAL ELECTRONICS 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>3</td><td>2024</td></tr>
</table>

Preamble

The aim of this course is to equip the students with essential knowledge and practical skills in the design, analysis, and implementation of digital electronic systems. The course ensures the design and implementation of the combinational and sequential logic circuits, synchronous and asynchronous counters, and the concepts of a hardware description language VHDL. Students will gain the analytical and practical expertise to understand and design digital electronic systems for industry applications.

Prerequisite

Nil

Course Outcomes

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

CO 1	Understand and formulate digital functions using Boolean Algebra and minimize using K-map. (Cognitive Knowledge Level: Apply)
CO 2	Design and realize the combinational and sequential logic circuits. (Cognitive Knowledge Level: Apply)
CO 3	Design and implement the synchronous and asynchronous counters using flip-flops. (Cognitive Knowledge Level: Apply)
CO 4	Design and implementation of decimal decoders with display and implement simple circuits using a hardware description language VHDL. (Cognitive Knowledge Level: Apply)
CO 5	Develop the team management skills and prepare laboratory reports that logically and scientifically communicate experimental information. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	2	1		1	2	1	3	2
CO 2	3	3	3	3	2	1		1	2	1	2	2
CO 3	3	3	3	3	2	1		1	2	1	2	2
CO 4	3	2	3	3	3	2		1	2	1	2	2
CO 5	2	2	2	2	2	1	1	1	2	1	2	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
Performance	10 marks
Viva-Voce	5 marks
Lab Record	5 marks
Internal Exam	15 marks
Micro Project	5 marks

End Semester Examination (ESE) Pattern

The following guidelines should be followed regarding the award of marks

1. Preliminary work: 25 Marks
   (a) Circuit Diagram: 15 Marks
   (b) Theory and Procedure: 10 Marks
2. Implementing the work/Conducting the experiment: 30 Marks (usage of equipment and troubleshooting)
3. Result and Inference: 15 Marks
4. Viva Voce: 30 Marks

Micro Project: Students must complete a mandatory micro project in groups of up to four members. The project should involve the design and realization of a functional digital circuit along with a small hardware implementation. This project will be evaluated as part of the continuous internal evaluation, with a maximum of 5 marks. **Students having a certified Lab Record and Micro Project Report are only eligible to appear for the End Semester Examination.**

SYLLABUS

LIST OF EXPERIMENTS

1	a) Verification and realization of De Morgan's theorem. b) Realization of SOP and POS functions after K-map reduction.
2	Half adder and full adder realization using NAND gates.
3	4-bit adder/subtractor and BCD adder realization using IC 7483.
4	BCD to decimal decoder and BCD to 7-segment decoder realization.
5	Study of multiplexer IC and realization of combinational circuits using multiplexers.
6	Realization of SR, T, D and JK flip-flops using gates.
7	a) Study of flip-flop ICs (7474, 7476). b) Study of counter ICs (7490, 7493).
8	Realization of ripple up and down counters and modulo-N counters using flip-flops.
9	Design of synchronous up, down, and modulo-N counters.
10	Realization of 2-bit comparator using gates and study of 4-bit comparator IC 7485.
11	Realization of shift register counters, Ring counter and Johnson's counter.
12	a) Study of shift register IC 7495. b) Implementation of half adder and full adder using VHDL.

Reference Books

1. Floyd T. L., *Digital Fundamentals*, Pearson Education, 11th ed., 2017.
2. Salivahanan , *Digital Circuits and Design*, Oxford University Press, 6th ed., 2018.
3. A. Anand Kumar, *Fundamental of Digital Electronics* , Prentice Hall, 4th ed., 2016.
4. C. H. Roth and L. L. Kimney , *Fundamentals of Logic Design*, Cengage Learning, 7th ed., 2013.
5. Bhupesh Bhatia and M. V. Subramanyam, *Basics of Digital Electronics* , Tata McGraw-Hill Education, 2020.

B24MC2T04	UNIVERSAL HUMAN VALUES 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	1	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 (1 number) 25 marks
(Conducted for 50 marks and reduced to 25)
Assignments/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. R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, Excel Books, New Delhi, 3rd ed., 2023.

2. R R Gaur, R Asthana, G P Bagaria, *The Teacher's Manual for a Foundation Course in Human Values and Professional Ethics*, Excel Books, New Delhi, 3rd ed., 2023.

3. D D Basu, *Introduction to the constitution of India*, Lexis Nexis,New Delhi, 26th ed., 2022.

4. P M Bhakshi, *The constitution of India*, Universal Law, 19th ed., 2023.

Reference Books

1. M Govindarajan, S Natarajan and V S Senthil Kumar, *Engineering Ethics*, PHI Learning Private Ltd, 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,. Hayt W. H., Kemmerly J. E., and Durbin S. M., *The constitution of India*, Govt of India, New Delhi, 2019.

4. J N Pandey, *The constitutional Law of India*, Central Law Agency, Allahabad, 51th ed., 2019.

5. M V Pylee, *Indias Constitution*, S Chand and Company, New Delhi, 16th ed., 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	24 Hours
	Module 1: Introduction to Values	**6**
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**
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**
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**
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 (CO 1)

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 marks)

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 marks)

7. Distinguish between ‘animal consciousness’ and ‘human consciousness’. (9 marks)

OR

8. ‘Relationship is - between one Self (I1) and another Self ’. Examine this statement (9 marks)

9. Summarize the various methods of acquiring Indian citizenship. (10 marks)

OR

10. Examine the salient features of the Indian constitution. (10 marks)

11. Explain the meaning, significance and classification of the Directive Principles of State Policy. (10 marks)

OR

12. Explain the fundamental duties of an Indian Citizen. (10 marks)

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 number) 25 marks
(Conducted for 50 marks and reduced to 25)
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 each. Part B contains 2 questions from each module out of which one has 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)

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**
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 and technological interventions	1
1.3	Energy Policy and Planning: National Energy Policy, Energy Conservation Act, BEE initiatives	1
1.4	Energy Auditing: Preliminary and Detailed audits, Performance Indicators, Case Studies	2
1.5	Energy-efficient Buildings and Smart Cities: Passive design, daylighting, automation	1
	Module 2: Renewable Energy Technologies	**6**
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**
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**
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 (CO 1)

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 marks)
   (b) Explain the significance of energy conservation in the Indian context. (5 marks)

OR

6. (a) Describe energy auditing and mention any two efficiency improvement techniques. (5 marks)
   (b) What is the role of energy-efficient buildings in smart city development? (4 marks)

7. (a) Explain the working principle of wind turbines with a neat diagram. (5 marks)
   (b) Describe any two advanced renewable energy technologies. (4 marks)

OR

8. (a) Discuss the types and role of energy storage systems in renewable energy. (5 marks)
   (b) Explain the concept of smart grid integration. (4 marks)

9. (a) What are the major environmental impacts of energy consumption? (4 marks)
   (b) Explain physical, chemical, and biological methods of water pollution control. (6 marks)

OR

10. (a) Describe the working of waste-to-energy technologies. (5 marks)
    (b) List and briefly explain any two environmental regulations in India. (5 marks)

11. (a) Define sustainable development and explain its principles. (4 marks)
    (b) What are carbon credits and how do they promote sustainability? (6 marks)

OR

12. (a) Explain the key phases of Life Cycle Assessment (LCA). (5 marks)
    (b) What is the importance of green buildings and certification systems in achieving sustainable urban infrastructure? (5 marks)

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MINOR

B24EEM31	CIRCUIT THEORY	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to equip students with a comprehensive understanding of circuit analysis, focusing on both time-domain and frequency-domain methods, as well as the application of Laplace transforms in solving complex electrical circuits. The course covers key topics such as DC and AC circuit analysis, coupled circuits, resonance, and two-port networks. Upon completion, students will be capable of analyzing and solving electrical circuits and applying network analysis methods to real-world electrical engineering problems.

Prerequisites

Basics of Electrical Engineering/Fundamentals of Electrical Engineering, Ordinary Differential Equations and Transforms.

Course Outcomes

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

CO 1	Apply the circuit theorems of electrical engineering to solve DC and AC circuits in steady-state. (Cognitive Knowledge Level: Apply)
CO 2	Solve electric circuits under various switching conditions to determine transient and steady-state behavior in the time domain. (Cognitive Knowledge Level: Apply)
CO 3	Apply and solve first and second-order DC and AC circuits using Laplace transforms, considering various initial conditions. (Cognitive Knowledge Level: Apply)
CO 4	Solve coupled circuits with sinusoidal excitation and analyze resonance in RLC circuits. (Cognitive Knowledge Level: Apply)
CO 5	Evaluate parameters of two-port networks and use transformations to solve network 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	3	3	1	1		1	1		1	1	3	2
CO 2	3	3	1	3		1	1		1	1	3	2
CO 3	3	3	1	1	1	1	1		1	1	3	2
CO 4	3	3	1	1	1	1	1		1	1	1	2
CO 5	3	3	2	1	3	1	1		1	1	1	2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (% Marks)	**Test 2 (% Marks)**	
Remember	20	20	10
Understand	40	40	40
Apply	40	40	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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

Circuit Theorems

DC and sinusoidal steady state analysis of circuits with dependent and independent sources applying superposition principle, source transformation, Thevenin's theorem, Norton's theorem, maximum power transfer theorems, and Reciprocity theorem.

MODULE 2 (9 hours)

Time Domain Analysis of First and Second-Order Circuits

Behaviour of R, L, C under switching conditions, time domain analysis of simple RL, RC, RLC series and parallel networks with excitation and initial conditions - Transient and steady-state response - time constant - underdamped, critically damped, overdamped and undamped RLC network

MODULE 3 (9 hours)

Circuit Analysis in the Frequency Domain

Review of Laplace transform. S-domain Analysis of Circuits - Solution of simple RL, RC, and RLC DC networks using Laplace Transforms, transformed equivalent of resistance, inductance, and capacitance - concept of the transformed circuit in s-domain.
AC circuit analysis in the frequency domain - Solution of RL, RC, and RLC circuits with sinusoidal excitation using Laplace Transforms, transformed circuits in s-domain.

MODULE 4 (9 hours)

Coupled Circuits

Conductively coupled circuits and mutual impedance - mutual inductance, dot polarity convention, coefficient of coupling - series and parallel coupled circuits, analysis of coupled circuits in s-domain.

Resonance in RLC Circuits

Resonance in series RLC circuits - impedance, phase angle, current, voltage, bandwidth, quality factor. Parallel resonance circuits (Concept only), resonant frequency for a tank circuit.

MODULE 5 (9 hours)

Two Port Networks

One-port network, two-port networks - Characterization in terms of impedance (Z), admittance (Y), hybrid (h) and transmission (T) parameters - conditions for symmetry and reciprocity of two-port networks, interconnection of two-port networks - series, parallel, and cascade, T-π representations, and transformation.

Text Books

1. Hayt W. H., Kemmerly J. E., and Durbin S. M., *Engineering Circuit Analysis*, Tata McGraw Hill, 10th ed., 2023.
2. K. S. Suresh Kumar, *Electric Circuit Analysis*, Pearson Publications, 2nd ed., 2020.
3. Alexander and Sadiku, *Fundamentals of Electric Circuits*, McGraw-Hill, 6th ed., 2021.
4. Allan H. Robbins, Wilhelm C. Miller, *Circuit Analysis: Theory and Practice*, Cengage Learning, 5th ed., 2016.

Reference Books

1. Joseph A. Edminister and Mahmood Nahvi, *Theory and Problems in Electric circuits*, McGraw Hill, 5th ed., 2010.
2. A. Sudhakar, Shyammohan S Palli, *Circuits and Networks*, McGraw Hill, 4th ed., 2019.
3. Van Valkenberg, *Network Analysis*, Prentice Hall India Learning Pvt. Ltd., 3rd ed., 2018.
4. Chakrabarti, *Circuit Theory Analysis and Synthesis*, DhanpatRai and Co., 7th ed., 2021.
5. R. Gupta, *Network Analysis and Synthesis*, S. Chand and Company Ltd, 2nd ed., 2020.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Circuit Theorems	**9**
1.1	Linearity and Superposition principle - Application to the analysis of DC and AC (sinusoidal excitation) circuits. Application of source transformation in electric circuit analysis	2
1.2	Thevenin's theorem - Application to the analysis of DC circuits	1
1.3	Thevenin's theorem - Application to the analysis of AC circuits	1
1.4	Norton's theorem - Application to the analysis of DC circuits	1
1.5	Norton's theorem - Application to the analysis of AC circuits	1
1.6	Maximum power transfer theorem - DC and AC steady state analysis with dependent and independent sources.	2
1.7	Reciprocity Theorem - Application to the analysis of DC and AC Circuits.	1
	Module 2: Time Domain Analysis of First and Second-Order Circuits	**9**
2.1	Behaviour of R, L, C under switching conditions	1
2.2	Time domain analysis of simple RL series and parallel networks with excitation and initial conditions	1
2.3	Time domain analysis of simple RC series and parallel networks with excitation and initial conditions	1
2.4	Time domain analysis of simple RLC series and parallel networks with excitation and initial conditions	2
2.5	Transient and steady-state response - time constant	1
2.6	Underdamped and critically damped RLC network	1
2.7	Overdamped and undamped RLC network	2
	Module 3: Circuit Analysis in the Frequency Domain	**9**
3.1	Review of Laplace transform	1
3.2	Solution of simple RL DC networks using Laplace transforms	1
3.3	Solution of simple RC DC networks using Laplace transforms	1
3.4	Solution of simple RLC DC networks using Laplace transforms	1
3.5	Transformed equivalent of resistance, inductance, and capacitance - concept of the transformed circuit in s-domain	1

3.6	Solution of RL circuits with sinusoidal excitation using Laplace transforms	1
3.7	Solution of RC circuits with sinusoidal excitation using Laplace transforms	1
3.8	Solution of RLC circuits with sinusoidal excitation using Laplace transforms	1
3.9	Transformed circuits in s-domain	1
	Module 4: Coupled Circuits, Resonance in RLC Circuits	9
4.1	Conductively coupled circuits and mutual Impedance	1
4.2	Mutual inductance, dot polarity convention	1
4.3	Coefficient of coupling - series and parallel coupled circuits	1
4.4	Analysis of coupled circuits in s-domain	2
4.5	Resonance in series RLC circuits - impedance, phase angle, current, voltage, bandwidth, quality factor	2
4.6	Parallel resonance circuits (Concept only), resonant frequency for a tank circuit	2
	Module 5: Two-port Networks	**9**
5.1	One-port network, two-port networks	1
5.2	Characterization in terms of impedance (Z) and admittance (Y) parameters	2
5.3	Characterization in terms of hybrid (h) and transmission (T) parameters	2
5.4	Conditions for symmetry and reciprocity of two-port networks	1
5.5	Interconnection of two-port networks series and parallel networks	1
5.6	Interconnection of two-port networks cascade networks	1
5.7	T-π representations and transformation	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. State and explain network theorems.
2. Problems on solving circuits using network theorems.
3. Apply source transformation to analyze a circuit.

Course Outcome 2 (CO 2)

1. Distinguish between the natural response and forced response.
2. Problems related to steady state and transient analysis of RL, RC, and RLC series circuits with DC excitation and initial conditions.
3. Problems related to steady state and transient analysis of RL, RC, and RLC series circuits with sinusoidal excitation.

Course Outcome 3 (CO 3)

1. Problems related to mesh analysis of transformed circuits in the s-domain.
2. Problems related to node analysis of transformed circuits in the s-domain.
3. Problems on transformed circuits in the s-domain.

Course Outcome 4 (CO 4)

1. Problems related to solutions of transformed circuits, including mutually coupled circuits in the s-domain.
2. Develop the impedance/admittance Vs frequency plot for the given RLC network.
3. Evaluate the parameters such as quality factor, bandwidth.

Course Outcome 5 (CO 5)

1. Problems to find Z, Y, h, and T parameters of simple two-port networks.
2. Derive the expression for Z parameters in terms of T parameters.
3. Show that the overall transmission parameter matrix for the cascaded two-port network is simply the matrix product of transmission parameters for each individual two-port network in cascade.

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: : B24EEM31

Course Name: : CIRCUIT THEORY

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. State and explain Norton's theorem.
2. Three resistors, 20 Ω, 90 Ω, and 10 Ω, are star-connected. Obtain the equivalent delta circuit.
3. Develop s-domain equivalent circuit of an inductor having an initial current of Io.
4. Define Damping ratio. Draw the transient response of a second-order system for various values of the damping ratio.
5. A voltage of v(t) = 10 cos(1000t + 60) is applied to a series RLC circuit in which R=10 Ω, L=0.02 H and C=10^{-4} F. Find the steady current.
6. Find the transform representation in the s-domain of an inductor with initial current and the transform representation in the s-domain of a capacitor with initial voltage.
7. Compare series and parallel resonance on the basis of resonant frequency, impedance, and bandwidth.
8. Two inductively coupled coils have self inductances L1 = 50 mH and L2 = 200 mH. If the coefficient of coupling is 0.5 (a), find the value of mutual inductance between the coils, and (b) what is the maximum possible mutual inductance?
9. What are the conditions for reciprocity of a two-port network in terms of Z parameters? What are the similar conditions in terms of y parameters?

10. How do we find equivalent T network of a two port network if z parameters are given?

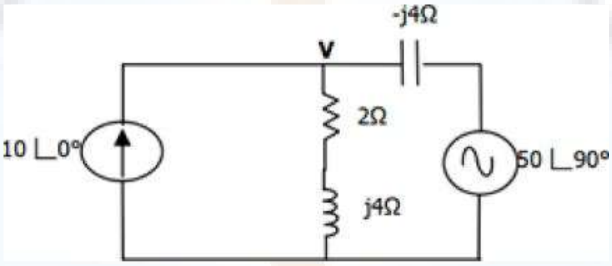
PART B

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

11. (a) State and explain the Reciprocity theorem with an example. (6 marks)
    (b) State and prove the maximum power transfer theorem. (8 marks)

OR

12. (a) Use the superposition theorem to find the voltage V shown in the figure. (8 marks)



    (b) State Thevenin's theorem. How is Thevenin equivalent circuit developed? (6 marks)

13. Derive the dynamic equations for analyzing the behavior of step response of a series RLC circuit.

(14 marks)

OR

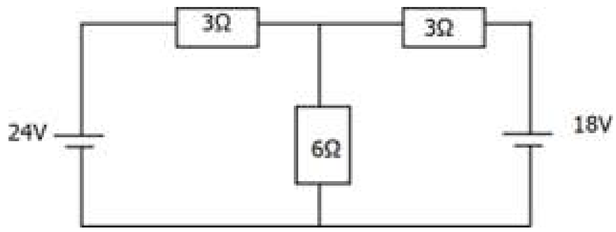
14. A capacitor C having capacitance of 0.2 F is initially charged to 10 volts and it is connected to an RL series circuit comprising of R=4Ω and L = 1 H, by means of a switch at time t=0. Find the current through the circuit by means of Laplace transformation method. (14 marks)

15. (a) An LC network comprises of series inductor branches L1 and L2 each of inductance 2 H and parallel capacitor branches C1 and C2 each with capacitance 1 F. Find the transform impedance Z(s). (6 marks)
    (b) What are reciprocal networks? What are the conditions that should be satisfied by a network to be reciprocal? (8 marks)

OR

16. (a) How is transfer function representation of a network function helpful in analyzing the behavior of the network? Mention the significance of poles and zeros in network functions?

(8 marks)



(b) Using Laplace transformation, find the current in the 6 Ω resistor. (6 marks)

17. (a) In a series RLC circuit, for frequencies more than the resonant frequency, what nature of reactance is exhibited? Substantiate the reason for the answer. (6 marks)

    (b) A series RLC circuit consists of R= 25 Ω, L = 0.01 H, C = 0.04 µF. Calculate the resonant frequency. If 10 V is applied to the circuit at resonant frequency, calculate the voltages across L and C. Find the frequencies at which these voltages are maximum. (8 marks)

OR

18. (a) A coil of resistance 20 ohm and inductance of 200 mH is connected in parallel with a variable capacitor. This combination is connected in series with a resistance of 8000 ohm.Supply voltage is 200 V, 50Hz. Calculate The value of C at resonance, The Q of the coil, Dynamic resistance of the circuit. (7 marks)

    (b) Derive expressions for selectivity and bandwidth of a parallel tuned circuit. (7 marks)

19. A two-port network has the following z parameters: $z_{11} = 10\ \Omega$, $z_{12} = z_{21} = 5\ \Omega$, $z_{22} = 12\ \Omega$. Evaluate the y parameters for the network. (14 marks)

OR

20. A symmetrical T-network has the following open-circuit and short-circuit impedances: $Z_{oc} = 800\ \Omega$ (open circuit impedance) $Z_{sc} = 600\ \Omega$ (short circuit impedance). Calculate impedance values of the network. (14 marks)

B24EEM32	ELECTRIC CIRCUITS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to equip students with a comprehensive understanding of circuit analysis, focusing on both time-domain and frequency-domain methods, as well as the application of Laplace transforms in solving complex electrical circuits. The course covers key topics such as DC and AC circuit analysis, three-phase systems, and two-port networks. Upon completion, students will be capable of analyzing and solving electrical circuits and applying network analysis methods to real-world electrical engineering problems.

Prerequisites

Basics of Electrical Engineering/Fundamentals of Electrical Engineering, Ordinary Differential Equations and Transforms.

Course Outcomes

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

CO 1	Apply the circuit theorems of electrical engineering to solve DC circuits in steady-state. (Cognitive Knowledge Level: Apply)
CO 2	Solve electric circuits under various switching conditions to determine transient and steady-state behavior in the time domain. (Cognitive Knowledge Level: Apply)
CO 3	Apply and solve first and second-order DC and AC circuits using Laplace transforms, considering various initial conditions. (Cognitive Knowledge Level: Apply)
CO 4	Analyze balanced and unbalanced 3-phase star-connected and delta-connected systems. (Cognitive Knowledge Level: Apply)
CO 5	Evaluate parameters of two-port networks and use transformations to solve network 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	3	3		2		1	1	1	1	1		1
CO 2	3	3	3	2		1	1	1	1	1		1
CO 3	3	3		2		1	1	1	1	1		1
CO 4	3	3		2	1	1	1	1	1	1		1
CO 5	3	3	3	2	1	1	1	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	10
Understand	40	40	40
Apply	40	40	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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

DC Circuit Analysis and Theorems

Review of mesh analysis. Nodal voltage analysis of circuits containing resistors and independent sources. Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, and Reciprocity theorem (with independent sources only).

MODULE 2 (9 hours)

Time Domain Analysis of First and Second-Order Circuits

Behaviour of R, L, C under switching conditions, time domain analysis of simple RL, RC, RLC series and parallel networks with excitation and initial conditions - Transient and steady-state response - time constant - underdamped, critically damped, overdamped and undamped RLC network

MODULE 3 (9 hours)

Circuit Analysis in the Frequency Domain

Review of Laplace transform. S-domain Analysis of Circuits - Solution of simple RL, RC, and RLC DC networks using Laplace Transforms, transformed equivalent of resistance, inductance, and capacitance - concept of the transformed circuit in s-domain.
AC circuit analysis in the frequency domain - Solution of RL, RC, and RLC circuits with sinusoidal excitation using Laplace Transforms, transformed circuits in s-domain.

MODULE 4 (9 hours)

Three-phase Networks

Three phase power in sinusoidal steady state-complex power, apparent power and power triangle. Steady state analysis of three-phase, three-wire and four-wire balanced and unbalanced Y circuits, Balanced and unbalanced Δ circuit. Three phase power measurement and two-wattmeter method.

MODULE 5 (9 hours)

Two Port Networks

One-port network, two-port networks - Characterization in terms of impedance (Z), admittance (Y), hybrid (h) and transmission (T) parameters - conditions for symmetry and reciprocity of two-port networks, interconnection of two-port networks - series, parallel, and cascade, T- representations and transformation.

Text Books

1. Hayt W. H., Kemmerly J. E., and Durbin S. M., *Engineering Circuit Analysis*, Tata McGraw Hill, 10th ed., 2023.

2. K. S. Suresh Kumar, *Electric Circuit Analysis*, Pearson Publications, 2nd ed., 2020.

3. Alexander and Sadiku, *Fundamentals of Electric Circuits*, McGraw-Hill, 6th ed., 2021.

4. Allan H. Robbins, Wilhelm C. Miller, *Circuit Analysis: Theory and Practice*, Cengage Learning, 5th ed., 2016.

Reference Books

1. Joseph A. Edminister and Mahmood Nahvi, *Theory and Problems in Electric circuits*, McGraw Hill, 5th ed., 2010.

2. A. Sudhakar, Shyammohan S Palli, *Circuits and Networks*, McGraw Hill, 4th ed., 2019.

3. Van Valkenberg, *Network Analysis*, Prentice Hall India Learning Pvt. Ltd., 3rd ed., 2018.

4. Chakrabarti, *Circuit Theory Analysis and Synthesis*, DhanpatRai and Co., 7th ed., 2021.

5. R. Gupta, *Network Analysis and Synthesis*, S. Chand and Company Ltd, 2nd ed., 2020.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: DC Circuit Analysis and Theorems	**9**
1.1	Review of mesh analysis	1
1.2	Nodal voltage analysis of circuits containing resistors and independent sources	2
1.3	Superposition theorem - application to the analysis of DC circuit with independent sources	2
1.4	Thevenin's theorem, Norton's theorem - application to the analysis of DC circuits with independent sources.	2
1.5	Maximum Power Transfer theorem, and Reciprocity theorem - application to the analysis of DC circuits with independent sources	2
	Module 2: Time Domain Analysis of First and Second-Order Circuits	**9**
2.1	Behaviour of R, L, C under switching conditions	1
2.2	Time domain analysis of simple RL series and parallel networks with excitation and initial conditions	1
2.3	Time domain analysis of simple RC series and parallel networks with excitation and initial conditions	1
2.4	Time domain analysis of simple RLC series and parallel networks with excitation and initial conditions	2
2.5	Transient and steady-state response - time constant	1
2.6	Underdamped and critically damped RLC network	1
2.7	Overdamped and undamped RLC network	2
	Module 3: Circuit Analysis in the Frequency Domain	**9**
3.1	Review of Laplace transform	1
3.2	Solution of simple RL DC networks using Laplace transforms	1
3.3	Solution of simple RC DC networks using Laplace transforms	1
3.4	Solution of simple RLC DC networks using Laplace transforms	1
3.5 3.6	Transformed equivalent of resistance, inductance, and capacitance - concept of the transformed circuit in s-domain Solution of RL circuits with sinusoidal excitation using Laplace transforms	1 1
3.7	Solution of RC circuits with sinusoidal excitation using Laplace transforms	1
3.8	Solution of RLC circuits with sinusoidal excitation using Laplace transforms	1
3.9	Transformed circuits in s-domain	1
	Module 4: Three-phase Networks	**9**

4.1	Three phase power in sinusoidal steady state-complex power, apparent power and power triangle.	2
4.2	Steady state analysis of three-phase three-wire and four-wire balanced and unbalanced Y circuits	3
4.3	Steady state analysis of three-phase three-wire and four-wire Balanced and unbalanced Delta circuit.	2
4.4	Three phase power measurement and two-wattmeter method.	2
	Module 5: Two-port Networks	**9**
5.1	One-port network, two-port networks	1
5.2	Characterization in terms of impedance (Z) and admittance (Y) parameters	2
5.3	Characterization in terms of hybrid (h) and transmission (T) parameters	2
5.4	Conditions for symmetry and reciprocity of two-port networks	1
5.5	Interconnection of two-port networks series and parallel networks	1
5.6	Interconnection of two-port networks cascade networks	1
5.7	T-π representations and transformation	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. State and explain the network theorems.
2. Problems on solving circuits using network theorems.

Course Outcome 2 (CO 2)

1. Difference between under-damped, critically damped, and over-damped RLC circuits.
2. Problems on time domain analysis of RL, RC, and RLC series and parallel circuits.

Course Outcome 3 (CO 3)

1. Distinguish between the natural response and forced response.
2. Problems on steady state and transient analysis of RL, RC, and RLC series circuits with DC and sinusoidal excitation.

Course Outcome 4 (CO 4)

1. Problems on the analysis of balanced star and delta configurations.
2. Problems on analysis of unbalanced star and delta configurations.

Course Outcome 5 (CO 5)

1. Problems on finding Z and Y parameters of simple two-port networks.
2. Problems on finding h parameters and transmission parameters in two-port networks.

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: B24EEM32

Course Name: ELECTRIC CIRCUITS

Max. Marks: 100 Duration: 3 hours

PART A

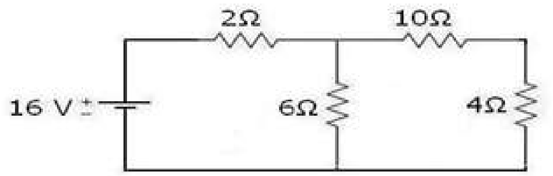
Answer all questions. Each question carries 3 marks.

1. Compare the analogy between the Nodal and Mesh analysis methods.
2. State and explain the superposition theorem with suitable examples
3. Differentiate between under-damped and over-damped RLC network.
4. Differentiate between transient and steady state analysis.
5. Explain the initial value and final value theorem.
6. How do you transform sources in the s-domain?
7. Define the terms, real power, reactive power,star-connected three-phase, and apparent power.
8. Draw the circuit of a four-wire star connected three phase circuit and mark the line and phase voltage.
9. Explain the condition for symmetry and reciprocity with respect to Z-parameters.
10. Draw the equivalent circuit representation in terms of h-parameters.

PART B

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

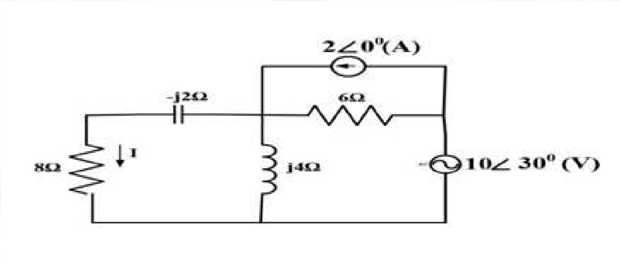
11. (a) Draw the Thevenin's equivalent circuit and hence find the power dissipated across R_L. (10 marks)



(b) Compare the difference between dependent and independent sources. (4 marks)

OR

12. (a) Determine the power dissipated across 8 Ω for the circuit shown by applying the Superposition theorem. (10 marks)



(b) State and explain Maximum power transfer theorem. (4 marks)

13. (a) An RLC circuits consists of a resistor R= 20Ω, L= 0.5H and a capacitor C= 0.1 F a step voltage of 10V is applied at t=0. Find the natural response of the circuit, including the characteristic equation, roots, and general solution. (9 marks)

(b) Derive the expression for the time constant of an RL circuit. (5 marks)

OR

14. (a) A RC circuit consists of a resistor R=10 Ω and L=1 H. If a step voltage of 5 V is applied at t=0, find the energy stored in the inductor at t=0.5 s. (7 marks)

(b) Explain the role of damping in RLC circuits. (7 marks)

15. (a) The current through 5 Ω resistor is I(s) =(5s+3)/(s^2+5s+6). Find the power dissipated across the 5 Ω resistor. (7 marks)

(b) Derive the equation for the transient current flow through a series RL circuit with a DC source and zero initial condition in the s-domain. (7 marks)

OR

16. (a) Derive the equation for the transient current flow through series RC circuit with DC source and zero initial condition in s-domain. (7 marks)

(b) Explain the term time constant with respect to series RL circuit with suitable figures. (7 marks)

17. (a) Explain two watt-meter method to measure the three phase power with the help of suitable equations. (7 marks)

(b) Derive the relationship between the line and phase voltage in a three-phase star-connected circuit. (7 marks)

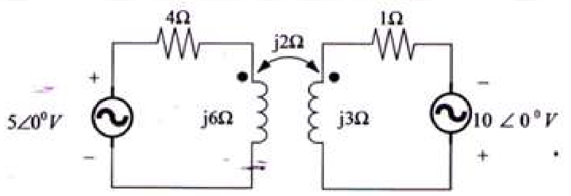
OR

18. (a) A three-phase, three-wire, balanced, delta-connected load yields wattmeter readings of 154 W and 557 W. Obtain the load impedance if the line voltage is 141.4 V. (7 marks)

(b) Derive the relationship between the line and phase current of a three-phase delta-connected circuit (7 marks)

19. (a) Derive the relationship between h and transmission parameters. (6 marks)

(b) Find the Z-parameters of the two-port circuit. (8 marks)



OR

20. (a) Explain Y parameters with its equivalent circuit representation. (10 marks)

(b) Differentiate driving point and transfer functions with respect to a two-port network.

(4 marks)

<table>
<tr><td rowspan="2">B24EEM33</td><td rowspan="2">INTRODUCTION TO POWER ENGINEERING</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>
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Preamble

This course aims to give students a comprehensive understanding of power generation, transmission, and distribution systems, focusing on various conventional and modern technologies. It provides an overview of key topics such as hydroelectric, steam, diesel, gas turbine, and nuclear power plants, the economics of power generation, transmission system design, AC and DC distribution systems, and the introduction to smart grids. Upon successful completion, students will gain a solid foundation in power generation technologies, electrical transmission, distribution systems, and smart grid concepts, equipping them with the skills to analyse, design, and optimize electrical power systems efficiently.

Prerequisites

Basics of Electrical Engineering/Fundamentals of Electrical Engineering

Course Outcomes

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

CO 1	Understand the various conventional sources of energy generation. (Cognitive Knowledge Level: Understand)
CO 2	Understand the economics of power generation and power factor improvement. (Cognitive Knowledge Level: Understand)
CO 3	Design mechanical parameters of a transmission system. (Cognitive Knowledge Level: Apply)
CO 4	Design electrical parameters of a transmission system. (Cognitive Knowledge Level: Apply)
CO 5	Classify and analyse different types of AC and DC distribution systems and smart grid concepts. (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	1				1
CO 2	3	3	1	1		1	1	1				1
CO 3	3	3	1	1		1	1	1				1
CO 4	3	3	1	1		1	1	1				1
CO 5	3	3	1	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

noindent There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

Generation of Power

Conventional sources: Hydroelectric power plants - selection of site. General arrangement of the hydel plant, components of the plant, classification of the hydel plants. Water turbines - Pelton wheel, Francis, Kaplan, and propeller turbines, small hydro generation.
Steam power plants - Working of steam plant, power plant equipment, and layout, steam turbines.
Diesel power plant - Elements of diesel power plant, applications.
Gas Turbine Power Plant - Introduction merits and demerits, selection site, fuels for gas turbines, general arrangement of simple gas turbine power plant, comparison of gas power plant with steam power plants.
Nuclear Power Plants - Nuclear reaction, nuclear fission process, nuclear plant layout, classification of reactors.

MODULE 2 (8 hours)

Economics of Power Generation

Types of loads, load curve, terms and factors, peak load and base load, cost of electrical energy, numerical problems.
Power factor improvement - causes of low power factor, disadvantages, methods of power factor improvement, calculations of power factor correction, economics of power factor improvement.

MODULE 3 (10 hours)

Transmission System

Different types of transmission systems - High voltage transmission - advantages.
Mechanical design of overhead transmission line: Main components of overhead lines, types of conductors, line supports.
Insulators - types, string efficiency, methods of improving string efficiency, numerical problems.
Corona - Critical disruptive voltage, visual critical voltage, corona loss, factors affecting corona, advantages and disadvantages, methods of reducing corona - numerical problems (Derivations not required).
Sag and tension - calculation - supports are at equal levels - effect of ice and wind loading - numerical problems (Derivations not required).

MODULE 4 (9 hours)

Electrical Design of Transmission Line

Constants of transmission line – Resistance, inductance, and capacitance.
Inductance of a single-phase transmission line, capacitance of a single-phase transmission line, inductance of a three-phase transmission line, capacitance of a three-phase transmission line - numerical Problems (For symmetrical and transposed lines, Effect of earth neglected, numerical problems, Derivations not required).

MODULE 5 (9 hours)

Distribution Systems and Smart Grid

Introduction to distribution system - Types, Feeder, Distributor, Service mains.
Types of DC distributors - distributor fed at one end and at both ends - concentrated loading only, numerical problems.
Types of AC distributors - power factor referred to sending end voltage - power factor referred to respective load voltage - numerical problems.
Smart Grid - Introduction - challenges and benefits, architecture of smart grid.

Text Books

1. D. P. Kothari and I. Nagrath, *Power System Engineering*, Tata McGraw Hill, 3rd ed., 2019.
2. C. L. Wadhwa, *Electrical Power system*, New Age International Publishers, 7th ed., 2017.
3. V. K. Mehta, Rohith Mehta, *Principles of Power System*, S. Chand and Company Ltd, 4th revised ed., 2022.
4. Gupta J. B., *Transmission and Distribution of Electrical Power,* S. K. Kataria and Sons, 2009.

Reference Books

1. A. Chakrabarti, M. L. Soni, P. V. Gupta, V. S. Bhatnagar, *A text book of Power system Engineering*, Dhanpat Rai, 2000
2. Grainer J. J, Stevenson W. D., *Power system Analysis*, McGraw Hill Education, 1st ed., 2017.
3. Stuart Borlase, *Smart Grids, Infrastructure, Technology and Solutions*, CRC Press, 2013.
4. S. Pabla, *Electric Power Distribution*, 7th ed., Tata McGraw Hill Publication, 2019.
5. Uppal S. L. and S. Rao, *Electrical Power Systems*, Khanna Publishers, 19th reprint, 2024.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Conventional Energy Sources	**9**
1.1	Introduction and history of power generation	1
1.2	Hydel power plant - schematic, components	1
1.3	Hydel power plant - turbines	1
1.4	Steam power plant - schematic, components	1
1.5	Steam power plant - turbines	1
1.6	Diesel power plant: Elements of diesel power plant, applications	1
1.7	Gas Turbine Power Plant: Introduction, merits and demerits, selection site, fuels for gas turbines	1
1.8	General arrangement of simple gas turbine power plant, comparison of gas power plant with steam power plants	1
1.9	Nuclear power generation - Nuclear reaction, nuclear fission process, nuclear plant layout, classification of reactors	1
	Module 2: Economics of Power Generation and Power Factor Improvement	**8**
2.1	Introduction - Important terms associated with power generation such as maximum demand, load factor	1
2.2	Numerical problems on the economics of generation	1
2.3	Load curve and load duration curve	1
2.4	Problems on load curve and load duration curve	1
2.5	Significance of power factor in power system, methods of power factor improvement	1
2.6	Numerical problems on capacitor value evaluation and power factor improvement	1
2.7	Economics of power factor improvement	1
2.8	Numerical problems	1
	Module 3: Transmission System	**10**
3.1	Different types of transmission system - High voltage transmission – advantages	1
3.2	Mechanical design of overhead transmission line: Main components of overhead lines – types of conductors, line supports	1
3.3	Insulators - Types, String efficiency	1
3.4	Methods of improving string efficiency	1
3.5	Numerical problems	1
3.6	Corona – Critical disruptive voltage, visual critical voltage, corona loss (Derivations not required)	1
3.7	Factors affecting corona, advantages and disadvantages, methods of reducing corona	1

3.8	Numerical problems	1
3.9	Sag and tension - calculation - supports are at equal levels - effect of ice and wind loading	1
3.10	Numerical problems	1
	Module 4: Electrical Parameters of a Transmission Line	**9**
4.1	Constants of transmission line – Resistance, inductance, and capacitance, skin effect, proximity effect	1
4.2	Inductance of a single-phase transmission line	1
4.3	Numerical problems	1
4.4	Capacitance of a single phase transmission line (Effect of earth neglected)	1
4.5	Numerical problems	1
4.6	Inductance of a three-phase transmission line with symmetrical spacing, transposition of lines (Derivations not required)	1
4.7	Numerical problems	1
4.8	Capacitance of a three-phase transmission line with symmetrical spacing- transposition of lines (Derivations not required)	1
4.9	Numerical problems	1
	Module 5: Distribution Systems and Smart Grid	**9**
5.1	Introduction to distribution system - Types	1
5.2	Feeder, Distributor, Service mains	1
5.3	DC distribution system - various types, distributor fed at one end	1
5.4	Distributor fed at both ends	1
5.5	Numerical problems on DC distributor	1
5.6	AC distribution system various types - power factor referred to sending end voltage	1
5.7	Power factor referred to respective load voltages	1
5.8	Numerical problems	1
5.9	Smart grid - Introduction - challenges and benefits - architecture of smart grid	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Schematic and equipment of Conventional Power generation schemes.
2. Comparison of various turbines associated with conventional generation.
3. What are the methods employed for improving efficiency of thermal power plant?

Course Outcome 2 (CO 2)

1. Definition and Calculation of various terms associated with power generation.
2. Problems on the economics of power generation and power factor improvement.
3. Methods of improving power factor.

Course Outcome 3 (CO 3)

1. Mechanical design of transmission lines.
2. Problems of corona, sag, and insulators.
3. What are the critical voltages in the formation of Corona? What is the effect of Corona?

Course Outcome 4 (CO 4)

1. Problems on inductance of transmission lines.
2. Problems on capacitance of transmission lines.
3. Definition on transposition of line and changes in electrical parameters.

Course Outcome 5 (CO 5)

1. Problems on DC distribution systems.
2. Problems on AC distribution systems.
3. Architecture and technologies in smart grid.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg. No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24EEM33

Course Name: INTRODUCTION TO POWER ENGINEERING

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Illustrate the environmental factors affecting hydel energy generation.
2. How are turbines classified? How is a turbine selected for a site?
3. Explain the significance of load factor and load curve.
4. Discuss the disadvantages of low power factor in power system.
5. What is corona? Explain the factors have an influence on corona loss.
6. Describe the merits of high voltage transmission.
7. Illustrate skin effect in transmission line.
8. Explain transposition of lines. Comment on its necessity in the system.
9. Discuss the requirements of a distribution system.
10. Distinguish between feeder, distributor, and service mains.

PART B

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

11. (a) Explain the general arrangement of gas turbine power plant. (8 marks)
    (b) Describe the importance of small hydro power generation along with their advantages and disadvantages. (6 marks)

OR

12. (a) With the help of a block diagram, illustrate the working of a nuclear power plant. (14 marks)

13. A generating station has the following daily load cycle:

Time (Hours)	0-6	6-10	10-12	12-16	16-20	20-24
Load (MW)	40	50	60	50	70	40

Draw the load curve and calculate (i) Units generated per day (ii) Average load and (iii) load factor. (14 marks)

OR

14. Illustrate the various methods of power factor improvement with suitable sketches. (14 marks)

15. (a) Derive the equation for Sag in transmission lines, when the support is at equal heights. (8 marks)
    (b) Discuss the difference between disruptive critical corona and visual critical corona. (6 marks)

OR

16. (a) In a 33 kV overhead line, there are three units in the string of insulators. If the capacitance between each insulator pin and earth is 11% of the self-capacitance of each insulator, find (i) the distribution of voltage over 3 insulators and (ii) string efficiency. (9 marks)
    (b) Illustrate various types of conductors used in power system. (5 marks)

17. (a) A 3-phase 70 km long transmission line has its conductors of 1 cm diameter spaced at the corners of the equilateral triangle of 100 cm side. Find the inductance per phase of the system. (6 marks)
    (b) Derive capacitance of a single-phase two wire transmission line. (8 marks)

OR

18. (a) The three conductors of a 3-phase line are arranged at the corners of a triangle of sides 2 m, 2.5 m, and 4.5 m. Calculate the inductance per km of the line when the conductors are regularly transposed. The diameter of each conductor is 1.24 cm. (6 marks)

(b) A single-phase transmission line has two parallel conductors 3 m apart, radius of each conductor being 1 cm. Calculate the capacitance of the line per km. (8 marks)

19. (a) Compare radial and ring main distribution system with the help of appropriate schematics. (6 marks)

(b) A two conductor main, AB, 500 m in length is fed from both ends at 250 V. Loads of 50 A, 60 A, 40 A and 30 A are tapped at distances of 100 m, 250 m, 350 m and 400 m from end A respectively. If the cross section of conductor is 1 cm^2 and specific resistance of material is 1.7 µΩ cm, determine the minimum consumer voltage. (8 marks)

OR

20. (a) A single-phase distributor one km long has resistance and reactance per conductor of 0.1 Ω and 0.15 Ω respectively. At the far end, the voltage $V_B = 200$ V and the current is 100 A at a pf of 0.8 lagging. At the mid-point M of the distributor, a current of 100 A is tapped at a pf of 0.6 lagging with reference to the voltage V_M at the mid-point. Calculate (i) voltage at mid-point (ii) sending end voltage V_A (iii) phase angle between V_A and V_B (9 marks)

(b) Outline the architecture of smart grid. (5 marks)

MAR ATHANASIUS COLLEGE OF ENGINEERING
Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER 4

SYLLABUS

SEMESTER 4

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T04A	STOCHASTIC PROCESSES AND NUMERICAL METHODS	3-1-0-3	4	4
B	B24EE2T05	SIGNALS AND SYSTEMS	2-2-0-2	4	3
C	B24EE2T06	POWER ELECTRONICS	3-1-0-3	4	4
D	B24EE2T07	ELECTROMAGNETIC THEORY	2-1-0-2	3	3
E	B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	3-0-0-3	3	3
F	B24EE2T08	MICROPROCESSORS AND MICROCONTROLLERS	2-2-0-2	4	4
G	B24EE2L05	ELECTRICAL MACHINES LAB I	0-0-3-3	3	2
H	B24EE2L06	ELECTRONIC CIRCUITS LAB II	0-0-3-3	3	2
M	B24EEM4X	MINOR	3-1-0-3	4	4
N	B24EEH4X	HONORS	2-2-0-2	4	4
			TOTAL*	36	25

*Total does not include the credits of honors and minor courses

MINOR

BASKET 1	
COURSE CODE	**COURSE**
B24EEM41	LINEAR CONTROL SYSTEMS
BASKET 2	
COURSE CODE	**COURSE**
B24EEM42	FUNDAMENTALS OF ELECTRICAL MACHINES
BASKET 3	
COURSE CODE	**COURSE**
B24EEM43	ENERGY STORAGE SYSTEMS

HONORS

BASKET 1	
COURSE CODE	**COURSE**
B24EEH41	NETWORK ANALYSIS AND SYNTHESIS
BASKET 2	
COURSE CODE	**COURSE**
B24EEH41	NETWORK ANALYSIS AND SYNTHESIS
BASKET 3	
COURSE CODE	**COURSE**
B24EEH41	NETWORK ANALYSIS AND SYNTHESIS

B24MA2T04A	STOCHASTIC PROCESSES AND NUMERICAL METHODS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble:

This course introduces students to the modern theory of probability and statistics, covering important models of random variables and analysis of random processes using appropriate time and frequency domain tools. A brief course in numerical methods familiarises students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

Prerequisites

Nil

Course Outcomes:

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

CO 1	Understand the concept, properties, and important models of discrete random variables and, using them, analyse suitable random phenomena. (Cognitive Knowledge Level: Apply)
CO 2	Understand the concept, properties, and important models of continuous random variables and, using them, analyse suitable random phenomena. (Cognitive Knowledge Level: Apply)
CO 3	Analyse stochastic processes using autocorrelation, power spectrum, and understand multivariable probability distribution. (Cognitive Knowledge Level: Apply)
CO 4	Compute roots of equations, evaluate definite integrals, and perform interpolation on given numerical data using standard numerical techniques. (Cognitive Knowledge Level: Apply)
CO 5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data, and solving ordinary differential equations. (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	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 contains 10 questions carrying 3 marks each. Part B contains 2 questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (8 hours)

Univariate Discrete Probability Distributions

Discrete random variables and their probability distributions, expectation, mean, and variance, binomial distribution, poisson distribution, poisson approximation to the binomial distribution.

MODULE 2 (8 hours)

Univariate Continuous Probability Distributions

Continuous random variables and their probability distributions, expectation, mean, and variance, uniform, exponential, and normal distributions and Central limit theorem (without proof).

MODULE 3 (11 hours)

Bivariate Probability Distribution and Stochastic Processes

Discrete bivariate distributions, marginal distributions, independent random variables, expectation (multiple random variables). Continuous bivariate distributions, marginal distributions, independent random variables, expectation (multiple random variables), i.i.d random variables. Random processes and classification, mean and autocorrelation, wide sense stationary (WSS) processes, autocorrelation and power spectral density of WSS processes and their properties.

MODULE 4 (9 hours)

Numerical Methods - I

Errors in numerical computation-round-off, truncation, and relative error, solution of equations - Newton-Raphson method. Interpolation - finite differences, Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method. Numerical integration - Trapezoidal rule and Simpson's 1/3rd rule. (Proof or derivation of the formulae not required for any of the methods in this module).

MODULE 5 (9 hours)

Numerical Methods - II

Solution of linear systems - Gauss-Seidel and Jacobi iteration methods. Curve fitting-method of least squares, fitting straight lines and parabolas. Solution of ordinary differential equations - Euler and Classical Runge-Kutta method of second and fourth order. (Proof or derivation of the formulae not required for any of the methods in this module).

Text Books

1. Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, Cengage, 8th ed., 2012.
2. Oliver C. Ibe, *Fundamentals of Applied Probability and Random Processes*, Elsevier, 2005.
3. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 10th ed., 2016.

Reference Books

1. Hossein Pishro-Nik, *Introduction to Probability, Statistics and Random Processes*, Kappa Research, 2014. (Also available online at www.probabilitycourse.com)
2. V. Sundarapandian, *Probability, Statistics and Queueing theory*, PHI Learning, 2009.
3. Gubner, *Probability and Random Processes for Electrical and Computer Engineers*, Cambridge University Press, 2006.
4. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 36th ed., 2010.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
1	**Module 1: Univariate Discrete Probability Distributions**	**8**
1.1	Discrete probability distributions	4
1.2	Binomial distribution - mean, variance, Poisson distribution - mean, variance, Poisson approximation to binomial	4
2	**Module 2: Univariate Continuous Probability Distributions**	**8**
2.1	Continuous random variables and probability distributions, expected value, mean and variance	3
2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Central limit theorem	1
3	**Module 3: Stochastic Processes**	**11**
3.1	Discrete bivariate distributions, marginal distributions, independence of random variables (discrete), expected values	2.5
3.2	Continuous bivariate distributions, marginal distributions, independent random variables, expected values	2.5
3.3	Random process - definition and classification, mean, autocorrelation	2
3.4	WSS processes its autocorrelation function and properties	2
3.5	Power spectral density	2
4	**Module 4: Numerical Methods-I**	**9**
4.1	Roots of equations - Newton-Raphson	2
4.2	Interpolation - finite differences, Newton's forward and backward formula	3
4.3	Newton's divided difference method, Lagrange's method	2
4.4	Numerical integration - Trapezoidal rule and Simpson's 1/3rd rule	2
5	**Module 5: Numerical Methods - II**	**9**
5.1	Solution of linear systems - Gauss-Seidel method, Jacobi iteration	2
5.2	Curve-fitting - fitting straight lines and parabolas to pairs of data points using method of least squares	2
5.3	Solution of ODE-Euler and Classical Runge-Kutta methods of second and fourth order	5

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. The probability that a batsman scores a century in a cricket match is $\frac{1}{3}$. Find the probability that out of 5 matches, he may score a century in (i) at least 2 matches (ii) at most 2 matches (iii) no match.
2. A random variable follows Poisson distribution such that $P(X = 0) = \frac{2}{3}P(X = 1)$ Find
   (a) P(X=1)
   (b) P(X>1)
3. Of all customers purchasing automatic garage-door openers, 75% purchase a chain-driven model. Let X the number among the next 15 purchasers who select the chain-driven model.
   (a) What is the pmf of X?
   (b) If the store currently has in stock 10 chain-driven models and 8 shaft-driven models, what is the probability that the requests of these 15 customers can all be met from existing stock?

Course Outcome 2 (CO 2)

1. The heights of adult men in a city are normally distributed with a mean $\mu = 70$ inches and a standard deviation $\sigma = 3$ inches. What is the probability that a randomly selected man is taller than 73 inches?
2. Assume that the time between arrivals of customers at a particular bank is exponentially distributed with a mean of 4 minutes
   (a) Find the probability that the time between arrivals is greater than 5 minutes.
   (b) Find the probability that the time between arrivals is between 1 and 4 minutes.
3. Derive the mean and variance of uniform distribution.

Course Outcome 3 (CO 3)

1. A random process $X(t)$ has a power spectral density given by

$$S_{XX}(\omega) = \begin{cases} 4 - \frac{\omega^2}{9}, & |\omega| \leq 6 \\ 0, & \text{otherwise} \end{cases}$$

   Determine the average power.

2. A random process $X(t)$ is given by $X(t) = Ycos(2\pi t)$, $t \geq 0$ where Y is a random variable that is uniformly distributed between 0 and 2. Find the expected value and auto correlation function of $X(t)$.

3. A random process $Y(t)$ is given by $Y(t) = Acos(\omega t + \phi)$ where A, ω, ϕ are independent variables. Assume that A has mean 3 and a variance of 9, ϕ is uniformly distributed between $-\pi$ and π, and ω is uniformly distributed between -6 and 6. Determine if the process is stationary in the wide sense.

Course Outcome 4 (CO 4)

1. Use Newton-Raphson method find correct to 4 decimals places, the root between 0 and 1 of the equation $x^3 - 6x + 4 = 0$.

2. A river is 80m wide. The depth y in meters at a distance x meters from one bank is given by the following table. Find approximately the area of cross section.

X	0	10	20	30	40	50	60	70	80
Y	0	5	8	10	15	12	7	3	1

3. Using Lagrange's interpolation formula, fit a polynomial to the given data.

X	1	2	7	8
Y	4	5	5	4

Course Outcome 5 (CO 5)

1. Solve the equations using Gauss elimination method.

   $x + 2y + z = 3$
   $2x + 3y + 2z = 5$
   $3x - 5y + 5z = 2$
   $3x + 9y - z = 4$

2. Obtain the value of y at $x = 0.2$ using Runge- Kutta method of fourth order for the differential equation $\frac{dy}{dx} = 1 + y^2$ with $h = 0.2$, $y(0) = 0$.

3. Write the normal equations for fitting the curve $y = a + bx^2$.

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: B24MA2T04A

Course Name: STOCHASTIC PROCESSES AND NUMERICAL METHODS
Common to EEE and ECE

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Determine the binomial distribution for which mean is 4 and variance is 3.
2. Suppose $E(X) = 5$ and $E[X(X-1)] = 25$. Find $E(X^2)$.
3. Derive the mean and variance of exponential distribution.
4. Find mean and variance of the Uniform distribution $f(x) = \frac{1}{10}$, $10 \leq x \leq 20$.
5. Define stationary random process. Define two types of stationary random process.
6. Write down the properties of the power spectral density.
7. Use trapezoidal rule to evaluate $\int_0^1 x^3$considering five subintervals.
8. Write the formula for finding $\sqrt{5}$ using Newton-Raphson's Method.
9. Using Euler's method, find $y(0.2)$ if $y' = x + y$, $y(0) = 1$.
10. Write the normal equations for fitting the curve $y = a + bx^2$.

PART B

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

11. (a) A car hire firm has 2 cars which it hires out day by day. The number of demands for a car on each day is distributed as a Poisson distribution with mean 2. Calculate the proportion of days on which (i) neither car is used (ii) some demand is refused. (7 marks)

    (b) Suppose that 20% of all copies of a particular textbook fail a certain binding 7 strength test. Let X denote the number among 15 randomly chosen copies that fail the test. Using the table of Binomial distributions or by direct calculation. 1) Find the probability that at most 8 will fail the test. 2) Find the probability that exactly 8 will fail the test. 3) Find the probability that at least 8 will fail the test. 4) Find the probability that failure is between 4 and 7 (inclusive). (7 marks)

OR

12. (a) The number of gamma rays emitted per second by a certain radioactive substance follows a Poisson distribution with mean 8. Determine the probability that (i) three particles are emitted in one second (ii) at most one particle is emitted in one second (iii) more than one particle is emitted in one second. (7 marks)

    (b) Derive the mean and variance of binomial distribution. (7 marks)

13. (a) The weight of certain brand of shampoo packets are uniformly distributed between 9.3 gm and 10.5 gm. In a random lot of 100 packets how many packets (i) exceed 10 gm (ii) are below 10.2 gm. (7 marks)

    (b) In a normal distribution 7% of the items are under 35 and 10% of the items are above 55. Calculate the mean and variance. (7 marks)

OR

14. (a) The time (in hours) required to repair a machine is exponentially distributed with mean 2. (i) What is the probability that the repairing time exceeds 2 hours? (ii) What is the conditional probability that a repair takes at least 10 hours given that its duration exceeds 9 hours? (7 marks)

    (b) The life time of a certain type of electric bulbs may be considered to follow exponential distribution with mean $50hrs$. Use central limit theorem to find the approximate probability that 100 of these electric bulbs will provide a total of more than $6000hrs$ of burning time. (7 marks)

15. (a) Verify whether X and Y are independent if $f(x, y) = 24xy$, $0 \leq X \leq 1$, $0 \leq Y \leq 1$, $X + Y \leq 1$. (7 marks)

    (b) Find the power spectral density function of the WSS process whose autocorrelation function is $e^{-\alpha\tau^2}$. (7 marks)

OR

16. (a) The power spectral density of a WSS process is $\dfrac{\omega^2+9}{\omega^4+5\omega^2+4}$. Find the auto-correlation function and power of the process.

(7 marks)

(b) The joint probability distribution of X and Y is given by $f(x,y) = \dfrac{2x+3y}{54}$, $X = 1, 2$; $Y = 1, 2, 3$. Find the marginal distributions of X and Y.

(7 marks)

17. (a) Use Lagrange's interpolation formula to find $y(2)$ from the following table

X	1	3	4
Y	1	27	64

(7 marks)

(b) Compute $y(13)$ using Newton's Backward difference formula, if given

X	3	6	9	12	15
Y	18	27	36	45	54

(7 marks)

OR

18. (a) Evaluate $\int_0^2 xe^x dx$ using Simpson's $\frac{1}{3}$rd rule with $n = 8$. (7 marks)

(b) The positive root of the equation $x^3 + x + 1 = 0$ using Newton-Raphson method correct to 4 decimal places.

(7 marks)

19. (a) Solve by Gauss-Seidel method the following system:

$28x + 4y - z = 32$
$x + 3y + 10z = 24$
$2x + 17y + 4z = 35$

(7 marks)

(b) Fit a straight line to the points (0,2), (2,0), (3, -2) , (5, -3) using method of least squares. (7 marks)

OR

20. (a) Apply Gauss-Seidel method to solve the equations

$20x + y - 2z = 17$
$3x + 20y - z = -18$
$2x - 3y + 20z = 25$ (7 marks)

(b) Solve using Runge-Kutta method of order 4: $y' = 8.5 - 20x + 12x^2 - 2x^3$, $y(0) = 1$ for $x = 0.5$ [Choose $h = 0.5$]. (7 marks)

B24EE2T05	SIGNALS AND SYSTEMS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	2	0	2	3	2024

Preamble

This course provides a comprehensive introduction to signals and systems, covering their classification, properties, and mathematical modeling. It explores frequency-domain analysis using Fourier and Laplace transforms, system modeling techniques, and discrete-time system characterization with Z-transforms. This course enhances the understanding of signals and systems, preparing students for careers in communication, control, and signal processing.

Prerequisites

Circuits and Networks.

Course Outcomes

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

CO 1	Understand the fundamental concepts of signals, their classifications, and basic operations on continuous-time and discrete-time signals. (Cognitive Knowledge Level: Understand)
CO 2	Analyze continuous time signals in the frequency domain using Fourier series and Fourier transforms, and interpret spectral properties. (Cognitive Knowledge Level: Apply)
CO 3	Model continuous-time LTI systems using differential equations, Laplace transforms, and block diagrams. (Cognitive Knowledge Level: Apply)
CO 4	Understand the process of sampling, and analyze discrete-time signals in the frequency domain. (Cognitive Knowledge Level: Apply)
CO 5	Model discrete-time LTI systems using difference equations, Z-transforms, and block diagrams. (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	2	1	1	1	1	1	1	1
CO 2	3	3	2	2	2	1	1	1	1	1	1	1
CO 3	3	3	2	2		1	1	1	1	1		1
CO 4	3	3	2	2	1	1	1	1	1	1		1
CO 5	3	3	2	2	2	1	1	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	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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (10 hours)

Introduction to Signals and Systems

Concept of signals - continuous and discrete-time signals - practical examples, elementary signals, classification of signals, basic operations on signals.
Concept of system - classification of systems, properties of systems - time invariance - linearity - causality - memory - stability, practical examples of LTI systems - electrical, mechanical, and thermal systems, step response, impulse response - convolution integral and convolution sum.

Use simulation software like MATLAB/Scilab to demonstrate elementary signals and its operations (Tutorial/Assignment only).

MODULE 2 (9 hours)

Frequency Domain Characterization of Continuous-time Signals and Systems

Fourier series - existence, harmonic analysis of common signals.
Fourier transform - existence, Fourier transform of common signals, properties of Fourier transform, energy spectral density, and power spectral density, concept of frequency response – magnitude response and phase response.

Use simulation software like MATLAB/Scilab to obtain Fourier Series/Transform of common signals (Tutorial/Assignment only).

MODULE 3 (9 hours)

Characterization and Modeling of Continuous-time LTI Systems

Review of Laplace transform. Differential equation representation of continuous-time LTI systems, transfer function representation of differential equation.
Modeling of LTI systems - electrical, and translational and rotational mechanical systems
Block diagram representation - open loop and closed loop systems, effect of feedback in systems, block diagram reduction, signal flow graph - Mason's gain formula.

MODULE 4 (9 hours)

Frequency Domain Characterization of Discrete-time Signals and Systems

Sampling process - impulse train sampling, sampling theorem - aliasing effect, signal reconstruction - zero order and first order hold circuits.
Discrete-time (DT) Fourier series - properties, discrete-time Fourier transform (DTFT) - properties, frequency response of simple DT systems - magnitude response and phase response.

MODULE 5 (9 hours)

Characterization and Modeling of Discrete-time LTI Systems

Z-transform - region of convergence, Z-transform of standard signals, properties of Z-transform, Inverse Z-transform - partial fraction method.
Difference equation representations of LTI systems - analysis, Z-transfer function - delay operator, block diagram representation - direct form, cascade and parallel representations of 2nd order systems.

Use simulation software like MATLAB/Scilab to obtain Z-transform of common signals (Tutorial/Assignment only).

Text Books

1. Simon Haykin, Barry Van Veen, *Signals and Systems*, Wiley, 2nd ed., 2007.
2. Oppenheim A.V., Willsky A.S. & Nawab S.H., *Signals and Systems*, Prentice Hall, 2nd ed., 2015.
3. Nagrarth I. J, Saran S. N and Ranjan R, *Signals and Systems*, Tata McGraw-Hill, 2nd ed., 2012.
4. Nagarath I. J. and Gopal M., *Control System Engineering*, New Age Publishers, 8th ed., 2024.

Reference Books

1. John G. Proakis & Dimitris G.Manolakis, *Digital Signal Processing Principles*, Prentice Hall, 4th ed., 2007.
2. Kumar, A. Anand, *Signals and Systems*, PHI Learning, 3rd ed., 2012.
3. Farooq Husain, *Signals and Systems*, Umesh publications, 2nd ed., 2005.
4. Nise N. S., *Control Systems Engineering*, Wiley Eastern, 6th ed., 2018.
5. Bracewell R.N., *Fourier Transform & Its Applications*, McGraw Hill, 3rd ed., 1999.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	46 Hours
	Module 1: Introduction to Signals and Systems	**10**
1.1	Concept of signals -Continuous and discrete-time signals -practical examples, elementary signals	1
1.2	Classification of signals, basic operations on continuous-time signals	1
1.3	Basic operations on discrete-time signals	1
1.4	Concept of system - classification of systems	1
1.5	Properties of systems - time invariance	1
1.6	Properties of systems - linearity	1
1.7	Properties of systems - causality - memory - stability	1
1.8	Practical examples of LTI systems - electrical, mechanical and thermal systems	1
1.9	Step response, impulse response - convolution integral and convolution sum	2
	Module 2: Frequency Domain Characterization of Continuous-time Signals and Systems	**9**
2.1	Fourier Series - Existence	1
2.2	Fourier Series - harmonic analysis of common signals	2
2.3	Fourier transform - Existence, Fourier transform of common Signals	2
2.4	Properties of Fourier transform	1
2.5	Energy spectral density, and power spectral density	1
2.6	Concept of frequency response - magnitude response, phase response	2
	Module 3: Characterization and Modeling of Continuous-time LTI Systems	**9**
3.1	Laplace transform (Review only)	1
3.2	Differential equation representation of continuous-time LTI systems, transfer function representation of differential equation	1
3.3	Modeling of LTI systems - electrical systems	1
3.4	Modeling of LTI systems - translational mechanical systems	1
3.5	Modeling of LTI systems - rotational mechanical systems	1
3.6	Block diagram representation - Open loop and closed loop systems, effect of feedback in systems	1
3.7	Block diagram reduction	1
3.8	Signal flow graph - Mason's gain formula	2
	Module 4: Frequency Domain Characterization of Discrete-time Signals and Systems	**9**

4.1	Sampling process - Impulse train sampling	1
4.2	Sampling theorem - Nyquist rate-aliasing effect	1
4.3	Signal reconstruction - zero order and first order hold circuits	1
4.4	Discrete-time (DT) Fourier series - properties	1
4.5	Discrete-time Fourier Transform (DTFT)	1
4.6	Discrete-time Fourier Transform (DTFT) - properties	2
4.7	Frequency response of simple DT systems - magnitude response and phase response	2
	Module 5: Characterization and Modeling of discrete-time LTI	**9**
5.1	Z-transform - Region of convergence, Z-transform of standard signals	2
5.2	Properties of Z-transform	1
5.3	Inverse Z-transform- partial fraction method	1
5.4	Difference equation representations of LTI systems - analysis	1
5.5	Z-transfer function - delay operator, block diagram representation - direct form	2
5.6	Block diagram representation - cascade representations of 2nd order systems	1
5.7	Block diagram representation - parallel representations of 2nd order systems	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Solve problems on basic signals and their operations.
2. Solve problems with properties of continuous and discrete time systems.
3. Solve problems based on types of systems using the convolution integral and sum.

Course Outcome 2 (CO 2)

1. Find the Fourier series of common signals.
2. State and prove the Fourier transform properties.
3. Obtain the frequency response of a given LTI system.

Course Outcome 3 (CO 3)

1. Obtain the differential equation representation of given continuous-time LTI systems.
2. Solve problems on block diagram reduction.
3. Reduce the given block diagram using Mason's Gain Formula.

Course Outcome 4 (CO 4)

1. State and prove the sampling theorem.
2. Solve problems related to discrete transfer function and impulse response.
3. Determine the discrete Fourier transform and frequency response of the given system.

Course Outcome 5 (CO 5)

1. Solve problems related to the realization of discrete-time systems.
2. Obtain the Z-transform and ROC of a given discrete-time signal.
3. Obtain all possible Inverse Z-transform.

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: : B24EE2T05

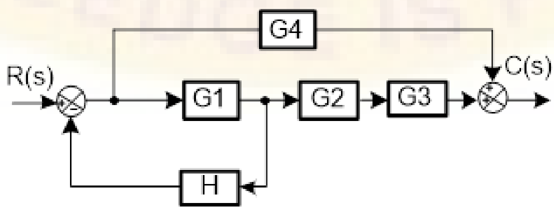
Course Name: : SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define unit step signal. Sketch the signal $u(t) - u(t+2)$, where $u(t)$ is the unit step signal.
2. Check whether the following systems are linear or not.
   (a) $y(t) = x(t^2)$
   (b) $y(t) = e^{-2x(t)}$
3. Explain the Dirichlet's conditions for the existence of Fourier Series.
4. Obtain the Fourier Transform of $e^{-at}u(t)$.
5. Construct the signal flow graph for the following system represented by the block diagram.



6. Describe Mason's gain formula for signal flow graph.
7. Explain a ZOH circuit and derive its transfer function.

8. Obtain the transfer function of the given discrete time system described by the difference equation $y(n) - \frac{5}{4}y(n-1) + \frac{1}{6}y(n-2) = 2x(n)$.

9. State and prove any two properties of Z-transform.

10. Obtain the Z-transform and ROC of the signal $x(n) = 2^n u(n)$.

PART B

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

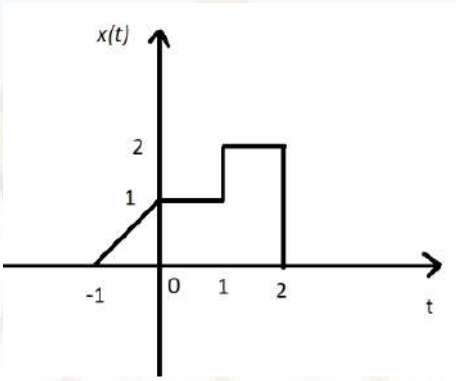
11. (a) Obtain the convolution of the following signals.
$x_1(t) = e^{-2t}u(t)$ and $x_2(t) = e^{-4t}u(t)$ (7 marks)

(b) Differentiate energy and power signals. Determine the energy and power of the signal $x(t) = (1 + e^{-2t})u(t)$. (7 marks)

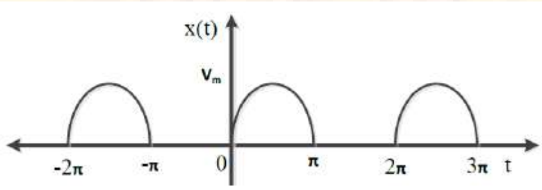
OR

12. (a) Determine whether the system $y(n) = nx(n)$ is i) linear ii) time-invariant iii) dynamic and iv) causal. (7 marks)

(b) The signal x(t) is given below, draw the signals, (a) $x(t+3)$ (b) $x(-2t+2)$. (7 marks)



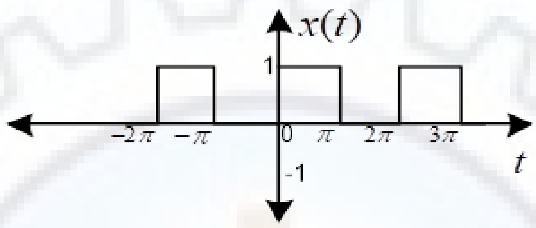
13. (a) Find the trigonometric Fourier series for the half-wave rectified sine wave shown in figure. (10 marks)



(b) State and prove the time differentiation property of the Fourier transform. (4 marks)

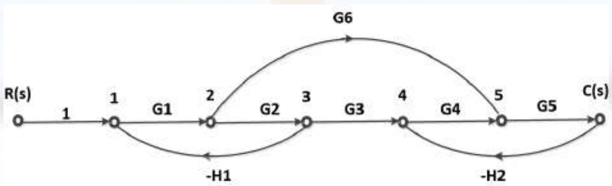
OR

14. (a) Obtain the trigonometric Fourier series of the signal given below. (7 marks)



(b) The input and output of relationship of a causal system is described by $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = x(t)$, (i) Obtain the frequency response of the system (ii) Find the impulse response of the system. (7 marks)

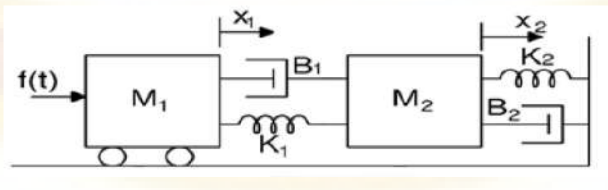
15. (a) The signal flow graph of a control system is shown in figure. obtain the transfer function $\frac{C(s)}{R(s)}$. (10 marks)



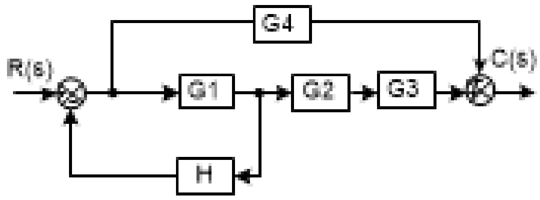
(b) Determine the transfer function of the given LTI system $\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = 2\frac{dx(t)}{dt} - 3x(t)$. (4 marks)

OR

16. (a) Derive the transfer function $\frac{X_2(S)}{F(S)}$ of the given mechanical system. (10 marks)



(b) Determine the overall transfer function for the system shown below. (4 marks)



17. (a) State and prove sampling theorem with necessary figures. (8 marks)

    (b) State and prove the time reversal property of Discrete-time Fourier transform. (6 marks)

OR

18. (a) Calculate the Nyquist rate and Nyquist interval for the signal, $x(t) = sin200\pi t + cos100\pi t$. (6 marks)

    (b) Determine the DTFS of $\{.....3, 2, -2, 1, \underset{\uparrow}{3}, 2, -2, 1, ...\}$. (8 marks)

19. (a) Find the inverse z-transform of $X(z)$
    $X(z) = \frac{3z^{-1}}{(1-z^{-1}(1-2z^{-1})}$ if ROC is i) $|z| > 2$ ii)$|z| < 1$. (6 marks)

    (b) An LTI system is described by the difference equation
    $y(n) - \frac{9}{4}y(n-1) + \frac{1}{2}y(n-2) = x(n) - 3x(n-1)$.
    Specify the ROC of H(z) and determine h(n) for the following conditions i) the system is stable ii) the system is causal. (8 marks)

OR

20. The system function of a discrete-time system is $H(z) = \frac{(1-z^{-1})^4}{(1-z^{-1}+\frac{7}{8}z^{-2})(1+2z^{-1}+\frac{3}{4}z^{-2})}$. Realize the system using a cascade of a second-order system in direct form II. (14 marks)

B24EE2T06	POWER ELECTRONICS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to introduce the fundamental principles and applications of power electronics, covering power semiconductor devices, power conversion techniques, and PWM strategies essential for modern electrical and electronic systems. The course covers power semiconductor devices, phase-controlled rectifiers, inverters, DC-DC converters, and AC-AC converters. Provides an in-depth understanding of device characteristics, switching techniques, harmonic effects, and efficiency considerations in power electronic circuits. On completion of this course, students will be able to analyze and design power electronic circuits, evaluate the performance of power converters, and apply power electronic principles in industrial and renewable energy applications.

Prerequisites

Electronics Circuits I, Circuits and Networks.

Course Outcomes

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

CO 1	Analyze the characteristics of power semiconductor devices, and demonstrate their switching principles and circuit implementations. (Cognitive Knowledge Level: Understand)
CO 2	Analyze the operation and performance of single-phase and three-phase phase-controlled rectifiers with various loads in continuous and discontinuous conduction modes. (Cognitive Knowledge Level: Apply)
CO 3	Understand the operation of single-phase and three-phase inverters and compare different PWM techniques. (Cognitive Knowledge Level: Understand)
CO 4	Solve single-phase AC circuits by applying the fundamental laws of electrical engineering and analyze the same using circuit theorems. (Cognitive Knowledge Level: Apply)
CO 5	Understand the operation of AC voltage controllers and cycloconverters, analyze their performance with different loads, and evaluate their 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	3	3	3				2	2			3
CO 2	3	3	3	3				2	2			3
CO 3	3	3	3	3	3		2	2	2	2	2	3
CO 4	3	3	3	3	3	2	2	2	2	2	2	3
CO 5	3	3	3	3	3	2	2	2	2	2	2	3

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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (11 hours)

Introduction to Power Electronics

Power Electronics - scope and application, unipolar and bipolar switches, ideal and practical switches - characteristics, losses, EMI.

Power Semiconductor Devices

Thyristors - Basic structure, static and dynamic characteristics, two transistor analogy, methods of turning on, gate triggering circuits - R, RC, Snubber circuits.
Power Diodes and Power Transistor - Basic structure, static and dynamic characteristics.
Power MOSFET and IGBT - structure and operational principle, switching characteristics.
Wide band gap devices (GaN, SiC) - Advantages over silicon devices - Properties.

MODULE 2 (9 hours)

Phase Controlled Rectifiers using SCR (AC-DC Converters)

Single-phase - half wave-controlled rectifiers, half and fully-controlled converters - R, RL, RLE loads - continuous and discontinuous current operation. Analysis - average voltage, input side harmonics, and power factor. Line commutated inverters.

Three-phase - half-wave-controlled rectifier with R and RL loads, full wave fully controlled converters - R, RL, RLE loads - continuous current operation.

MODULE 3 (9 hours)

Inverters (DC-AC Converters)

Voltage source inverters - single-phase - half-bridge inverters and full-bridge inverters - square wave operation, harmonics due to switching, minimization of harmonics.

Introduction to PWM - single pulse and multiple pulse modulation, sinusoidal PWM - advantages, unipolar PWM, bipolar PWM - comparison.

Three-phase inverters - square wave operation (120^0 and 180^0) - comparison, SPWM in three-phase inverters.

MODULE 4 (8 hours)

DC-DC Converters

Choppers - step-down and step-up choppers - single-quadrant, two-quadrant, and four-quadrant choppers, pulse width modulation, and current limit control in DC-DC converters.

Switching regulators - buck, boost, and buck-boost, operation with continuous conduction mode, waveforms, design - switch selection, filter inductance, and capacitance.

MODULE 5 (8 hours)

AC-AC Converters

AC Voltage Controllers (ACVC) - single-phase full-wave ACVC with R and RL loads - waveforms - RMS output voltage, input power factor with R load.

Cycloconverters – single-phase cycloconverters - principle of operation, types - mid-point and bridge type cycloconverters, three-phase cycloconverters - three-phase to single-phase, three-phase to three-phase, advantages, and disadvantages, applications.

Use simulation software to simulate power electronic converters to enhance practical understanding (Tutorial/Assignment only).

Text Books

1. Rashid M. H., *Power Electronics Circuits, Devices and Applications*, Prentice Hall India, 3rd ed., 2009.
2. Daniel W. Hart, *Power Electronics*, Tata McGraw-Hill Education, Vol.1, 3rd ed., 2011.
3. P. S. Bimbhra, *Power Electronics*, Khanna Publishers, 4th ed., 2012.
4. M. D. Singh and K. B. Khanchandani, *Power Electronics*, Power Electronics, 2nd ed., 2006.
5. B. J. Baliga, , *Fundamentals of Power Semiconductor Devices*, Springer , 2nd ed., 2019.

Reference Books

1. Mohan, Underland and Robbins, *Power Electronics: Converters, Applications and Design*, John Wiley & Sons, 3rd ed., 2003.
2. Robert W. Erickson and Dragan Maksimović, *Fundamentals of Power Electronics*, Springer Nature, 3rd ed., 2020.
3. G. K. Dubey, *Thyristorised Power Controllers*, Wiley Eastern Ltd, 1993.
4. Straughen and Dewan, *Power Semiconductor Circuits*, John Wiley & Sons, 1975.
5. Cyril W. Lander, *Power Electronics*, McGraw Hill, 3rd ed., 1993.
6. John G. Kassakian, Martin F. Schlecht, and George C. Verghese, *Principles of Power Electronics*, Cambridge University Press, 2nd ed., 2023.
7. Muhammad H. Rashid, *Power Electronics Handbook*, Academic Press, 4th ed., 2017.
8. P. C. Sen, *Principles of Electric Machines and Power Electronics*, John Wiley & Sons, 2nd ed., 1996.
9. Bimal K. Bose, *Modern Power Electronics and AC Drives*, Prentice Hall, 1st ed., 2001.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Introduction to Power Electronics and Power Semiconductor Devices	**11**
1.1	Scope and Application, unipolar and bipolar switches, Ideal and Practical switches -characteristics - losses, EMI	1
1.2	Thyristors - Basic structure, static and dynamic characteristics	1
1.3	Two transistor analogy	1
1.4	Methods of turning on, gate triggering circuits -R, RC triggering	2
1.5	Snubber circuits	1
1.6	Power Diode: Basic structure, Static and dynamic characteristics	1
1.7	Power Transistor: Basic structure, Static and dynamic characteristics	1
1.8	Power MOSFET and IGBT: Structure and operational principle, switching characteristics	2
1.9	Wide band gap devices (GaN, SiC): Advantages over silicon devices - Properties	1
	Module 2: Phase Controlled Rectifiers using SCR (AC-DC)	**9**
2.1	Single Phase Half wave-controlled rectifier- R, RL, RLE loads - continuous and discontinuous current operation, Analysis	2
2.2	Single Phase Semi converter - R, RL, RLE loads, Analysis	2
2.3	Single Phase Full converter - R, RL, RLE loads, Analysis	1
2.4	Line commutated inverters	1
2.5	Three Phase: Half wave-controlled rectifier with R and RL loads, Analysis	2
2.6	Three Phase fully controlled converters - R, RL, RLE loads - continuous current operation	1
	Module 3: DC-AC Converters	**9**
3.1	Single-phase half-bridge inverters and full-bridge inverters - square wave operation, harmonics due to switching, minimization of harmonics	2
3.2	Introduction to PWM - single pulse and multiple pulse modulation	2
3.3	Sinusoidal PWM - advantages	1
3.4	Unipolar PWM, bipolar PWM - comparison	1
3.5	Three-phase inverters - square wave operation (120^0 and 180^0) - comparison	2
3.6	SPWM in three-phase inverters	1

	Module 4: DC-DC Converters	**8**
4.1	Step-down and step-up choppers	1
4.2	Single-quadrant and two-quadrant choppers	2
4.3	Four-quadrant choppers	1
4.4	Pulse width modulation, and current limit control in DC-DC converters	1
4.5	Buck converter - continuous conduction mode, waveforms, design	1
4.6	Boost converter - continuous conduction mode, waveforms, design	1
4.7	Buck Boost converter - continuous conduction mode, waveforms, design	1
	Module 5: AC-AC Converters	**8**
5.1	Voltage Controllers (ACVC) - single-phase full-wave ACVC with R and RL loads - waveforms - RMS output voltage, input power factor with R load	2
5.2	Single-phase mid-point type cycloconverters - principle of operation	1
5.3	Single-phase bridge type cycloconverters - principle of operation	1
5.4	Three-phase cycloconverters - three-phase to single-phase-advantages, and disadvantages, applications	2
5.5	Three-phase cycloconverters - three-phase to three-phase, - advantages, and disadvantages, applications	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Explain the significance of power electronics in modern electrical and electronic systems.
2. With examples compare unipolar and bipolar switches in terms of their switching characteristics and performance.
3. Analyze the role of the two-transistor analogy in explaining the behavior of a thyristor.
4. Explain the basic structure and working principle of a power diode. Also draw the static and dynamic characteristics.
5. How the wider band gap in GaN and SiC devices contributes to lower power losses?

Course Outcome 2 (CO 2)

1. Describe the difference between continuous and discontinuous current operation in rectifiers.
2. Explain the effect of increasing the firing angle on the power factor of a single-phase rectifier.
3. Analysis of single phase rectifiers.
4. Analyze the operation of three-phase full-wave rectifier at various firing angles.
5. Describe how a single-phase rectifier can function as a line-commutated inverter.

Course Outcome 3 (CO 3)

1. Explain the square wave mode operation of a single phase half bridge inverter.
2. Define pulse-width modulation (PWM) and its purpose in inverters.
3. Describe the difference between single-pulse and multiple-pulse modulation.
4. Compare unipolar PWM and bipolar PWM.
5. Explain the operation of a three-phase square wave inverter in 120° and 180° conduction modes.

Course Outcome 4 (CO 4)

1. Analyze the performance of a four-quadrant chopper in regenerative braking applications.
2. Design a buck converter for a given input voltage, output voltage, and load current.
3. What are the control strategies used in DC-DC converters for voltage control?
4. Analyze the operation of a buck converter with necessary waveforms during CCM operation.
5. Apply the inductor and capacitor selection criteria to minimize current and voltage ripple in a boost converter.

Course Outcome 5 (CO 5)

1. Explain the basic working principle of a single-phase cycloconverter.
2. Explain how a three-phase to single-phase cycloconverter operates.
3. Discuss the applications of cycloconverters in industries.
4. Describe how a cycloconverter achieves variable frequency operation.
5. Explain how the output frequency of a cycloconverter is controlled.

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: : B24EE2T06

Course Name: : POWER ELECTRONICS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List out the different turn-on methods of SCR. Explain any one method.
2. Explain the characteristics and advantages of wide band gap devices.
3. A single-phase full converter feeds power to RLE load with $R = 6\ \Omega$, $L = 6\ mH$ and $E = 60\ V$. The AC voltage source is 230 V, 50 Hz. For continuous conduction, find the average value of load current for a firing angle of 30^0 and 60^0.
4. Explain the significance of freewheeling operation in semi-converters.
5. Define Modulation Index and Modulation Frequency in PWM.
6. Explain half-bridge square wave voltage source inverter.
7. Explain Current Limit Control in chopper circuits.
8. What is meant by continuous conduction mode in the context of switching regulators?
9. Explain the effect of an RL load on the output waveform of a single-phase ACVC.
10. What is a cycloconverter? List out some of its applications.

PART B

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

11. (a) Explain the basic structure of a thyristor and describe its static and dynamic characteristics in detail. (7 marks)

    (b) Discuss the two-transistor analogy of a thyristor and explain how it helps in understanding thyristor operation. (7 marks)

OR

12. (a) Explain the working of R and RC gate triggering circuits with neat circuit diagrams. (7 marks)

    (b) Explain the structure and operational principle of a Power MOSFET and discuss its advantages over BJTs. (7 marks)

13. Explain the working of a half-wave-controlled rectifier feeding RL load, with necessary waveforms. Derive the expression for average voltage, input side harmonics and power factor. (14 marks)

OR

14. (a) Explain the working of three phase fully controlled bridge rectifier, feeding RL load, with 60^0 firing angle. (7 marks)

    (b) A three-phase, full-wave bridge rectifier containing six ideal thyristors supplies a resistive load R=100 Ω. The ideal supply 240 V, 50 Hz provides balanced sinusoidal voltages. Calculate the average load current and power dissipation at (a) 30^0, (b) 60^0, and (c) 90^0. (7 marks)

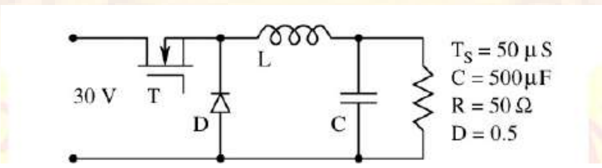
15. (a) Explain the need for PWM in inverters. Discuss the principle of sinusoidal PWM (SPWM) and its advantages over square wave operation. (7 marks)

    (b) Explain the multiple pulse width modulation used in a single-phase inverter and draw relevant waveforms. (7 marks)

OR

16. Compare 120^0 and 180^0 conduction modes of three phase inverters with circuit diagram and waveform analysis. (14 marks)

17. Figure shows a non-isolated buck converter operating at a duty ratio of 0.5 at a switching frequency of 20 kHz. The components may be taken to be ideal.



    i. Evaluate the value of L such that the converter operates in the discontinuous mode.

    ii. Evaluate the diode conduction time and the output voltage under such conditions.

(14 marks)

OR

18. A boost converter is used to step up a DC voltage from 12 V to 24 V to power a load. The converter operates at a switching frequency of 20 kHz, and the inductor value is 1 mH. The output power required by the load is 48 W. Assume the circuit operates in continuous conduction mode (CCM). Determine the duty cycle required to achieve the desired output voltage, the average input current drawn from the supply, the peak-to-peak inductor current ripple, If a 220 µF capacitor is used as an output filter, determine the ripple voltage across the capacitor and the efficiency of the converter if the total power loss in the circuit is 2 W.

(14 marks)

19. Explain the difference between phase-angle control and integral cycle control in AC voltage controllers.

(14 marks)

OR

20. Describe how the three-phase input is converted to a single-phase output in this type of cycloconverter. (14 marks)

B24EE2T07	ELECTROMAGNETIC THEORY	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

The course aims to equip the students with an understanding of the fundamental principles of static and time varying Electromagnetic fields. This is accomplished by a strong conceptual understanding of basic laws and theorems of electromagnetics and its applications with the art of technical problem solving. Upon successful completion of the course, the students will be empowered to analyze and comprehend the diverse static and dynamic electromagnetic systems that surround us.

Prerequisites

Nil

Course Outcomes

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

CO 1	Apply fundamental concepts of coordinate sytems and basic laws of electromagnetics to solve static electric fields. (Cognitive Knowledge Level: Apply)
CO 2	Understand and apply the basic concepts of electric potential, capacitance, divergence of vector fields to solve various electromagnetic problems. (Cognitive Knowledge Level: Understand)
CO 3	Understand and apply the basic laws and theorems along with the concepts of curl and boundary conditions of static and time-varying electromagnetic fields to solve electromagnetic problems. (Cognitive Knowledge Level: Apply)
CO 4	Apply Maxwells equations to develop and analyse electromagnetic wave equations of different mediums and its various parameters. (Cognitive Knowledge Level: Apply)
CO 5	Apply and analyse wave propagation through transmission lines and its charateristics. (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	1		1	1		1		1	1
CO 2	3	3	1	1		1	1		1		1	1
CO 3	3	3	1	1		1	1		1		1	1
CO 4	3	3	1	1		1	1		1		1	1
CO 5	3	3	1	1		2	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	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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

Co-ordinate Systems and Static Electric Fields

Review of coordinate systems - rectangular, cylindrical, and spherical coordinate systems - coordinate transformation between cartesian-cylindrical and cartesian-spherical. Static electric fields - Coulomb's law, electric field intensity, field due to a line charge, surface charge distribution. Electric flux and flux density, Gauss's law and its application - the field due to an infinite line charge, infinite sheet charge.

MODULE 2 (6 hours)

Electric Potential and Capacitance

Electric potential - gradient of a scalar field, potential gradient, conservative property of electric field, equipotential surfaces. Capacitance - capacitance of co-axial cable, two wire lines, divergence of a vector field - physical interpretation, Divergence theorem, Poisson's and Laplace's equations.

MODULE 3 (9 hours)

Static Magnetic Fields and Introduction to Time-varying Fields

Introduction to magnetic flux, flux density, magnetic field intensity, self inductance.
Static magnetic fields - Biot-Savart's Law, magnetic field intensity due to a - finite and infinite wire carrying current, on the axis of a circular loop carrying current, magnetic flux density, ampere's circuital law, and simple applications, curl of a vector field - physical interpretation, Stokes' Theorem. Boundary conditions for electric fields and magnetic fields. Conduction current and displacement current densities, continuity equation for current. Modified form of Ampere's circuital law, Faraday's Law, and Gauss's Law - Maxwell's equation in differential and integral form.

MODULE 4 (7 hours)

Electromagnetic Waves

Introduction to electromagnetic waves, Poynting vector, and Poynting theorem. Uniform plane waves, wave equations from Maxwell's equation in phasor form, propagation of uniform plane waves in free space, loss-less and lossy dielectric medium, uniform plane waves in good conductor, transverse nature of electromagnetic waves, skin effect and skin depth, intrinsic impedance, attenuation constant, and propagation constant in all mediums.

MODULE 5 (6 hours)

Transmission Line

Transmission line parameters, transmission line equation, and solutions, propagation constants, characteristic impedance, wavelength, velocity of propagation. Standing wave ratio (SWR), reflection coefficient, impedance matching - solution of problems, electromagnetic interference.

Text Books

1. Matthew N. O. Sadiku, *Principles of Electromagnetics*, Oxford University Press, 6th ed., 2015.
2. Hayt W. H. and J. A. Buck, *Engineering Electromagnetics*, McGraw-Hill, 9th ed., 2019.
3. P. M. Ramanathan K. A. Gangadhar *Electromagnetic Theory*, Khanna Publishers, 2009.

Reference Books

1. Joseph Edminister, Mahmood Nahvi, *Electromagnetics*, Schaum's Outlines, 4th ed., 2013.
2. John Kraus and Daniel Fleisch, *Electromagnetics with applications*, McGraw-Hill Education, 5th ed., 2017.
3. S. P. Seth, *Elements of Electromagnetic fields*, Dhanpat Rai Publishing Co Pvt Ltd, 2001.
4. David K. Cheng, *Fundamentals of Engineering Electromagnetics*, Pearson Education, 1st ed., 2019.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	37 Hours
	Module 1: Co-ordinate Systems and Static Electric Fields	**9**
1.1	Review of coordinate systems - rectangular, cylindrical, and spherical coordinate systems	2
1.2	Coordinate transformation between cartesian-cylindrical and cartesian-spherical.	2
1.3	Static electric fields - Coulomb's law, electric field intensity, field due to a line charge, surface charge distribution	2
1.4	Electric flux and flux density,Gauss's law and its application - the field due to an infinite line charge, infinite sheet charge, Numerical problems	2
1.5	Numerical problems	1
	Module 2: Electric Potential and Capacitance	**6**
2.1	Electric potential - gradient of a scalar field, electric potential - potential gradient, con-servative property of electric field, equipotential surfaces, Numerical problems	2
2.2	Capacitance - capacitance of co-axial cable, two wire lines (concept and equations only), Numerical problems	2
2.3	Divergence of a vector field- physical interpretation, Divergence theorem, Poisson's and Laplace's equations	2
	Module 3: Static Magnetic Fields and Introduction to Time-varying Fields	**9**
3.1	Introduction to magnetic flux, flux density, magnetic field intensity, self inductance	1
3.2	Static magnetic fields - Biot-Savart's Law, magnetic field intensity due to a - finite and infinite wire carrying current, on the axis of a circular loop carrying current, magnetic flux density	2
3.3	Numerical problems	1
3.4	Ampere's circuital law, and simple applications	1
3.5	Curl of a vector field - physical interpretation, Stokes' Theorem, numerical problems	1
3.6	Boundary conditions for electric fields and magnetic fields	1
3.7	Conduction current and displacement current densities, continuity equation for current. Modified form of Ampere's circuital law, Faraday's Law, and Gauss's Law- Maxwell's equation in differential and integral form	2
	Module 4: Electromagnetic Waves	**7**
4.1	Introduction to electromagnetic waves, Poynting vector, and Poynting theorem	1

4.2	Uniform plane waves, wave equations from Maxwell's equation in phasor form, propagation of uniform plane waves in free space, lossless and lossy dielectric medium, uniform plane waves in good conductor	2
4.3	Numerical problems	1
4.4	Transverse nature of electromagnetic waves, skin effect and skin depth, intrinsic impedance, attenuation constant, and propagation constant in all mediums. Numerical problems	2
4.5	Numerical problems	1
	Module 5: Transmission Line	**6**
5.1	Transmission line parameters, transmission line equation, and solutions	2
5.2	Propagation constants, characteristic impedance, wavelength, velocity of propagation- Numerical problems	2
5.3	Standing wave ratio (SWR), reflection coefficient, impedance matching - solution of problems, electromagnetic interference	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Solve problems based on coordinate transformation.
2. Solve problems using Coloumb's law in static electric fields.
3. Explain Gauss's law and its applications.

Course Outcome 2 (CO 2)

1. Evaluate Problems on electric potential.
2. State and derive Divergence of a vector field.
3. Explain Poisson's and Laplace's equation.

Course Outcome 3 (CO 3)

1. Explain Biot Savart's law and its applications.
2. Develop the boundary conditions of static magnetic fields.
3. Describe conduction and displacement currents.

Course Outcome 4 (CO 4)

1. Derive Poynting theorem and explain.
2. Derive wave equation of lossy dielectrics in phasor form.
3. Solve problems on propagation constants of EM waves in different mediums.

Course Outcome 5 (CO 5)

1. Derive the wave equations for a transmission line.
2. Solve problems on characteristic impedance of Transmission lines.
3. Explain terms standing wave ratio, reflection coefficient, EM interference.

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: B24EE2T07

Course Name:ELECTROMAGNETIC THEORY

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Describe the transformation of variables in cartesian coordinate system to its equivalent in cylindrical coordinate system.
2. State and explain Gauss's law for static electric fields.
3. Explain the conservative nature of electric field.
4. Define Divergence and explain its physical interpretation.
5. State and explain Ampere's circuital law for magnetic fields.
6. Compare Conduction current and Displacement current.
7. Define Poynting vector and its significance.
8. Define the term skin depth.
9. Explain characteristic impedance of a lossless transmission line.
10. Define the term standing wave ratio (SWR).

PART B

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

11. (a) Transform vector $A = 5a_r + 2sin\phi a_\theta + 2cos\theta a_\phi$ in spherical to Cartesian coordinate system. (6 marks)

    (b) Evaluate both sides of the Divergence theorem for the region $r \leq 1$ and if $A = 3rsin2\theta cos^2\phi a_r$. (8 marks)

OR

12. (a) Derive co-ordinate transformation between Cartesian and Spherical systems. (10 marks)

    (b) Explain the physical significance of divergence of a vector field. (4 marks)

13. (a) State and Prove Gauss's Law. (4 marks)

    (b) Four point charges are located at the four corners of the rectangle. Length and breadth of rectangle are 5 cm and 2 cm respectively. Find the magnitude and direction of the resultant force on Q_1. (10 marks)

OR

14. (a) Derive the expression of electric field intensity due to infinite line charge having line charge density ρ C/m. (6 marks)

    (b) Using Gauss's Law derive an expression for the capacitance per unit length between two infinitely long concentric conducting cylinders. The medium between two cylinders is completely filled with air. (8 marks)

15. (a) State the boundary conditions at the boundary of two magnetic media of permeability μ_1 and μ_2. (10 marks)

    (b) Flux lines are received at an iron-air boundary at 880. If the iron has a relative permeability of 350, determine the angle from the normal with which the flux emerges into air. (4 marks)

OR

16. (a) Find the incremental contribution ΔH to magnetic field intensity at the origin caused by a current element in free space, $IdL = 3a_z\ nA$, located at (3,-4, 0). (8 marks)

    (b) Derive the magnetic field intensity on the axis of a circular loop carrying current. (6 marks)

17. (a) A 10 GHz plane wave traveling in free space has an amplitude 15 V/m. Find velocity of propagation, wavelength, amplitude of H, characteristic impedance of media, and propagation constant. (10 marks)

    (b) What is skin effect and skin depth? (4 marks)

OR

18. (a) Explain about Poynting Theorem. Show that the power flow along a concentric cable is the product of voltage and current using the Poynting Theorem. (10 marks)

    (b) What is a uniform plane wave? What are its properties? (4 marks)

19. (a) Explain in detail impedance matching of lines. (10 marks)

    (b) Explain the terms, propagation constant and phase velocity applied to transmission lines. (4 marks)

OR

20. (a) Derive the basic transmission line wave equation. (9 marks)

    (b) What are the different parameters of transmission lines? (5 marks)

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 contains 10 questions carrying 3 marks each. Part B contains 2 questions from each module, out of which one is to be answered. Each question carries 14 marks and can have maximum of two subdivisions.

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, 2020.

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, 2020.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1: Fundamentals of Business Economics	**8**
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**
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**
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**
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**
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	

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

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

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

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 marks)

    (b) What is the Cobb- Douglas production function? Mention its feature. If the production function of a firm is Q = 30 L1/2K1/2, 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 marks)

OR

12. (a) State the Law of diminishing marginal utility. Also mention the assumptions and importance of the law. (7 marks)

    (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 marks)

13. (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 marks)

    (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 marks)

OR

14. (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 marks)

    (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
    (a) the P/V ratio
    (b) breakeven point
    (c) Margin of safety at this level of sales
    (d) If it sells each unit for Rs.20, how many units should the company sell to break even?
    (e) Find the sales required to earn a profit of Rs.20000. (7 marks)

15. (a) With the help of a figure, examine the circular flow of income in a multi sector economy. (7 marks)

(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 marks)

OR

16. (a) Elucidate the economic problem of inflation. What are its main types? State the government measures to control inflation. (7 marks)

(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 marks)

17. (a) Discuss the functions of the RBI. What are the main quantitative techniques used by the RBI? (7 marks)

(b) State the meaning of balance sheet in accounting. Draw a format of the balance sheet showing the different entries. (7 marks)

OR

18. (a) Write a note on the management of cash and marketable securities. (7 marks)

(b) State the significance of profit and loss account. Illustrate a format of the profit and loss account. (7 marks)

19. (a) Elaborate the main functions performed by the stock market in an economy. (7 marks)

(b) Elucidate the various sources of business financing available to companies. (7 marks)

OR

20. (a) Elaborate the meaning of mutual funds. Discuss the different types of mutual funds. (7 marks)

(b) Distinguish between FDI and FII. (7 marks)

B24EE2T08	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	2	0	2	4	2024

Preamble

This course aims to provide a comprehensive understanding of microprocessors, microcontrollers, and embedded systems, equipping students with essential knowledge of programming and system design. The course covers the 8085 microprocessor, assembly language programming, embedded systems fundamentals, Arduino, and ARM-based development. By the end of the course, students will be able to design and develop embedded applications and find efficient solutions for real-world challenges in industrial automation.

Prerequisites

Problem Solving and Programming Techniques.

Course Outcomes

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

CO 1	Understand the internal architecture, instruction set, and execution process of the 8085 microprocessor, including machine cycles and timing diagrams. (Cognitive Knowledge Level: Understand)
CO 2	Develop and implement assembly language programs for the 8085 microprocessor to perform arithmetic operations, data handling, and interrupt handling. (Cognitive Knowledge Level: Apply)
CO 3	Understand embedded system fundamentals, microcontroller architecture, and design real-time system applications, with a focus on Arduino-based development. (Cognitive Knowledge Level: Apply)
CO 4	Design and implement embedded applications using Arduino, including sensor interfacing, actuator control, and real-time data processing. (Cognitive Knowledge Level: Apply)
CO 5	Understand ARM-based embedded system architecture, including ARM instruction sets, Raspberry Pi architecture, and real-world applications of microcontrollers. (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	1	1			1		2
CO 2	3	3	3	3	2	1	1			1		2
CO 3	3	2	2	2	3	1	1	1	1	1	2	2
CO 4	3	3	3	3	3	1	1	1	1	1	2	2
CO 5	3	2	2	2	3	1	1	1	1	1	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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

8085 Microprocessor

Internal architecture of 8085 microprocessor, functional block diagram, instruction set - addressing modes, classification of instructions - data transfer operations, arithmetic operations, logic operations, branching operations, I/O and machine control operations, status flags. Machine cycles and T states - fetch and execute cycles - timing diagram for instruction and data flow.

MODULE 2 (10 hours)

Assembly Language Programming

Assembly language programs (ALP) in 8085 microprocessor - data handling/data transfer, arithmetic operations, code conversion - BCD to binary - binary to BCD, sorting, stack and subroutines - conditional CALL and return instructions. Time delay subroutines using 8-bit register, 16-bit register pair, and nested loop control. Interrupt and interrupt handling - hardware and software interrupts, interrupt structure.

MODULE 3 (8 hours)

Embedded Systems

Introduction to embedded systems, current trends and challenges, applications of embedded systems - hard and soft real-time systems. Introduction to microcontrollers - microprocessor vs microcontroller. Introduction to Arduino UNO (8-bit) - hardware fundamentals of ATmega328P microcontroller-based board. Arduino architecture, pin diagram, and functions of pins - overview of main features such as I/O ports, timers, interrupts, PWM, ADC(introduction only). Introduction to Arduino IDE - Arduino libraries, steps for creating an Arduino program - Arduino sketch structure and flow- setup and loop functions.

MODULE 4 (9 hours)

Arduino Programming

Programming - data types - operators, conditional statements - loops, arrays and functions, built-in functions in Arduino, program to blink an LED and its control, interfacing LCD, seven segment LED, switch interface, binary counter working with LED controlled by switch/potentiometer, working with basic sensors and actuators using Arduino.

MODULE 5 (9 hours)

ARM (Advanced RISC Machines) based Embedded System Design

ARM architecture - RISC, CISC-ARM program model - pipeline (3/5 stage) - memory organization - privileged model - exceptions - ARM instruction set - overview of ARM CPU cores. Overview of Raspberry Pi - Introduction to Raspberry Pi, comparison of various Rpi models, understanding SoC architecture and SoCs used in Raspberry Pi, pin description of Rpi, on-board components of Rpi.

Seminar on applications of microcontrollers on consumer electronics (Tutorial/Assignment only).

Text Books

1. Ram, B. Dhanpat, *Fundamentals of Microprocessor and Micro controllers*, Dhanpat Rai Publications (P) Ltd., New Delhi, 8th ed., 2021.
2. Ramesh Gaonkar, *Microprocessor, Architecture,Programming and Applications*, Penram International Publishing, 6th ed., 2014.
3. Michael Margolis, *Arduino Cookbook*, O'Reilly Media, Inc., 3rd ed., 2020.
4. Steve Furber, *ARM System On Chip Architecture*, Addison-Wesley Publication, 2nd ed., 2000.
5. SM. Rafiquzzaman, *Microprocessor Theory and Application*, Wiley Publication, 1st ed., 2008.

Reference Books

1. Simon Monk, *Programming the Raspberry Pi, Getting Started with Python* , McGraw Hill Professional, 3rd ed., 2021.
2. Derek Molloy, *Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux*, Wiley publications, 1st ed., 2016.
3. CyberPunk Architects , *The Computer Programming Bible: A Step by Step Guide On How To Master From The Basics to Advanced of Python, C, C++, C#, HTML Coding Raspberry Pi3*, C.P.A Inc, 1st ed., 2020.
4. John C. Shovic, *Raspberry Pi IoT Projects: Prototyping Experiments for Makers*, APress, 1st ed., 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: 8085 Microprocessor	**9**
1.1	Internal architecture of 8085 microprocessor	1
1.2	Functional block diagram	2
1.3	Instruction set - addressing modes - classification of instructions	2
1.4	Status flags-Machine cycles and T states	2
1.5	Fetch and execute cycles	1
1.6	Timing diagram for instruction and data flow	2
1.6	Solution of network equations by matrix representation	2
	Module 2: Assembly Language Programming	**10**
2.1	Introduction to assembly language programming - data transfer operations, arithmetic operations, logic operations, branching operations, I/O, and machine control operations	2
2.2	Assembly language programs (ALP) in 8085 microprocessor - data handling/data transfer, arithmetic operations	2
2.3	Code conversion - BCD to Binary - Binary to BCD	1
2.4	Sorting, stack and subroutines - conditional CALL and return instructions	1
2.5	Time delay subroutines using 8-bit register, 16-bit register pair, and nested loop control	2
2.6	Interrupt and interrupt handling - hardware and software interrupts	2
	Module 3: Embedded Systems	**8**
3.1	Introduction to embedded systems, current trends and challenges, applications of embedded systems - hard and soft real-time systems	2
3.2	Introduction to microcontrollers - microprocessor vs microcontroller. Introduction to Arduino UNO (8-bit) - hardware fundamentals of ATmega328P microcontroller-based board	2
3.3	Arduino Architecture, pin diagram, and functions of pins - overview of main features such as I/O ports, timers, interrupts, PWM, ADC (introduction only)	2
3.4	Introduction to Arduino IDE - Arduino libraries, steps for creating an Arduino program- Arduino sketch structure and flow- setup and loop functions(simple programs)	2
	Module 4: Arduino Programming	**9**
4.1	Programming - data types- operators	1
4.2	Conditional statements - loops, arrays and functions	1
4.3	Built-in functions in Arduino	1

4.4	Program to blink an LED and its control, interfacing LCD, seven segment LED	2
4.5	Switch interface, binary counter working with LED controlled by switch/potentiometer	2
4.6	Working with basic sensors and actuators using Arduino	2
	Module 5: ARM (Advanced RISC Machines) based Embedded System Design	**9**
5.1	ARM architecture - RISC, CISC	1
5.2	ARM program model- Pipeline (3/5 stage)	2
5.3	Memory organization - privileged model - exceptions	1
5.4	ARM instruction set(simple programs) - overview of ARM CPU cores	1
5.5	Overview of Raspberry Pi - Introduction to Raspberry Pi, comparison of various Rpi models	1
5.6	Understanding SoC architecture and SoCs used in Raspberry Pi, pin description of Rpi, on-board components of Rpi	2
5.7	Seminar on applications of microcontrollers on consumer electronics (Tutorial/Assignment only)	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Describe the register organization in 8085 microprocessor.
2. Explain the Stack and subroutine operations.
3. Draw the timing diagrams of different instructions of 8085 microprocessor.

Course Outcome 2 (CO 2)

1. Describe the addressing modes of 8085 microprocessor.
2. Describe the various types of 8085 microprocessor instructions.
3. Write an ALP for data transfer, arithmetic, logical and branching operations.

Course Outcome 3 (CO 3)

1. Explain the architecture of Arduino UNO.
2. Differentiate between microprocessor and microcontroller.

3. Differentiate hard and soft real systems.

Course Outcome 4 (CO 4)

1. Explain the working of sensors of Arduino UNO.
2. List the data types in Arduino UNO.
3. Differentiate hard and soft real systems.

Course Outcome 5 (CO 5)

1. Explain RISC ARM architecture.
2. Illustrate 3/5 pipeline stages of ARM program model.
3. Explain ARM memory organization.

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: : B24EE2T08

Course Name: : MICROPROCESSORS AND MICROCONTROLLERS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List the control and status signals of 8085.
2. Explain the operation of the following 8085 instructions:
   (i) DAD D (ii) INR M (iii)XCHG
3. Describe the addressing modes of 8085 microprocessor.
4. Write an ALP for data transfer, arithmetic, logical and branching operations.
5. Explain the architecture of Arduino UNO.
6. Differentiate hard and soft real systems.
7. Explain the working of sensors of Arduino UNO.
8. Write a program to control the externally connected LED blinking.
9. Explain RISC ARM architecture.
10. Explain ARM memory organization.

PART B

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

11. (a) Explain the architecture of 8085 microprocessor with the help of a neat diagram. (10 marks)

    (b) dentify the machine cycles of the following instructions:
    (i) MOV B, M (ii) MVI A, 05H (iii) STA 2065H (iv) OUT 0lH. (4 marks)

OR

12. (a) Sketch and explain the timing diagram of the instruction MOV M, A with opcode 77H stored in the memory location 4500H. (9 marks)

    (b) Define PUSH and POP instructions of 8085. (5 marks)

13. Write a program to sort an array of 5 numbers in ascending order. (14 marks)

OR

14. Write an 8085 ALP to find 2' complement of an 8-bit number which is stored in location 2050H. (14 marks)

15. (a) Explain hard real-time considerations and soft real-time considerations. (4 marks)

    (b) Explain the main features of the ATmega328P microcontroller, and how do they influence the performance of the Arduino UNO. (10 marks)

OR

16. Arduino UNO considered an 8-bit microcontroller. Justify. (14 marks)

17. (a) Explain the data types in Arduino programming. (7 marks)

    (b) Explain conditional statements in Arduino, and how are they used to control program flow. (7 marks)

OR

18. (a) Illustrate the working of the digitalWrite() function work, and how do you use it to control an LED. (7 marks)

    (b) Write a program to display text on an LCD screen using the LiquidCrystal library. (7 marks)

19. (a) Differentiate between RISC (Reduced Instruction Set Computing) and CISC (Complex Instruction Set Computing). (7 marks)

    (b) Illustrate key differences between a 3-stage and 5-stage pipeline in terms of instruction processing and performance. (7 marks)

OR

20. (a) Explain Raspberry Pi, and its primary use cases in the fields of education, hobbyist projects, and embedded systems. (7 marks)

    (b) Explain the key differences between the Raspberry Pi 3, Raspberry Pi 4, and Raspberry Pi Zero models. (7 marks)

B24EE2L05	ELECTRICAL MACHINES LAB I	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

This course provides hands-on experience in operating and testing DC machines and transformers, reinforcing concepts such as voltage regulation, efficiency, and load performance. The course includes a series of experiments focused on the operation, performance analysis, and efficiency assessment of various electrical machines, including DC shunt generators, DC motors, and single-phase and three-phase transformers. By engaging with these experiments, students will develop a robust understanding of machine operations, enhance their analytical skills, and be well-prepared to tackle real-world challenges in the electrical engineering domain.

Prerequisite

DC Machines and Transformers.

Course Outcomes

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

CO 1	Analyze the performance characteristics of DC machines by conducting suitable no load/load tests. (Cognitive Knowledge Level: Apply)
CO 2	Determine the losses and efficiency in DC machines by conducting suitable no load/load tests. (Cognitive Knowledge Level: Apply)
CO 3	Determine the voltage regulation, efficiency, and losses of single phase and three phase transformers by conducting suitable no load/load tests. (Cognitive Knowledge Level: Apply)
CO 4	Understand the load sharing between parallel connected single-phase transformers by conducting suitable tests. (Cognitive Knowledge Level: Understand)
CO 5	Develop team management skills and prepare laboratory reports that logically and scientifically communicate experimental information. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	1	1	2	2	1	3	3	1	3
CO 2	3	2	2	1	1	2	2	1	3	3	1	3
CO 3	3	2	2	1	1	2	2	1	3	3	1	3
CO 4	3	2	2	1	1	2	2	1	3	3	1	3
CO 5	1	1	1	1	1	2	2	1	3	3	1	3

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
Performance	10 marks
Viva-Voce	5 marks
Lab Record	5 marks
Internal Exam	20 marks

End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding the award of marks

1. Preliminary work : 25 Marks
   (a) Circuit Diagram: 15 Marks
   (b) Theory and Procedure: 10 Marks
2. Implementing the work/Conducting the experiment : 30 Marks (usage of equipment and troubleshooting)
3. Result and Inference : 15 Marks
4. Viva Voce : 30 Marks

Students having a certified Lab record are only eligible to appear for the End Semester Examination.

SYLLABUS

LIST OF EXPERIMENTS

1	Plot Open Circuit Characteristics (OCC) of DC shunt generator to determine the critical field resistance and critical speed.
2	Load test on DC shunt and compound generator to plot the external and internal characteristics.
3	Brake test on DC shunt and series motors to plot their performance characteristics.
4	Swinburne's Test on a DC shunt machine to predetermine the efficiency of the machine when working as a motor and as a generator for various load conditions.
5	Hopkinson's test on a pair of DC machines to determine the efficiency of the DC machine while working as a motor and generator under various load conditions.
6	Retardation test on a DC machine to determine hysteresis, eddy current, friction and windage losses, and moment of inertia of the rotating system.
7	OC and SC tests on a single-phase transformer to predetermine the voltage regulation and efficiency at different loads and power factors.
8	Direct load test on a single-phase transformer to determine the voltage regulation and efficiency at different loads and power factors.
9	Sumpner's test on single phase transformers to predetermine regulation and efficiency at different loads and power factors.
10	Separation of constant losses of a single-phase transformer.
11	Parallel operation of two single-phase transformers.
12	OC and SC tests on a three-phase transformer to predetermine the efficiency and regulation at different load conditions and power factors.

Reference Books

1. P. S. Bimbhra, *Electrical Machinery*, Khanna Publishers, 7th ed., 2021.
2. D. P. Kothari and I. J. Nagrath, *Electric Machines*, Tata McGraw Hill, 5th ed., 2017.
3. B. L. Theraja , *A Textbook of Electrical Technology*, S. Chand and Company, 2014.
4. V. K. Mehta and Rohit Mehta, *Principles of Electrical Machines*, S. Chand and Company, 2014.
5. M. V. Deshpande, *Electrical Machines*, Prentice Hall India, 2011.
6. A. E. Fitzgerald, C. Kingsley and S. Umans, *Electric Machinery*, McGraw Hill, 6th ed., 2003.
7. A. E. Clayton and N. N. Hancock, *The Performance and design of Direct Current Machines*, CBS Publishers and Distributors, 2018.

B24EE2L06	ELECTRONIC CIRCUITS LAB II	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

This course aims to provide hands-on experience in designing and analyzing various analog and mixed-signal circuits using operational amplifiers, waveform generators, and data converters. The lab covers op-amp-based circuits, oscillators, multivibrators, ADC/DAC, and phase-locked loops, focusing on practical applications in signal processing and instrumentation. Upon completion, students will be able to design, implement, and test analog circuits, analyze their performance, and apply them in real-world electronic systems.

Prerequisite

Electronic Circuits II.

Course Outcomes

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

CO 1	Understand and design fundamental operational amplifier circuits such as inverting, non-inverting, summing, integrator, and differentiator circuits and precision rectifiers for signal processing applications. (Cognitive Knowledge Level: Understand)
CO 2	Design, implement and test square and triangular wave generators, oscillators (RC Phase-Shift, Wien Bridge), and multivibrators (astable, monostable, Schmitt trigger) using op-amps and timers. (Cognitive Knowledge Level: Apply)
CO 3	Understand and implement Digital-to-Analog Converters (DAC), Analog-to-Digital Converters (ADC), and instrumentation amplifiers for measurement and signal conditioning applications. (Cognitive Knowledge Level: Understand)
CO 4	Understand the working of Phase-Locked Loops (PLL) as free-running oscillators and frequency multipliers in communication and control systems. (Cognitive Knowledge Level: Understand)
CO 5	Develop team management skills and prepare laboratory reports that logically and scientifically communicate experimental information. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	2	1	1	1	1	2	2	1	2
CO 2	3	3	3	2	1	1	1	1	2	2	1	2
CO 3	3	3	3	2	1	1	1	1	2	2	1	2
CO 4	3	3	3	2	1	1	1	1	2	2	1	2
CO 5	3	3	3	2	1	1	1	1	2	2	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
Performance	10 marks
Viva-Voce	5 marks
Lab Record	5 marks
Internal Exam	15 marks
Micro Project	5 marks

End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding the award of marks

1. Preliminary work : 25 Marks
   (a) Circuit Diagram: 15 Marks
   (b) Theory and Procedure: 10 Marks
2. Implementing the work/Conducting the experiment : 30 Marks (usage of equipment and troubleshooting)
3. Result and Inference : 15 Marks
4. Viva Voce : 30 Marks

Micro Project: Students must complete a mandatory micro project in groups of up to four members. The project should involve the design and realization of a functional analog circuit using an operational amplifier (Op-Amp), along with a small hardware implementation. This project will be evaluated as part of the continuous internal evaluation, with a maximum of 5 marks. **Students having a certified Lab Record and Micro Project Report are only eligible to appear for the End Semester Examination.**

SYLLABUS

LIST OF EXPERIMENTS

1	Design and implementation of inverting, non-inverting, summer, integrator, and differentiator circuits using Op-Amp.
2	Design and testing of Square and Triangular Wave Generator.
3	Design and testing of Precision Rectifier using Op-Amp.
4	Design and testing of RC Phase-Shift Oscillator using Op-Amp.
5	Design and testing of Wien Bridge Oscillator.
6	Design and testing of Schmitt Trigger.
7	Design and testing of Astable Multivibrator using IC 741.
8	Design and testing of Astable and Monostable Multivibrator Using IC 555.
9	Implementation of Instrumentation Amplifier Using IC 741.
10	Design and testing of Digital to Analog Converter (DAC) using a Weighted Resistor and Ladder Network.
11	Design and testing of Analog to Digital Converter (Flash ADC).
12	Implementation of Phase-Locked Loop as a Free-Running Oscillator and Frequency Multiplier.

Reference Books

1. Sergio Franco, *Design with Operational Amplifiers and Analog Integrated Circuits*, Tata McGraw-Hil, 4th ed., 2016.
2. D. Roy Choudhury and Shail Jain, *Linear Integrated Circuits*, New Age International Publishers, 4th ed., 2017.
3. Ramakanth A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, Pearson Education, 4th ed., 2015.

4. Adel S. Sedra and Kenneth C. Smith, *Microelectronic Circuits*, Oxford University Press, 7th ed., 2014.

5. Boylestad R. L. and L. Nashelsky, *Electronic Devices and Circuit Theory*, Pearson Education India, 11th ed., 2012.

6. Donald O. Pederson and Kartikeya Mayaram, *Analog Integrated Circuits for Communication*, Kluwer Academic Publishers, 2nd ed., 2007.

7. Jacob Millman and Christos C. Halkias, *Electronic Devices and Circuits*, McGraw-Hill Education, 3rd ed., 2010.

8. Marcel J. M. Pelgrom, *Analog-to-Digital Conversion*, Springer Publishers, 3rd ed., 2020.

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MINOR

<table>
<tr><td rowspan="2">B24EEM41</td><td rowspan="2">LINEAR CONTROL SYSTEMS</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>
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Preamble

This course provides a foundational understanding of classical control theory, focusing on linear systems. It covers system modeling, time and frequency domain analysis, stability analysis, and compensator design using the transfer function approach.

Prerequisites

Nil

Course Outcomes

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

CO 1	Understand the role of various control blocks and components in feedback systems. (Cognitive Knowledge Level: Understand)
CO 2	Illustrate various control system components and the time domain responses of the linear systems. (Cognitive Knowledge Level: Understand)
CO 3	Describe the concept of stability analysis in control systems. (Cognitive Knowledge Level: Understand)
CO 4	Apply Root locus technique to assess the performance of linear systems. (Cognitive Knowledge Level: Apply)
CO 5	Develop the frequency domain analysis of the given LTI systems. (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								3	
CO 2	3	3	2								3	
CO 3	3	3	2								3	
CO 4	3	3	3	2							3	
CO 5	3	3	3	2							3	

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (% Marks)	**Test 2 (% Marks)**	
Remember	20	20	10
Understand	40	40	40
Apply	40	40	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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

Overview of Control Systems

Open-loop and closed-loop systems, feedback-advantages and limitations. Applications of control systems in engineering. Mathematical modeling of systems - mechanical and electromechanical systems, transfer function of LTI systems. Force voltage and force current analogy - block diagram representation - block diagram reduction. Signal flow graph - Mason's gain formula - characteristic equation.

MODULE 2 (9 hours)

Control System Components

DC and AC servo motors – synchro - gyroscope - stepper motor - tacho generator.

Time-Domain Analysis

Standard test signals: Step, ramp, impulse, and sinusoidal. Transient and steady-state responses of systems. Time-domain specifications: Rise time, delay time, maximum peak overshoot, peak time, settling time, Steady state errors, and error constants. Step responses of first and second order systems.

MODULE 3 (9 hours)

Error Analysis

Steady state error analysis - static error coefficient of type 0, 1, 2 systems - dynamic error coefficients. Concept of stability: definition and types of stability (absolute and relative stability). Stability in time-domain and frequency-domain analysis. Concept of bounded input, bounded output (BIBO) stability. Pole-zero locations and their impact on stability. Routh-Hurwitz stability criterion: formulation and applications. Time response for various pole locations - stability of feedback system.

MODULE 4 (9 hours)

Root Locus Analysis

Introduction to the root locus technique. Definition and significance of root locus in control system design. Rules for constructing root locus: Steps to sketch a root locus manually. System behavior on the root locus-effect of varying system gain K on the root locus. Relation between root locus, transient response, and stability. Movement of poles with gain adjustment and impact on time-domain specifications. Analysis for specific systems-root locus for second-order systems: oscillation and damping analysis. Special cases: Systems with repeated poles, zeros at infinity, or poles at the origin.

MODULE 5 (9 hours)

Introduction to Frequency Domain Analysis

Importance of frequency response in control systems. Frequency response characteristics - Gain, phase, and frequency relationship. Magnitude and phase plots for system transfer functions. Concept of resonance and resonant frequency. Bode plot analysis - construction of Bode magnitude and phase plots. Analysis of gain margin (GM) and phase margin (PM). Correlation between time and frequency response, minimum phase system. Determining system stability using Bode plots. Impact of poles and zeros on Bode plots. Polar plot- Nyquist stability criterion - Nichols chart, Non-minimum phase system (Basic concept only).

Text Books

1. Nagarath I. J. and Gopal M, *Control System Engineering*, New Age Publishers 8th ed., 2025
2. Ogata K, *Modern Control Engineering*, Prentice Hall of India, 5th ed., 2020.
3. Nise N. S., *Control Systems Engineering*, Wiley Eastern, 8th ed., 2020.

Reference Books

1. Gopal M., *Control Systems Principles and Design*, Tata McGraw Hill, 4th ed., 2023.
2. Kuo B. C., *Automatic Control Systems*, Prentice Hall of India, 10th ed., 2017.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Overview of Control Systems	**9**
1.1	Open-loop and closed-loop systems, Feedback-Advantages and limitations. Applications of control systems in engineering	1
1.2	Mathematical Modeling of Systems- Mechanical and Electromechanical systems	1
1.3	Transfer function of LTI systems	1
1.4	Force voltage and force current analogy	1
1.5	Block diagram representation - block diagram reduction	2
1.6	Signal flow graph - Mason's gain formula - characteristic equation	2
1.7	Transient and steady-state responses of systems	1
	Module 2: Control System Components and Time Domain Analysis	**9**
2.1	DC and AC servo motors	1
2.2	Synchro, gyroscope	1
2.3	Stepper motor, Tacho generator	1
2.4	Standard test signals: Step, ramp, impulse, and sinusoidal	1
2.5	Transient and steady-state responses of systems	1
2.6	Time-domain specifications: Rise time, peak time, delay time, settling time, maximum peak overshoot	2
2.7	Steady-state errors and error constants	1
2.8	Step responses of first and second order systems	1
	Module 3: Error Analysis	**9**
3.1	Steady state error analysis	1
3.2	Static error coefficient of type 0, 1, 2 systems	1
3.3	Dynamic error coefficients	1
3.4	Concept of stability: Definition and types of stability (absolute and relative stability)	1
3.5	Stability in time-domain and frequency-domain analysis	1
3.6	Concept of bounded input, bounded output (BIBO) stability	1
3.7	Pole-zero locations and their impact on stability	1
3.8	Routh-Hurwitz stability criterion: Formulation and applications	1
3.9	Time response for various pole locations - stability of feedback system	1
	Module 4: Root Locus Analysis	**9**
4.1	Definition and significance of root locus in control system design	1

4.2	Rules for constructing root locus: Steps to sketch a root locus manually	2
4.3	System Behavior on the Root Locus-Effect of varying system gain K on the root locus	1
4.4	Relation between root locus, transient response, and stability.	1
4.5	Movement of poles with gain adjustment and impact on time-domain specifications	1
4.6	Analysis for Specific Systems - Root locus for second-order systems: Oscillation and damping analysis	2
4.7	Systems with repeated poles, zeros at infinity, or poles at the origin	1
	Module 5: Introduction to Frequency Domain Analysis	**9**
5.1	Importance of frequency response in control systems	1
5.2	Frequency Response Characteristics-Gain, phase, and frequency relationship	1
5.3	Magnitude and phase plots for system transfer functions	1
5.4	Concept of resonance and resonant frequency	1
5.5	Bode Plot Analysis - Construction of Bode magnitude and phase plots	1
5.6	Analysis of gain margin (GM) and phase margin (PM)	1
5.7	Correlation between time and frequency response, minimum phase system	1
5.8	Determining system stability using Bode plots. Impact of poles and zeros on Bode plot	1
5.9	Polar plot- Nyquist stability criterion-Nichols chart - Non-minimum phase system	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Explain how does the feedback element affect the performance of the closed loop system.
2. Summarize how Mason's gain formula can be used to derive the transfer function of a given system.
3. Problems on block diagram reduction.

Course Outcome 2 (CO 2)

1. Show the different time domain specifications for a given second order system with step input.
2. Derive and explain the transfer function of AC servo motor.
3. Problems to calculate error constants.

Course Outcome 3 (CO 3)

1. Problems related to static error constant and steady state error for a given input.
2. Explain how pole locations can alter the stability of the system.
3. Problems related to Routh-Hurwitz stability criterion.

Course Outcome 4 (CO 4)

1. Problems on construction of root locus for different systems.
2. Illustrate how the addition of poles and zeros have an effect on root locus.
3. What is the effect of repeated poles in a system?

Course Outcome 5 (CO 5)

1. Problems on construction of Bode plot for different systems.
2. Problems related to assess the stability of the given system using Bode plot.
3. Explain concept of Nyquist stability criterion.

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: : : B24EEM41

Course Name: : LINEAR CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

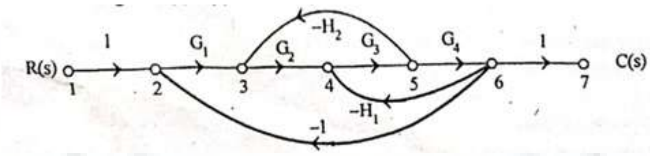
Answer all questions. Each question carries 3 marks.

1. Give a comparison between open loop and closed loop control systems.
2. Explain force-voltage and force-current analogies with one example each.
3. List The different Standard test signals used in the analysis of control systems.
4. For the closed loop system $G(s) = \frac{1}{s(s+5)}$ $H(s) = 0.05$,calculate the steady state error constants
5. Differentiate between absolute and relative stability.
6. How do pole-zero locations affect system stability?
7. What is the root locus technique? State its significance in control system design.
8. With suitable sketches explain how the addition of poles to the open-loop transfer function affect the root locus plots.
9. Explain the features of non-minimum phase systems.
10. Define gain margin and phase margin.

PART B

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

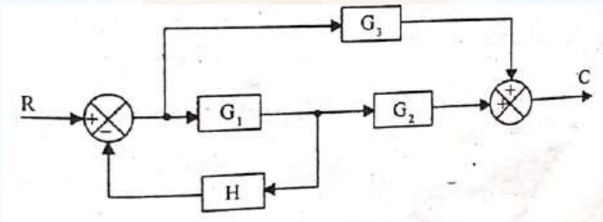
11. Applying Mason's gain formula, derive the transfer function of the system whose signal flow graph is given below. (14 marks)



OR

12. (a) List the advantages of negative feedback over positive feedback system. (4 marks)

(b) Reduce the block diagram and hence find out $\frac{C(s)}{R(s)}$. (10 marks)



13. (a) Derive the transfer function of an Armature controlled dc servo motor. Assess the effect of time constants on the system performance. (10 marks)

(b) Differentiate between Transient and steady-state responses of a second order system. (4 marks)

OR

14. (a) With the help of a neat diagram, define rise time, delay time, peak time, Maximum overshoot and settling time in time-domain specifications of a second order system when exited by a step input. (10 marks)

(b) A system has the transfer function $\frac{Y(s)}{X(s)} = \frac{50}{x^2+10s+50}$. Determine the damping ratio and natural frequency. (4 marks)

15. (a) Explain how Routh-Hurwitz stability criterion can be used to find out the stability of the system. Also, illustrate how to find out if the system is marginally stable using the Routh criteria. (10 marks)

(b) Using Routh criterion, determine the value of K for which the unity feedback closed loop system with $G(s) = \frac{K}{s(s^2+20s+8)}$ is stable. (4 marks)

OR

16. (a) Explain steady-state error analysis for type-0, type-1, and type-2 systems. Derive the steady-state error for a unit ramp input for a type-1 system.

    (10 marks)

    (b)) A type-1 system has the open-loop transfer function $G(s) = \frac{50}{s(s+5)}$. Find the steady-state error for a unit ramp input. (4 marks)

17. (a) Define Angle and Magnitude criteria used in the Root locus method. (4 marks)

    (b) Sketch root locus for a system with $G(s)H(s) = \frac{K(s+1)}{s(s+4)}$. Hence determine the range of K for the system stability. (10 marks)

OR

18. (a) Briefly explain the steps for constricting root locus of a system. (4 marks)

    (b) Sketch the root locus for a system with $G(s)H(s) = \frac{K}{s(s+1)(s+3)}$. (10 marks)

19. (a) What is a Nichols chart used for? (4 marks)

    (b) A system has the transfer function $G(s) = \frac{10}{s(s+2)}$. Construct the Bode magnitude and phase plots and determine the gain margin and phase margin. (10 marks)

OR

20. The open-loop transfer function of the system is given by $G(s) = \frac{50}{s(s+2)(s+5)}$. Construct the Bode magnitude and phase plots and determine the gain margin (GM) and phase margin (PM). (14 marks)

B24EEM42	FUNDAMENTALS OF ELECTRICAL MACHINES	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	0	4	2024

Preamble

The purpose of the course is to provide the concept of electrical machines including construction details, principle of operation and performance analysis. This course provides an overview of DC machines, transformers, synchronous machines and induction machines. After the completion of the course, the students will be able to identify the appropriate electrical machines required for different applications, considering the parameters like input supply voltage, output torque, and speed.

Prerequisites

Basics of Electrical Engineering/Fundamentals of Electrical Engineering.

Course Outcomes

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

CO 1	Analyze the knowledge about constructional details of DC machines. (Cognitive Knowledge Level: Apply)
CO 2	Evaluate the performance of a single phase transformer based on appropriate test results. (Cognitive Knowledge Level: Apply)
CO 3	Analyse the performance of the synchronous motor. (Cognitive Knowledge Level: Apply)
CO 4	Analyse the performance of different types of induction motors. (Cognitive Knowledge Level: Apply)
CO 5	Analyse the performance of single phase and permanent magnet motors which can be used for household 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	2			1	1			3
CO 2	3	3		1		2		1	1			3
CO 3	3	3	2	1		2		1	1			2
CO 4	3	3	2	1		2		1	1	1		2
CO 5	3	2		1	2	2	1	1	1	1	1	2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (% Marks)	**Test 2 (% Marks)**	
Remember	20	20	10
Understand	40	40	40
Apply	40	40	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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (10 hours)

DC Machines

Principle of operation of DC generator, emf equation, types of excitations - separately excited, shunt and series excited DC generators, compound generators. General idea of armature reaction, open circuit and load characteristics - simple numerical problems. Principles of DC motors, torque and speed equations, torque speed characteristics, characteristics and applications of DC shunt, series, and compound motors. Methods of starting, losses, and efficiency - numerical problems.

MODULE 2 (8 hours)

Transformers

Principle of operation, emf equation, phasor diagram, losses and efficiency, OC and SC tests. Equivalent circuits, efficiency calculations, maximum efficiency - all day efficiency, numerical problems.

MODULE 3 (9 hours)

Synchronous Machines

Parts of synchronous generator, principle of operation, types, emf equation of alternator, regulation of alternator under lagging and leading power factor – determination of regulation by emf method – numerical examples. Principle of operation of synchronous motors, methods of starting, V curves, synchronous condenser.

MODULE 4 (8 hours)

Three-phase Induction Motors

Slip ring and squirrel cage types, principle of operation, rotating magnetic field, equivalent circuit, torque slip characteristics, no load and blocked rotor tests. Methods of starting – direct online, star delta, rotor resistance, and auto transformer starting. Induction generator, principle of operation, self excited induction generators.

MODULE 5 (9 hours)

Single-phase Motors

Principle of operation of single phase induction motor, split phase motor, capacitor start motor. Stepper motor – principle of operation, types. Principle of operation and applications of universal motor and servo motor (DC and AC). Permanent magnet motors - principle of operation of PMSM and PMBLDC motor applications.

Text Books

1. P. S. Bimbhra, *Electrical Machinery*, Khanna Publishers, 7th ed., 2021.

2. D. P. Kothari and I. J. Nagrath, *Electric Machines*, Tata McGraw Hill, 5th ed., 2017.

3. B. L. Theraja , *A Textbook of Electrical Technology*, S. Chand and Company, 2014.

Reference Books

1. A. E. Fitzgerald, C. Kingsley and S. Umans, *Electric Machinery*, McGraw Hill, 6th ed., 2003.

2. Langsdorf M. N., *Theory of Alternating Current Machinery*, Tata McGraw Hill, 2001.

3. Say M. G., *The performance and Design of AC Machines*, CBS Publishers, New Delhi, 2002.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	**Topic**	**No of Lecture/Tutorial Hours**
	Total Hours	44 Hours
	Module 1: DC Machines	**10**
1.1	Principle of operation-emf equation-types of excitations - separately	3
1.2	General idea of armature reaction, OCC and load characteristics - numerical problems	2
1.3	Principles of DC motor-torque and speed equations-torque speed characteristics	2
1.4	Characteristics and applications of DC shunt, series and compound motors. Principles of starting, losses and efficiency - numerical problems	3
	Module 2: Transformers	**8**
2.1	Principle of operation - emf equation, phasor diagram	2
2.2	Losses and efficiency - OC and SC tests, Equivalent circuit	3
2.3	Efficiency calculations-maximum efficiency-all day efficiency - numerical problems	3
	Module 3: Synchronous Machines	**9**
3.1	Parts of synchronous generator - principle of operation - types	2
3.2	Emf equation of alternator - regulation of alternator under lagging and leading power factor - numerical problems	2

3.3	Determination of regulation by emf method -numerical examples	2
3.4	Principle of operation of synchronous motors-methods of starting. V-curves-synchronous condenser	3
	Module 4: Three-phase Induction Motors	**8**
4.1	Slip ring squirrel cage Types - principle of operation–rotating magnetic field	2
4.2	Torque-slip characteristics - noload and blocked rotor tests, equivalent circuit - numerical problems	3
4.3	Methods of Starting - direct online,star-delta, rotor resistance and autotransformer starting	2
4.4	Induction Generator - principle of operation - self excited induction generators	1
	Module 5: Single-phase Motors	**9**
5.1	Principle of operation Single Phase Induction Motor – split phase motor - capacitor start motor	2
5.2	Stepper motor - principle operation - types	2
5.3	Universal motor, servo motor - DC and AC servomotors–principle of operation, applications	3
5.4	Permanent magnet motors - principle operation PMSM and PMBLDC motor, applications	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Discuss the types of dc generators based on the method of excitation.
2. Discuss the applications of dc motors based on their characteristics.

Course Outcome 2 (CO 2)

1. Draw the phasor diagram of a single phase transformer.
2. Problems based on efficiency calculations, all day efficiency.

Course Outcome 3 (CO 3)

1. Derive the expression for induced emf of alternator.
2. Problems on calculating induced emf of alternator.

3. Why synchronous motor is not self starting? Discuss any two starting methods of synchronous motor?

4. What are V and Inverted V curves?

Course Outcome 4 (CO 4)

1. Explain the working principle of a three-phase induction motor.

2. Why starting current of induction motor is high? Explain any two starting methods.

Course Outcome 5 (CO 5)

1. With the help of a neat diagram explain any two starting methods of single phase induction motor.

2. Discuss the advantages of permanent magnet rotor compared to the conventional construction.

3. Explain the principle of operation of a stepper motor.

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: : B24EEM42

Course Name: : FUNDAMENTALS OF ELECTRICAL MACHINES

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Derive an expression for emf generated in a DC machine.
2. Explain the principle of operation of a DC motor.
3. Draw the phasor diagram of a single-phase transformer working under no load condition.
4. The emf per turn of a single-phase 2200/220 V, 50 Hz transformer is approximately 12 V. Calculate (a) the primary and secondary turns (b) the net cross-sectional area of the core if the maximum flux density is 1.5 Wb/ m^2.
5. How is voltage regulation of an alternator affected by the load connected to its terminals?
6. Why is the synchronous motor not self-starting?
7. Explain torque-slip characteristics of a three-phase induction motor.
8. A three-phase induction motor has 2 poles and is connected to 400 V, 50 supply. Calculate the actual rotor speed and rotor frequency when slip is 4%.
9. Explain the working of a single-phase induction motor.
10. List any three applications of PMBLDC motors.

PART B

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

11. (a) Briefly explain the armature reaction of a DC machine. (5 marks)

    (b) Classify DC generators based on their method of excitation with the help of neat diagrams. (9 marks)

OR

12. (a) Explain the power stages of a DC motor. (4 marks)

    (b) A 75 kW, 250 V DC compound generator has the following data. $R_a = 0.043\,\Omega$, $R_{se} = 0.004\,\Omega$, $R_f = 100\,\Omega$, Brush contact drop = 1 V/brush. Compare the generated emf when fully loaded for (i) short shunt compound (ii) long shunt compound. (10 marks)

13. (a) Draw the equivalent circuit of a single phase transformer and explain how the parameters are obtained from the test results. (10 marks)

    (b) In a 25 kVA, 2000/200 V transformer, the iron and copper losses are 300 W and 400 W respectively. Calculate the efficiency at unity pf at (i) full load (ii) half load. (4 marks)

OR

14. (a) What is all day efficiency? Explain its significance. (4 marks)

    (b) A transformer has its maximum efficiency of 0.98 at 20 kVA at unity pf. During the day it is loaded as follows: 12 hours - 2 kW at pf 0.6, 6 hours – 10 kW at pf 0.8, 6 hours – 20 kW at pf 0.9. Find the all day efficiency of the transformer. (10 marks)

15. (a) Explain the constructional details of a synchronous machine. (9 marks)

    (b) A 200 kVA, 3.3 kV, 50 Hz, three phase synchronous generator is star connected. The effective armature resistance is 5 Ω/phase and synchronous reactance is 29.2 Ω/phase. At full load calculate the voltage regulation for 0.8 lagging and 0.8 leading power factors. (5 marks)

OR

16. (a) i. Explain V curves of a synchronous motor. (3 marks)

    ii. What is a synchronous condenser? (2 marks)

    (b) What is voltage regulation? Explain the method of finding regulation by emf method. (9 marks)

17. (a) Explain the working principle of a three phase induction motor. (5 marks)

    (b) Explain the methods of starting of a three phase induction motor. (9 marks)

OR

18. (a) The no load and blocked rotor test results conducted on a 30 hp, 835 rpm, 440V, 3 phase, 60 Hz, squirrel cage induction motor are as follows.
No load test: 440V, 14 A, 1470 W
Blocked rotor test: 163V, 60A, 7200 W.
Resistance measured between two terminals is 0.5 Ω. Determine the equivalent circuit parameters. (10 marks)

(b) What is a self-excited induction generator?. (4 marks)

19. (a) What are the applications of servomotors? (4 marks)

(b) Explain the different types of stepper motors. (10 marks)

OR

20. (a) What are universal motors? Explain their working. (9 marks)

(b) Write a short note on permanent magnet motors. (5 marks)

B24EEM43	ENERGY STORAGE SYSTEMS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

The purpose of the course is to introduce the importance and application of energy storage systems. This course provides an overview of different energy storage technologies. After completion of this course students will be able to understand the applications of energy storage technologies.

Prerequisites

Introduction to Power Engineering.

Course Outcomes

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

CO 1	Understand the role of energy storage in power systems. (Cognitive Knowledge Level: Remember)
CO 2	Describe thermal, kinetic and potential storage technologies and their applications. (Cognitive Knowledge Level: Understand)
CO 3	Describe electrochemical, electrostatic and electromagnetic storage technologies. (Cognitive Knowledge Level: Understand)
CO 4	Illustrate energy storage technology in renewable energy integration. (Cognitive Knowledge Level: Understand)
CO 5	Analyse energy storage technology applications for smart grids. (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										
CO 2	3											
CO 3	3	2	1				1					
CO 4	3	2	1			1	1					1
CO 5	3	1	1			1	1					1

Assessment Pattern

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

noindent There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

Introduction to Energy Storage in Power Systems

Need and role of energy storage systems in power system, general considerations, energy and power balance in a storage unit, mathematical model of storage system: modelling of power transformation system (PTS) - central store (CS) and charge–discharge control system (CDCS), econometric model of storage system.
Storage applications - general considerations, static and dynamic duties of storage plant, storage at the user's level, storage and transport, applications.

MODULE 2 (10 hours)

Energy Storage Technologies I

Thermal energy storage - general considerations, storage media containment, power extraction, thermal energy storage in a power plant, economic evaluation. Flywheel storage - general considerations, flywheel as a central store, applications. Pumped hydro storage - general considerations, power extraction system, central store for pumped hydro. Compressed air energy storage - general considerations basic principles, central store, power extraction system, despatch and economic limitations. Hydrogen and other synthetic fuels - general considerations, synthetic storage media, hydrogen production, storage containment for hydrogen, hydride concept.

MODULE 3 (10 hours)

Energy Storage Technologies II

Electrochemical energy storage - General considerations, Primary vs Secondary batteries, battery parameters- C-rating, SoC, DoD, specific energy, specific power. Fuel cells - schematic diagram of an electrochemical fuel cell, thermal regime, power extraction system. Capacitor bank storage - capacitor storage media, power extraction Superconducting magnetic energy storage - basic principles, superconducting coils, cryogenic systems, power extraction. Considerations on the choice of a storage system - comparison of storage technique.

MODULE 4 (8 hours)

Energy Storage and Renewable Power Sources

Types of renewable energy sources - wave, wind, tidal, small-scale hydroelectric energy, solar thermal technologies and photovoltaics, storage role in isolated power systems with renewable power sources, storage role in an integrated power system with grid connected renewable power sources.

MODULE 5 (8 hours)

Energy Storage Applications

Smart grid, smart microgrid, smart house, field of electromobility - thyristor based battery charger and DC power supply, mobile storage system: Electric vehicles – Grid to Vehicle (G2V)-Vehicle to Grid (V2G), Management and control hierarchy of storage systems- aggregating energy storage systems and distributed generation (virtual power plant energy management with storage systems), battery SCADA, hybrid energy storage systems: configurations and applications.

Text Books

1. A. G. Ter-Gazarian,*Energy Storage for Power Systems*, The Institution of Engineering and Technology (IET) Publication, UK, 2nd ed., 2011.

2. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt, *Energy Storage in Power Systems* Wiley Publication, ISBN: 978-1-118-97130-7, 2016.

Reference Books

1. Electric Power Research Institute (USA), *Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits* (1020676), December 2010.

2. Paul Denholm, Erik Ela, Brendan Kirby and Michael Milligan, *The Role of Energy Storage with Renewable Electricity Generation*, National Renewable Energy Laboratory (NREL).

3. P. Nezamabadi and G. B. Gharehpetian, *Electrical energy management of virtual power plants in distribution networks with renewable energy resources and energy storage systems*, IEEE *Power Distribution Conference*, 2011.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Introduction to Energy Storage in Power Systems	**9**
1.1	General considerations - different parts of energy storage unit - static duty of storage plant - dynamic duty of storage plant	2
1.2	Energy and power balance in a storage unit- schematic structure of energy storage	1
1.3	Mathematical model of storage system	1
1.4	Econometric model of storage- capital cost of energy storage- annual cost of storage facility	2
1.5	Storage applications - general considerations, static and dynamic duties of storage plant	2
1.6	Storage at the user's level, storage and transport, applications	1
	Module 2: Energy Storage Technologies I	**10**
2.1	Thermal energy storage - general considerations, storage media containment, power extraction, thermal energy storage in a power plant, economic evaluation	2
2.2	Flywheel storage - general considerations, flywheel as a central store, applications	2
2.3	Pumped hydro storage - general considerations, power extraction system, central store for pumped hydro	2
2.4	Compressed air energy storage - general considerations basic principles, central store, power extraction system, despatch and economic limitations.	2
2.5	Hydrogen and other synthetic fuels - general considerations, synthetic storage media, hydrogen production, storage containment for hydrogen, hydride concept	2
	Module 3: Energy Storage Technologies II	**10**
3.1	Electrochemical energy storage - General considerations, Primary vs Secondary batteries	2
3.2	Battery parameters- C-rating, SoC, DoD, specific energy, specific power	1
3.3	Fuel cells - schematic diagram of an electrochemical fuel cell, thermal regime, power extraction system	2
3.4	Capacitor bank storage - capacitor storage media, power extraction	2
3.5	Superconducting magnetic energy storage - basic principles, superconducting coils, cryogenic systems, power extraction	2

3.6	Considerations on the choice of a storage system - comparison of storage technique	1
	Module 4: Energy Storage and Renewable Power Sources	**8**
4.1	Types of renewable power sources - wave, wind, tidal (brief description)	2
4.2	Small scale hydroelectric energy sources	1
4.3	Solar thermal technologies and photovoltaics	2
4.4	Storage role in isolated power system with renewable power	1
4.5	Storage role in an integrated power system with grid-connected renewable power sources	2
	Module 5: Energy Storage Applications	**8**
5.1	Smart grid, smart microgrid, smart house - concepts, characteristics, smart metering	2
5.2	Field of electromobility - thyristor based battery charger and DC power supply	1
5.3	Mobile storage system: Electric vehicles – Grid to Vehicle (G2V)-Vehicle to Grid (V2G)	1
5.4	Management and control hierarchy of storage systems - aggregating energy storage systems and distributed generation (virtual power plant energy management with storage systems)	2
5.5	Battery SCADA	1
5.6	Hybrid energy storage systems: configurations and applications	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. What are the different parts of a complete energy storage unit?
2. Explain the Dynamic Duty of storage plant.
3. What are the different types of central store?

Course Outcome 2 (CO 2)

1. List the applications of thermal energy storage systems.
2. Explain hydrogen-based power utility concept.
3. What are the different storage containments of hydrogen?

Course Outcome 3 (CO 3)

1. Explain the working of fuel cell along with schematic diagram.
2. Write short notes on supercapacitors.
3. Explain the arrangement of a control and protection system for Super Conducting Magnetic Energy Storage.

Course Outcome 4 (CO 4)

1. Explain small-scale hydroelectric energy.
2. Write short notes on wave energy and its storage system.
3. What are the different types of renewable power sources?

Course Outcome 5 (CO 5)

1. Explain distributed energy storage system.
2. What are the characteristics of smart grid system?
3. What is demand response?

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: : B24EEM43

Course Name: : ENERGY STORAGE SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Discuss the power transformation of energy storage system.
2. Explain the different components of energy storage system with schematic structure.
3. Define Flow equation related to thermal energy storage system.
4. Write the difference between hybrid and combined energy storage in power system.
5. Explain the chemical reaction of lead acid batteries.
6. Write down the basic principle of capacitor bank storage system.
7. Classify hydro power plants based on their rated capacity.
8. Briefly discuss small-scale hydroelectric energy system.
9. What is distributed energy storage system?
10. List the various layers of smart grid.

PART B

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

11. (a) Explain static duty of energy storage plant. (8 marks)
    (b) With neat diagram explain energy and power balance in a storage unit. (6 marks)

OR

12. (a) Explain the econometric model of energy storage. Derive the expression for annual cost of the system. (10 marks)
    (b) What are the key parameters considered for the comparison of energy storage in power system? (4 marks)

13. (a) Discuss the working principle of compressed air energy storage system. (10 marks)
    (b) Write a short note on flywheel energy storage system. (4 marks)

OR

14. (a) Write any three industrial methods to produce hydrogen. (9 marks)
    (b) Explain 'power to gas' concept. (5 marks)

15. (a) Explain the working of Li-ion batteries. (7 marks)
    (b) Describe the typical voltage–discharge profile for a battery cell. (7 marks)

OR

16. (a) Describe the basic principle and working of superconducting magnetic energy storage system. (7 marks)
    (b) With the help of a block diagram, explain the arrangement of control and protection system for superconducting magnetic energy storage system. (7 marks)

17. (a) What are the main features of renewable energy systems? (4 marks)
    (b) Explain the role of storage systems in an integrated power system with grid-connected renewable power sources. (10 marks)

OR

18. (a) Explain photovoltaics system. (12 marks)
    (b) Discuss the role of storage in an isolated power system with renewable power sources. (2 marks)

19. (a) Describe the distributed energy storage system. (6 marks)
    (b) "HEV act as a distributed energy generator and storage", justify your answer. (8 marks)

OR

20. (a) What is demand response? (5 marks)
    (b) Draw and explain the battery SCADA system. (9 marks)

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HONORS

B24EEH41	NETWORK ANALYSIS AND SYNTHESIS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	2	0	2	4	2024

Preamble

This course aims to provide an in-depth exploration of concepts and techniques beyond the foundational knowledge of electrical circuits and networks. It is designed to deepen knowledge beyond basic circuit analysis, focusing on the intricate behaviors of complex networks and introducing essential concepts in network synthesis and filter design. Its goal is to broaden the student's understanding and skills in both the theoretical and practical aspects of network behavior, enabling them to analyze and design more sophisticated electrical systems.

Prerequisites

Circuits and Networks.

Course Outcomes

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

CO 1	Apply network topology concepts in the formulation and solution of electric network problems. (Cognitive Knowledge Level: Apply)
CO 2	Apply Kirchoff's law and tellegens theorem to formulate and solve network equations involving both independent and dependent sources. (Cognitive Knowledge Level: Apply)
CO 3	Apply two-port network analysis in the design and analysis of filter and attenuator networks. (Cognitive Knowledge Level: Apply)
CO 4	Identify the properties and characteristics of network functions, and verify the mathematical constraints for their physical realisation. (Cognitive Knowledge Level: Understand)
CO 5	Synthesize passive one-port networks using standard Foster and Cauer forms. (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	1			1	1	2
CO 2	3	3	2	2	1	1	1			1	1	2
CO 3	3	3	2	2	1	1	1			1	1	2
CO 4	3	3	2	2	1	1	1			1	1	2
CO 5	3	3	2	2	1	1	1			1	1	2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (% Marks)	**Test 2 (% Marks)**	
Remember	30	30	20
Understand	40	40	50
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 contains 10 questions carrying 3 marks each. Part B contains two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (8 hours)

Network Topology

Linear oriented graphs - incidence matrix of a linear oriented graph - Kirchoff's laws in incidence matrix formulation - nodal analysis of networks (independent and dependent sources) - circuit matrix of linear oriented graph - Kirchoff's laws in fundamental circuit matrix formulation.

MODULE 2 (7 hours)

Loop and Nodal Analysis of Electric Networks

Planar graphs - mesh analysis - duality - cut-set matrix - fundamental cut set matrix - relation between circuit, cut-set and incidence matrices - Kirchoff's laws in fundamental cut set formulation - node-pair analysis - analysis using generalized branch model (node, loop and node pair analysis) - Tellegen's theorem.

MODULE 3 (12 hours)

Modeling of Two-port Networks

Modeling of Two-port networks - application examples - amplifiers, transmission lines, passive filters. Review of network parameter sets for two-port networks (z, y, h, g, T parameters, equivalent circuits)(Review may be done using assignments/homework).
Inter-relationship between parameters, Image parameter description of a reciprocal two-port network - Image impedance - characteristic impedance - propagation constant - derivation of characteristic impedance and propagation constant for T and Pi networks under sinusoidal steady state - Attenuation constant and phase constant. Filter terminology: Low pass, high pass, band-pass and band-reject filters. Constant k and m-derived filters - low pass, high pass, band-pass and band-stop filters - design - effect of cascading multiple sections. Resistive T, Pi, and lattice attenuators.

MODULE 4 (10 hours)

Network Functions

Network functions for one-port and two port networks - pole zero location for driving point and transfer functions - Impulse response of network functions from pole-zero plots - sinusoidal steady-state frequency response from pole-zero plots. Hurwitz polynomials - properties - Positive real functions - properties of positive real functions - passivity - necessary and sufficient conditions for positive real functions - physical realizability.

MODULE 5 (8 hours)

Synthesis of One Port Networks

Synthesis of reactive one-ports by Foster's and Cauer methods (forms I and II) - synthesis of LC, RC and RL driving point functions.

Text Books

1. K. S. Suresh Kumar, *Electric Circuit Analysis*, Pearson Education, 2nd ed., 2022.
2. Ravish R. Singh, *Network Analysis and Synthesis*, McGraw-Hill Education, 2013.
3. S. K. Bhattacharya, *Network Analysis and Synthesis*, Pearson Publications, 2013.
4. Chakrabarti, A, *Circuit Theory Analysis and Synthesis*, DhanpatRai Co., 7th - Revised ed., 2018.

Reference Books

1. Van Valkenburg M.E, *Introduction to Modern Network Synthesis*, Wiley Eastern.
2. Van Valkenburg M.E, *Network Analysis*, Prentice Hall India, 2014.
3. Charles A. Desoer and Ernest S. Kuh, *Basic Circuit Theory*, Tata McGraw-Hill, 10th ed., 2023.
4. William H. Hayt and Jack E. Kemmerly, *Engineering Circuit Analysis*, McGraw-Hill Education 8th ed., 2013.
5. Richard C. Dorf and James A. Svoboda, *Introduction to Electric Circuits*, Wiley, 9th ed., 2013.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Network Topology	**8**
1.1	Linear Oriented Graphs - Connected Graph, sub graphs, paths, incidence matrix of a linear oriented graph - Path matrix, its relation to incidence matrix	2
1.2	Kirchoff's Laws in incidence matrix formulation - nodal analysis of networks (independent and dependent sources), principle of v-shifting	2
1.3	Circuit matrix of linear oriented graph - Fundamental Circuit matrix Bf. Relation between All incidence matrix and All Circuit matrix	2
1.4	Kirchoff's laws in fundamental circuit matrix formulation	2
	Module 2: Loop and Nodal Analysis of Electric Networks	**7**
2.1	Loop analysis of electric networks (with independent and dependent sources) - Planar graphs - Mesh analysis - Duality	2
2.2	Cut set matrix - Fundamental cut set matrix - Relation between circuit, cut set and incidence matrices - Orthogonality relation	2
2.3	Kirchoff's laws in fundamental cut-set formulation - Node-pair analysis, i-shifting	2
2.4	Analysis using generalized branch model (node, loop and node pair analysis) - Tellegen's theorem	1
	Module 3: Modeling of Two-port Networks	**12**
3.1	Modeling of Two-port networks - application examples-amplifiers, transmission lines, passive filters. Review of network parameter sets for two-port networks (z, y, h, g, T parameters, equivalent circuits, Standard T - and pi networks) (Review may be done using assignments/homework). Interelationship between parameters	2
3.2	Image parameter description of a reciprocal two-port network - Image impedance	1
3.3	Characteristic impedance - propagation constant—derivation of characteristic impedance and propagation constant for T and Pi networks under sinusoidal steady state – Attenuation constant and phase constant	2
3.4	Filter terminology: Low pass, high pass, band-pass and band-reject filters. Gain characteristics. Constant k-derived low pass filter - Comparison with ideal low-pass filter - Prototype Low pass filter design	2

3.5	m-derived low pass filter sections, m-derived half-sections for filter termination. m-derived half-sections for input termination. Half-pi termination for pi section filters	2
3.6	Constant k- and m-derived high pass filters -Design. Constant k - band-pass filter - Design of prototype bandpass filter – Constant-k band-stop filter -effect of cascading multiple sections	2
3.7	Resistive attenuators - Symmetric T and Pi section attenuators - Lattice-section attenuator - Symmetrical bridged T-section attenuator - Asymmetrical T-Section and Pi-section attenuator	1
	Module 4: Network Functions	**10**
4.1	Network functions for one-port and two-port networks - calculation of network functions for ladder and general networks	2
4.2	poles and zeros for network functions - pole-zero location for driving point and transfer functions	2
4.3	Impulse response of Network functions from pole-zero plots - Sinusoidal steady-state frequency response from pole-zero plots	2
4.4	Hurwitz polynomials - properties - Positive real functions - Properties of positive real functions - passivity	2
4.5	Necessary and sufficient conditions for positive real functions - physical realizability	2
	Module 5: Synthesis of One Port Networks	**8**
5.1	Synthesis of reactive one-ports by Foster's and Cauer methods (forms I and II): Synthesis of R–C Network - Properties of the R–C Impedance or R–L Admittance Function	2
5.2	Foster Form-I of RC Network - Foster Form-II of RC Network, Cauer Forms of RC Network	2
5.3	Synthesis of RL Network - Properties of RL Function/RC Admittance Function - Foster Form-I of RL Network	1
5.4	Foster Form-II of RL Network - Cauer Form-I of RL Network - Cauer Form-II RL Network	1
5.5	Synthesis of LC Networks - Properties of LC Immittance - Foster Form-I of LC Network	1
5.6	Foster Form-II of LC Network - Cauer Form-I of LC Network - Cauer Form-II of LC Network	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

1. Questions on Network topology terminology, definitions.
2. Questions on identification of graphs, paths, sub-paths, etc and on incidence matrix.

3. Numerical problems on application of Kirchoff's laws in matrix formulation, nodal analysis.

Course Outcome 2 (CO 2)

1. Numerical problems on graph theory-based network analysis, cut-set, circuit matrices, nodal and loop analysis.
2. Questions on loop analysis of electric networks, cut-set formulation.
3. Questions on analysis of networks using generalized branch model using Tellegen's theorem.

Course Outcome 3 (CO 3)

1. Questions on modelling two-port networks, characteristics impedance and propagation constants.
2. Questions on definitions and properties of filters.
3. Numerical problems on constant-k and m-derived filter design and analysis.

Course Outcome 4 (CO 4)

1. Questions on the properties of network functions and realizability of passive impedance functions.
2. Questions on impulse response of network functions and properties of Hurwitz polynomials.
3. Numerical problems on the realizability of network functions, testing of positive real functions and Hurwitz polynomials.

Course Outcome 5 (CO 5)

1. Questions to describe synthesis of one-ports by Foster and Cauer forms for R-C and R-L networks.
2. Questions to describe the properties of immittance functions.
3. Numerical problems to synthesise networks in Foster and Cauer forms.

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: : B24EEH41

Course Name: : NETWORK ANALYSIS AND SYNTHESIS

Max. Marks: 100 Duration: 3 hours

PART A

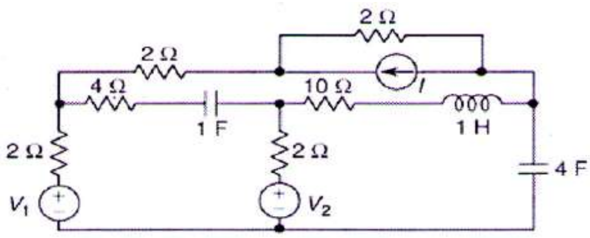
Answer all questions. Each question carries 3 marks.

1. What are the properties of incidence matrix associated with graph theory?
2. Describe the properties of the complete incidence matrix.
3. What are dual graphs? What is the condition for a network graph to have a dual? Illustrate with an example.
4. Describe a cut-set with an example.
5. What is propagation constant? Obtain the propagation constant of r network.
6. Draw the frequency response curves for ideal and non-ideal low pass filter, band pass filter, band reject filter, and high pass filter respectively.
7. Explain what is meant by poles and zeros of a network function.
8. List the properties of positive real functions.
9. What are the properties of LC immittance functions?
10. What is the network interpretation of removal of a pole at origin for an impedance function?

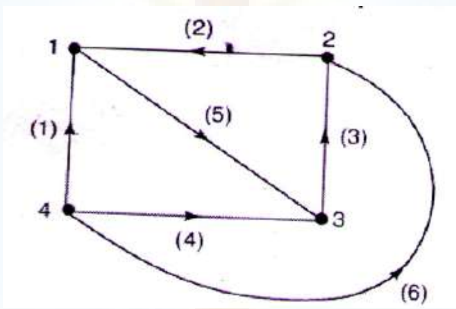
PART B

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

11. (a) For the network shown in figure, draw the oriented graph and write the incidence matrix, reduced incidence matrix and tie set matrix. (7 marks)



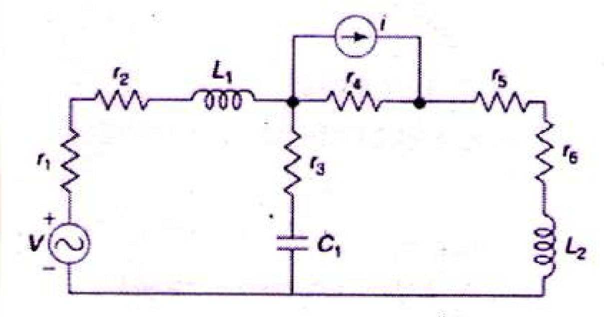
(b) For the given graph shown in figure, taking a tree of branches 2, 4, 5 write down the tieset matrix and KVL equations. (7 marks)



OR

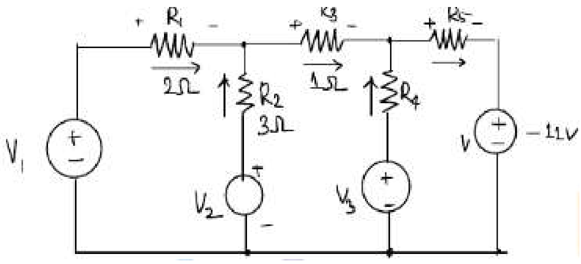
12. (a) State and express Kirchoff's Voltage law in topological form. (4 marks)

(b) For the circuit shown in figure. Draw the oriented graph and write (a) incidence matrix and (b) tie-set matrix. (10 marks)



13. (a) Find the power delivered by the independent voltage sources in the network shown in figure above by loop analysis (use graph theory). Prepare the network graph using the reference directions marked in the figure.

(7 marks)

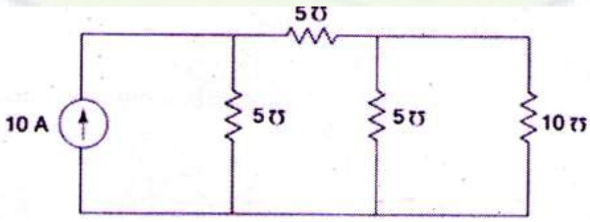


(b) A connected network has the fundamental circuit matrix given as for some choice of tree. Obtain the f-cut-set matrix for the same tree. (7 marks)

$$Bf = \begin{matrix} 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & -1 & 0 & 0 & 1 & 0 \\ 1 & -1 & -1 & 0 & 0 & 1 \end{matrix}$$

OR

14. For the network shown in figure, obtain equilibrium equation on node basis. (14 marks)



15. (a) Obtain the characteristic impedance of a T network. (8 marks)

(b) The ABCD parameters of a network are given as$A = \frac{6}{5}, B = \frac{17}{5}, C = \frac{1}{5}, D = \frac{7}{5}$. Find the image parameters and propagation constant. (6 marks)

OR

16. (a) Design an m-derived T-section low pass filter having cut off frequency of 1500 Hz, design impedance of 500 ohms and infinite attenuation frequency of 2000 Hz (8 marks)

(b) Express image parameters in terms of ABCD parameters. (6 marks)

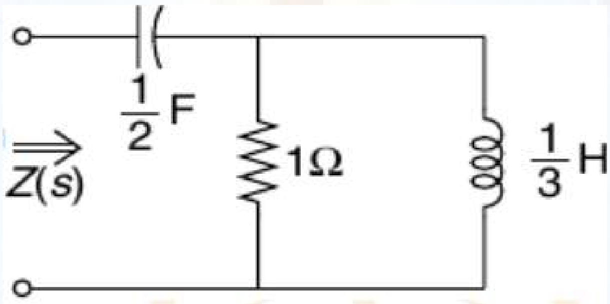
17. (a) Test the following polynomials for the Hurwitz property. (10 marks)
    i. $S^3 + S^2 + 2S + 2$
    ii. $S^7 + S^5 + S^3 + S$
    iii. $S^7 + 2S^6 + 2S^5 + S^4 + 4S^3 + 8S^2 + 8S + 4$

    (b) List out the properties of positive real function. (4 marks)

OR

18. (a) Find the limits of K so that the polynomial $s^3 + 14s^2 + 56s + K$may be Hurwitz. (6 marks)

    (b) Find the driving point impedance Z(s) in the form K $\frac{N(s)}{D(s)}$ for the network shown. Verify that Z(s) is positive real and that the polynomial D(s)+KN(s) is Hurwitz. (8 marks)



19. Realize following RL impedance function in Foster-I and Foster-II form. (14 marks)

$$\frac{Z(s)}{S} = \frac{(S+1)(S+4)}{S(S+5)(S+3)}$$

OR

20. (a) Check whether the driving point impedance Z(s) $=\frac{S^3+S^2+1}{S^3+2S^2-2S+10}$ represents a passive network or not. (4 marks)

    (b) For the network function Y(S) $=\frac{2(S+1)(S+3)}{(S+2)(S+4)}$, synthesis a Foster form and a Cauer form realisation. (10 marks)