SEMESTER 3

ELECTRICAL AND ELECTRONICS ENGINEERING

(STC 2025 Scheme)

25UMGT301	**FOURIER TRANSFORMS AND**	**Category**	**L**	**T**	**P**	**R**	**Credit**	**Year of Introduction**

	COMPLEX ANALYSIS	BSC	3	0	0	0	3	2025

Preamble: This course introduces basic ideas of Fourier transforms 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 of a complex variable, residue integration and conformal transformation.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	K3 Apply
CO2	Explain the analyticity of complex functions and apply it in Conformal mapping.	K3 Apply
CO3	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.	K3 Apply
CO4	Explain the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	1	3	1
CO2	3	3	2	2	-	-	-	-	-	-	1	2	1
CO3	3	3	2	2	-	-	-	-	-	-	1	2	1
CO4	3	3	2	2	-	-	-	-	-	-	1	2	1
Avg	3	3	2	2	-	-	-	-	-	-	1	2.25	1

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9

CO1	*	*	*	*	*			*	
CO2	*	*	*	*	*			*	
CO3	*	*	*	*	*			*	
CO4	*	*	*	*	*			*	

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*			*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (10 Hours)

Fourier integral, from Fourier series to Fourier integral Fourier cosine and and Sine integrals, Fourier Cosine and Sine Transform, Linearity, Transforms of Derivatives, Fourier Transform and its inverse, Linearity, Transforms of Derivative.
(Text1: Relevant topics from sections11.7, 11.8, 11.9)

Module 2 (10Hours)

Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of $w=z^2$, $w=e^z$, $w=\frac{1}{z}$, $w=sinz$.
(Text1: Relevant topics from sections 13.3,13.4,17.1,17.2,17.4)

Module 3 (11Hours)

Complex Integration: Line integrals in the complex plane (Definition & Basic properties),First evaluation method, Second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain, Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof).
(Text1:Relevant topics from sections14.1,14.2,14.3)

Module 4 (11Hours)

Taylor series and Maclaurin series, Laurent series (without proof), Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and Zeros, Formulas for Residues, Residue theorem (without proof), Residue Integration- Integral of Rational Functions of $cos\theta$and $sin\theta$.
(Text1:Relevant topics from sections 15.4,16.1,16.2,16.3,16.4)

Textbook

1.Kreyszig, E. (2016). *Advanced engineering mathematics* (10th ed.). John Wiley & Sons.

Reference Books

1. Zill, D. G., & Shanahan, P. D. (2015). *Complex analysis: A first course with applications* (3rd ed.). Jones & Bartlett Learning.

2. Ramana, B. V. (2023). *Higher engineering mathematics* (39th ed.). McGraw-Hill Education.

3. Grewal, B. S. (2018). *Higher engineering mathematics* (44th ed.). Khanna Publishers.

END SEMESTER EXAMINATION - MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25UMBT301**
Course Name	**FOURIER TRANSFORMS AND COMPLEX ANALYSIS**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1	Find the Fourier cosine integral of f(x)=$\begin{cases} 1\ ,\ if\ \lvert x\rvert < 1 \\ 0\ \ ,otherwise \end{cases}$	3	1	L2
2	Find the Fourier transform of f(x)=$\begin{cases} x,\ if\ \lvert x\rvert < 1 \\ 0\ ,otherwise \end{cases}$	3	1	L2
3	Show that the function f(z)= $\frac{\bar{z}}{z}$ does not have a limit as z=0	3	2	L3
4	Check whether the function u(x ,y) = xy^2 is the real art of	3	2	L3

	an analytic function.			
5	Evaluate $\int_c \ |z|dz$ where c is the line segment joining -i and i	3	3	L3
6	Evaluate $\int_c \frac{z^2}{z^2-1} dz$ where c is the unit circle	3	3	L3
7	Find the Taylor series expansion of f(z)= sin z about z= $\frac{\pi}{4}$	3	4	L2
8	Find pole and residue of $\tan z$	3	4	L2
Part B (***Answer any one full question from each Module. Each carries 9 marks***)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9(a)	Find the Fourier cosine integral of the function f(x)= e^{-ax},x>0 and hence show that $\int_0^\infty \frac{cos\omega x}{1+\omega^2} d\omega = \frac{\pi}{2}$	5	1	L3
(b)	Find the Fourier sine transform of the function f(x)= $\begin{cases} 1\ , & 0 < x < 1 \\ -1, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$	4	1	L2
OR				
10(a)	Find the Fourier transform of f(x)= $e^{-\alpha\|x\|}, \alpha > 0$	5	1	L3
(b)	Find the Fourier sine integral of f(x)= $\begin{cases} \sin x\ , 0 \le x \le \pi \\ 0\ , x > \pi \end{cases}$	4	1	L2
MODULE-II				
11(a)	Show that f(z)= $\sin z$ is differentiable everywhere. and find its derivative	5	2	L2
(b)	Show that u= $y^2 - 3x^2y$ is harmonic. and hence find the analytic function and harmonic conjugate	4	2	L3
OR				
12(a)	Find the analytic function whose imaginary part is $\frac{x-y}{x^2+y^2}$	5	2	L2
(b)	Find the image of the infinite strip $\frac{1}{4} < y < \frac{1}{2}$	4	2	L3
MODULE-III				
13(a)	Solve f(z)= $x^2 + ixy$ from A(1,1) to B(2,4) along the curve x=t and y=t	5	3	L3
(b)	Solve $\int_c \frac{z+4}{z^2+2z+5} dz$ where c is |z+1-i| = 2	4	3	L3
OR				

14(a)	Solve $\int_c \frac{e^z}{z^2+4}\, dz$ where c is $\lvert z-i\rvert = 2$	5	3	L3
(b)	Solve $\int_c Re(z)dz$ where c is a straight line from 0 to (1+2i)	4	3	L3
MODULE-IV				
13(a)	Expand f(z)= $\frac{z+1}{z-1}$ as a Taylor series about z= -1	5	4	L3
(b)	Find poles and residue of f(z)= $\frac{ze^{2iz}}{z^2+9}$	4	4	L2
OR				
14(a)	Solve $\int_c \frac{\sin\pi z^2+\cos\pi z^2}{(z-1)(z-2)}\, dz$ where c is $\lvert z\rvert=3$	5	4	L3
(b)	Expand f(z)= $\frac{1}{z^2}$ as Taylor series about z= 2	4	4	L2

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25UEET301	NETWORK THEORY	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble: This course covers circuit analysis techniques for DC and AC circuits under steady-state and dynamic conditions. It also introduces network parameters and transfer functions, forming a fundamental foundation for advanced electrical engineering courses.

Prerequisite: IEE 104 Introduction to Electrical and Electronics Engineering

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

CO	Course Outcomes	Knowledge Level
CO1	Apply circuit theorems to analyze DC and sinusoidal steady state circuits with dependent and independent sources.	K3 Apply
CO2	Apply differential equations and Laplace transform techniques to determine the transient response of RL, RC, and RLC circuits.	K3 Apply
CO3	Apply s-domain analysis to obtain transfer functions and determine poles and zeros of circuits, including coupled circuits and transformers	K3 Apply
CO4	Apply three-phase circuit analysis and two-port network parameters to compute and evaluate circuit performance.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	2	1	1
CO2	3	3	-	2	-	-	-	-	-	-	2	1	2
CO3	3	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	3	2	2	-	-	-	-	-	-	2	3	3
Avg	3	3	2	2	-	-	-	-	-	-	2	2	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	-	-	*	-
CO2	*	*	*	*	-	-	-	*	-
CO3	*	*	*	*	*	-	-	*	-
CO4	*	*	*	*	*	-	-	*	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	-	-	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (14 Hours)

DC and Sinusoidal steady state analysis of circuits with dependent and independent sources applying Superposition principle, Source transformation, Thevenin’s, Norton’s and Maximum Power Transfer theorems - Reciprocity theorem.

Module 2 (14 Hours)

Time domain analysis of first and second order dynamic circuits: Formulation of dynamic equations of RL, RC and RLC networks with DC excitation and initial conditions and complete solution using Laplace Transforms - Time constant - Complete solution of RL, RC and RLC circuits with sinusoidal excitation using Laplace Transforms - Damping ratio -Over damped, under damped, critically damped and undamped RLC networks.

Module 3 (13 Hours)

Transformation of impedance and admittance of R, L, and C into s-domain. Mesh and node analysis of circuits in s-domain. Series and parallel resonance.

Dot polarity convention. Sinusoidal steady-state analysis of coupled circuits. Analysis of coupled circuits in s-domain.

Power in three-phase circuits: complex power, active, reactive, and apparent power in balanced loads. Steady-state analysis of unbalanced three-phase circuits: three-wire delta connected circuits, and three-phase four-wire and three-wire star connected circuits (using Millman's theorem only). Concept of neutral shift.

Module 4 (15 Hours)

Introduction to two-port networks and basic concepts. Z, Y, h, and transmission (T/ABCD) parameters. Determination of parameters from circuit analysis.

Relationships between different parameter sets. Symmetrical and reciprocal networks.

Interconnection of two-port networks: series, parallel, and cascade connections. Applications of two-port networks in circuit analysis and communication systems.

Text Books:

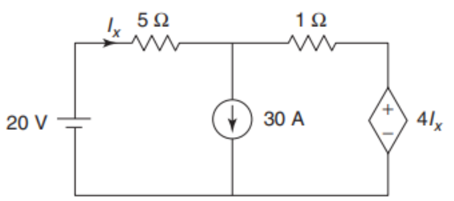
1. Ravish R. Singh (2013). *Network analysis and synthesis*. McGraw-Hill Education.
2. Sudhakar A., & Shyam Mohan S. P. (2015). *Circuits and networks: Analysis and synthesis* (5th ed.). McGraw-Hill Education.
3. A. Chakrabarti. (2018). *Circuit theory: Analysis and synthesis* (7th rev. ed.). Dhanpat Rai &Co..

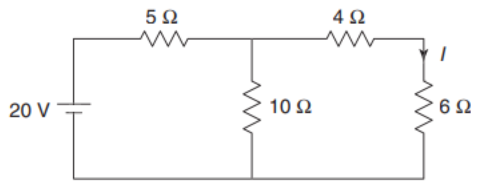
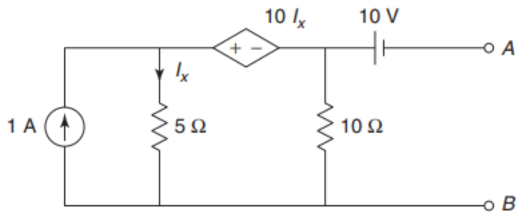
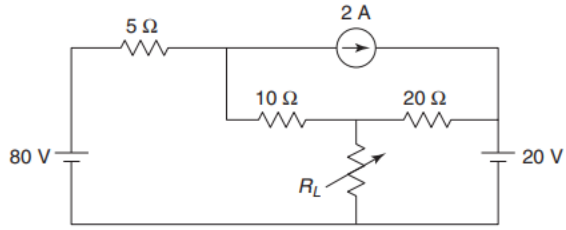
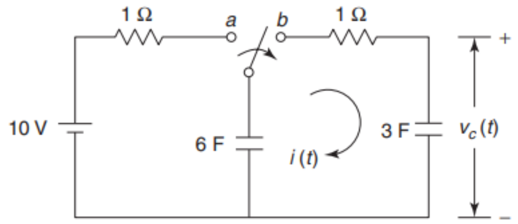
Reference Books:

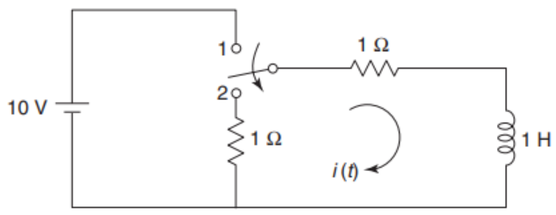
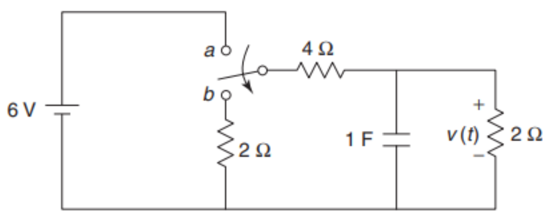
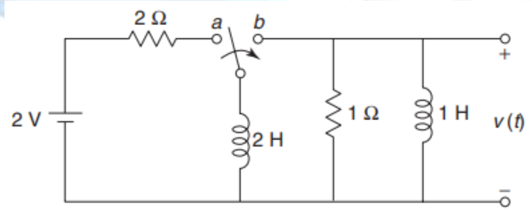
1. M. E. Van Valkenburg. (1980). *Network analysis* (3rd ed.). Prentice Hall India Learning Pvt. Ltd..
2. K. S. Suresh Kumar. (2013). *Electric circuit analysis*. Pearson.
3. John F. Wakerly. (2018). *Digital design: Principles and practices* (5th ed.). Pearson.
4. F. F. Kuo (1966). *Network analysis and synthesis*. John Wiley & Sons.
5. R. Gupta. (2010). *Network analysis and synthesis*. S. Chand & Company Ltd.

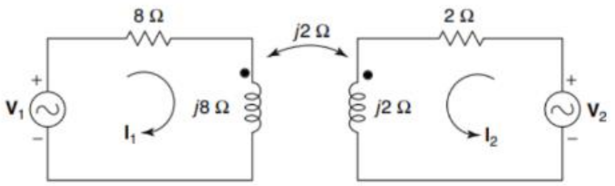
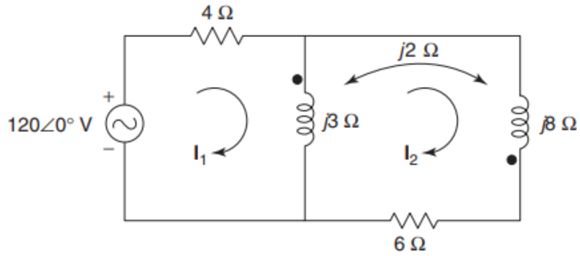
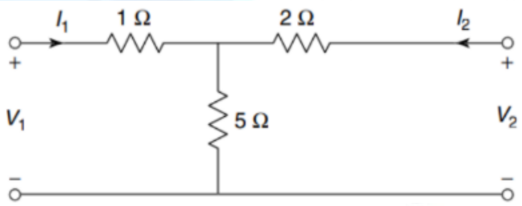
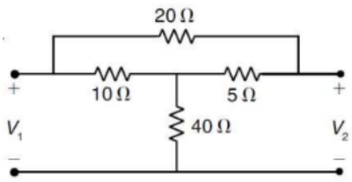
END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25UEET301**
Course Name	**NETWORK THEORY**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1	Explain the applicability and limitations of the Superposition theorem.	3	1	L2
2	Interpret the significance of Thevenin's theorem in circuit analysis.	3	1	L2
3	Describe the time constant of RL and RC circuits.	3	2	L2
4	Compare overdamped, underdamped andcritically damped RLC circuits with three points	3	2	L2
5	Explain the dot convention used in coupled circuits.	3	3	L2
6	Explain the concept of neutral shift in an unbalanced three-phase star-connected system	3	3	L2
7	Describe the role of transmission parameters in transmission line analysis.	3	4	L2
8	Explain h-parameters and their significance in network analysis.	3	4	L2
Part B (*Answer any one full question from each Module. Each carry 9 marks*)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9.a	Compute the current Ix in the figure shown below 	5	1	L3
9.b	Compute the current I and verify the reciprocity theorem	4	1	L3

				
10.a	Determine the Thevenin's equivalent network to the left of A-B in the figure. 	5	1	L3
10.b	Determine the value of load resistance R_L for maximum power transfer and the corresponding maximum power. . 	4	1	L3
Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a	In the network of figure shown below, the switch is moved from a to b at t = 0. Determine i (t) and Vc (t) 	5	2	L3
11.b	In the network of Figure, the switch is moved from the position 1 to 2 at t = 0, steady-state condition having been established in the position 1. Determine i (t) for t > 0.	4	2	L3

<table>
<tr><td></td><td>
</td><td></td><td></td><td></td></tr>
<tr><td colspan="4">OR</td><td></td></tr>
<tr><td>12.a</td><td>In the network in the figure , the switch is moved from a to b, at t = 0. Calculate v(t).

</td><td>5</td><td>2</td><td>L3</td></tr>
<tr><td>12.b</td><td>The network of Fig. 7.15 was initially in the steady state with the switch in the position a. At t=0, the switch goes from a to b. Compute an expression for voltage v (t) for t > 0

</td><td>4</td><td>2</td><td>L3</td></tr>
<tr><td colspan="5">Module III</td></tr>
<tr><td>Qn No.</td><td>Questions</td><td>Marks</td><td>CO</td><td>BL</td></tr>
<tr><td>13. a</td><td>A 400V, 50 Hz, 3 phase supply of phase sequence ABC is supplied to a delta connected load consisting of 100Ω resistance between lines A and B, 318mH inductance between lines B and C and 31.8μF capacitance between lines C and A. Determine phase and line currents</td><td>5</td><td>3</td><td>L3</td></tr>
<tr><td>13. b</td><td>Determine the ratio V_2/V_1 in the circuit if $I_1 = 0$</td><td>4</td><td>3</td><td>L3</td></tr>
</table>

				
OR				
14. a	A three-phase, 400 V RYB system, has a delta-connected load with Z_{RY} =10 < 900 Ω, Z_{YB}= 20 < 450 Ω, and Z_{BR} = 40 < −450 Ω. Determine the phase currents, line currents and total power. Assume positive phase sequence.	5	3	L3
14. b	Determine the current through the 6 Ω resistor in Figure using mesh analysis. 	4	3	L3
MODULE 1V				
Qn No.	**Questions**	**Marks**	**CO**	**BL**
15. a	Compute the Transmission parameters for the network shown below 	6	4	L3
15. b	Show that the transmission parameter of two cascaded two-port networks is the product of the transmission parameter matrices of individual two-port networks.	3	4	L3
OR				
16. a	Determine the Y parameters of the network in figure considering as two networks connected in parallel 	6	4	L3
16. b	Compute the expression for h parameters in terms of z parameters.	3	4	L3

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25UEET302	ELECTRICAL MACHINES I	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble:To introduce the fundamentals of DC machines and transformers, focusing on their construction, operation, characteristics, losses, efficiency, and testing for understanding electrical energy conversion and power system applications.

Prerequisite: IEE104 Introduction to Electrical & Electronics Engineering.

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

Course Outcome		Knowledge Level (KL)
CO1	Describe the constructional details of DC machines and apply the performance of DC generator under various conditions	K3 Apply
CO2	Apply the fundamentals of DC motors to assess their performance under different operating conditions.	K3 Apply
CO3	Apply the principles of single-phase transformers to evaluate their performance under various load conditions.	K3 Apply
CO4	Describe the constructional details and operation of 3-phase transformers and auto-transformer	K2 Understand

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	1	2	1	1	-	-	-	3	3	2
CO2	3	3	1	2	2	2	1	-	-	-	3	3	2
CO3	3	3	-	2	2	1	1	-	-	-	3	3	2
CO4	3	2	1	1	2	1	1	-	-	-	3	2	3
Avg	3	2.75	1	1.5	2	1.25	1	-	-	-	3	2.75	2.25

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*
*	*	*	*	-	*	*	*	*

*	*	*	*	*	*	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	-	-	-	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment/Industrial Visit report : 15 marks

SYLLABUS

Module 1 (14 Hours)

Constructional details of DC machines – armature winding – lap and wave windings. DC generator – principle of operation – EMF equation – numerical problems. Classification of DC generators– DC shunt generator – no-load characteristics– numerical problems. Armature reaction – cross magnetizing and demagnetizing effects– compensating winding – interpoles – commutation (concept only). Power flow diagram – losses and efficiency – maximum efficiency – numerical problems.

Module 2 (14 Hours)

DC motor – back EMF – torque equation Classification of DC motors. Characteristics of DC motors – numerical problems. Starting of DC motors – 3-point starter. Braking – regenerative braking, dynamic braking and plugging (concepts only). Speed control of DC shunt and series motors – field control and armature control Power flow diagram – losses and efficiency – numerical problems. Testing – Swinburne's test –numerical problems.

Module 3 (14 Hours)

Single phase transformers – constructional details – principle of operation – EMF equation – ideal and practical transformer – numerical problems. Operation on no-load and on-load – phasor diagram at different load conditions. Equivalent circuit – voltage regulation. Losses and efficiency – condition for maximum efficiency – numerical problems. Testing of transformers – polarity test – OC test – SC test – Sumpner's test – separation of losses – numerical problems.

*One assignment is based on an industrial visit to a transformer industry. Evaluation is done through the IV report and presentation, focusing on understanding and theory–practice correlation.

Module 4 (14 Hours)

Autotransformer – saving of copper. Three-phase transformer – construction – different connections of 3-phase transformers – Y-Y, Δ-Δ, Y-Δ, Δ-Y. Difference between power transformer and distribution transformer – all-day efficiency – numerical problems. Scott connection for 3-phase to 2-phase conversion (concept only). Vector groupings – Yy0, Dd0, Yd1, Yd11, Dy1, Dy11. On-load and off-load tap changing transformers.

Text Books:

1. Bimbra, P. S. (2011). *Electrical machinery* (7th ed.). Khanna Publishers.
2. Nagrath, I. J., & Kothari, D. P. (2017). *Theory of AC machines*. Tata McGraw Hill.
3. Gupta, J. B. (2022). *Theory & performance of electrical machines* (15th ed.). S. K. Kataria & Sons.

Reference Books:

1. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2003). *Electric machinery* (6th ed.). McGraw-Hill.
2. Langsdorf, M. N. (2001). *Theory of alternating current machinery*. Tata McGraw-Hill.
3. Deshpande, M. V. (2011). *Electrical machines*. Prentice Hall India.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25UEET302**
Course Name	**ELECTRICAL MACHINES I**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1.	Explain the constructional features of armature winding and distinguish between lap and wave windings.	3	1	L2
2.	Explain the principle of operation of a DC generator and write its EMF equation.	3	1	L2

3.	Explain the significance of back EMF in a DC motor.	3	2	L2
4.	Describe the methods of speed control of DC shunt motors.	3	2	L2
5.	Illustrate the principle of operation of a single-phase transformer.	3	3	L2
6.	Describe the purpose of open-circuit and short-circuit tests on transformers.	3	3	L2
7.	Illustrate the construction and applications of an autotransformer.	3	4	L2
8.	Explain the construction and applications of an autotransformer.	3	4	L2
Part B (*Answer any one full question from each Module. Each carry 9 marks*)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9.	Demonstrate the constructional parts of a DC machine and relate each part to its specific function during machine operation.	9	1	L3
OR				
10.	The open-circuit characteristics (OCC) of a DC generator driven at 400 rpm are as follows: Field Current (A) : 2,3, 4, 5, 6, 7, 8, 9. Terminal Voltage (V) : 110, 155, 186, 212, 230, 246, 260, 271.Determine the following: i) The voltage to which the machine will excite when run as a shunt generator at 400 rpm with shunt field resistance equal to 34 Ω ii) Resistance of the shunt field circuit to reduce the OC voltage to 220 V iii) Critical shunt field resistance iv) Critical speed if the shunt field circuit resistance is 34 Ω v) Lowest possible speed at which an OC voltage of 225 V can be obtained	9	1	L3
Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a.	Apply the concept of starting current to justify the necessity of a starter in a DC motor and demonstrate the operation of a three-point starter.	6	2	L3
11.b.	Explain any three methods of electric breaking in DC shunt	3	2	L2

	motor.			
OR				
12.a.	During Swinburne's test a 250V Dc machine was drawing 3A from the 250V supply. The resistances are 250 a and 0.2 a. Find the constant loss of the machine. Also find the efficiency of the machine when it is delivering a 20A at 250V	6	2	L3
12.b.	Explain any two methods of speed control in a DC shunt motor.	3	2	L2
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13. a.	Illustrate the construction and principle of operation of a single-phase transformer and explain its EMF equation with suitable diagrams.	5	3	L3
13. b.	Develop the phasor diagram of a transformer on lagging power factor load.	4	3	L3
OR				
14. a.	Illustrate the open-circuit and short-circuit tests on a transformer and determine its efficiency and voltage regulation from the test results.	5	3	L3
14. b.	Develop the condition for maximum efficiency of a transformer.	4	3	L3
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15. a.	Explain the construction and working of an autotransformer and the expression for saving of copper.	6	4	L2
15. b.	Classify the vector groups Yy0, Dd0 and Yd11.	3	4	L2
OR				
16. a.	Explain the different three-phase transformer connections (Y-Y, Δ-Δ, Y-Δ and Δ-Y) with neat diagrams.	6	4	L2
16. b.	Differentiate power transformers and distribution transformers.	3	4	L2

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25UEET303	ELECTRONIC DEVICES AND CIRCUITS	Category	L	T	P	R	Credit	Year of Introduction
		PBL	3	0	0	1	4	2025

Preamble: This course introduces semiconductor devices and analog electronic circuits used in amplification, waveform generation and signal conditioning. It covers diode, BJT, MOSFET biasing, operational amplifier, oscillator and timer circuits relevant to electrical engineering applications. The course emphasizes circuit analysis and practical implementation through project-based learning

Prerequisite: IEE104 Introduction to Electrical & Electronics Engineering

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

CO	Course Outcomes	Knowledge Level
CO1	Explain the operation and characteristics of semiconductor diodes and their use in rectifier, regulator and wave shaping circuits.	K2 Understand
CO2	Demonstrate the use of appropriate biasing techniques in BJT and MOSFET amplifier and switching circuits.	K3 Apply
CO3	Demonstrate the use of operational amplifiers in amplification and signal conditioning applications.	K3 Apply
CO4	Implement oscillator and 555 timer circuits for waveform generation applications.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	-	-	-	-	-	1	-	1	3	2

CO3	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**2**	**3**	**2**
CO4	**3**	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**2**	**3**	**3**
Avg	**3**	**2.25**	**2**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**1.5**	**2.75**	**2**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

WKs Mapped with the course

	WK1	**WK2**	**WK3**	**WK4**	**WK5**	**WK6**	**WK7**	**WK8**	**WK9**
CO1	*	*	*	*		*	-	*	-
CO2	*	*	*	*	*	*	-	*	-
CO3	*	*	*	*	*	*	-	*	-
CO4	*	*	*	*	*	*	-	*	-

WK1	**WK2**	**WK3**	**WK4**	**WK5**	**WK6**	**WK7**	**WK8**	**WK9**
*	*	*	*	*	*	-	*	-

Mark Distribution:

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
100	**60**	**40**	**2 Hours**

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 25 marks
Mini Project : 30 marks

SYLLABUS

Module 1 (14 Hours)

Intrinsic and extrinsic semiconductors, PN junction diode operation and V–I characteristics, ideal and practical diode models. Half wave, full wave and bridge rectifiers, ripple factor, rectifier efficiency and peak inverse voltage. Zener diode characteristics and voltage regulation. Clippers and clampers. Applications of Zener diode and LED.

Module 2 (14 Hours)

Structure and operation of BJT, CE, CB, and CC configurations, input and output characteristics, fixed bias and voltage divider bias. Hybrid model-voltage gain, input and output impedance. MOSFET operation, DMOSFET and EMOSFET characteristics, basic biasing, and MOSFET as switch.

Module 3 (14 Hours)

Ideal Op-Amp characteristics, 741 IC, block diagram, op amp configuration- inverting amplifier, non-inverting amplifier, voltage follower. Summing amplifier, integrator, differentiator and waveform generators, Zero crossing and voltage level detectors, Schmitt trigger circuit.

Module 4 (14 Hours)

Principle of oscillation and Barkhausen criterion. RC phase shift oscillator, LC oscillator, Hartley oscillator, and crystal oscillator. 555 timer IC, monostable and astable multivibrators and applications in waveform generation.

Text Books

1. Boylestad, R. L., & Nashelsky, L. (2009). *Electronic devices and circuit theory* (10th ed.). Pearson Education India.
2. Malvino, A. P., & Bates, D. J. (2010). *Electronic principles* (7th ed.). Tata McGraw-Hill Education.
3. Gupta, J. B. (2005). *Electronic devices and circuits*. S. K. Kataria & Sons.

Reference Books

1. Floyd, T. L. (2012). *Electronic devices* (9th ed.). Pearson Education.
2. Sedra, A. S., & Smith, K. C. (2015). *Microelectronic circuits* (7th ed.). Oxford University Press.
3. Millman, J., & Halkias, C. C. (2010). *Integrated electronics: Analog and digital circuits and systems*. Tata McGraw-Hill Education.
4. Paynter, R. T., & Clemons, J. (2007). *Paynter's introductory electronic devices and circuits* (7th ed.). Prentice Hall.

5. Streetman, B. G., & Banerjee, S. (2006). *Solid state electronic devices* (6th ed.). Pearson Education.

Project-Based Learning Component

This course promotes experiential learning by enabling students to design, simulate, and implement analog electronic circuits for practical engineering applications. The instructor shall serve as a mentor, providing guidance through technical discussions and periodic reviews. Students shall identify a relevant problem, prepare a project proposal with defined objectives and specifications, and develop suitable circuit solutions using concepts from semiconductor devices, amplifiers, operational amplifiers, oscillators, and timer circuits. The circuit shall be designed, simulated, implemented in hardware tested, and demonstrated.

Suggested Project Topics

Project topics shall involve the design, simulation, and implementation of analog electronic circuits such as:

1. Regulated DC power supply using Zener diode or voltage regulator IC
2. Audio amplifier using BJT
3. Multistage amplifier for low-signal applications
4. Electronic temperature measurement system using diode, transistor or Op-Amp
5. Light intensity measurement and control circuit using LDR and transistor
6. Signal conditioning circuits using operational amplifiers
7. Timer and pulse generation circuits using 555 timer IC
8. Analog alarm circuit using transistor or timer IC
9. Battery voltage monitoring and protection circuit
10. Automatic street light controller using analog circuits

Students may also propose other relevant analog electronic circuit projects aligned with course objectives, subject to approval by the course instructor.

Assessment and Evaluation of Project Activity

Sl. No.	Evaluation Component	Marks
1	Project Planning and Proposal	5
2	Progress Presentation and Technical Interaction	4
3	Participation and Team Work	3
4	Circuit Design, Execution, and Implementation	10

5	Final Demonstration and Presentation	5
6	Project Quality, Innovation, and Technical Merit	3
Total		**30**

Evaluation Guidelines

Project Planning and Proposal (5 Marks):

Assessment shall be based on clarity of problem definition, relevance of the project, understanding of background concepts, and feasibility of proposed solution.

Progress Presentation and Technical Interaction (4 Marks):

Evaluation shall consider individual contribution, technical understanding, and ability to respond to questions and suggestions.

Participation and Team Work (3 Marks):

Assessment shall be based on active involvement, individual responsibility, and collaboration within the team.

Circuit Design, Execution, and Implementation (10 Marks):

Evaluation shall consider circuit design accuracy, simulation verification, hardware implementation, troubleshooting ability, and proper functioning of the circuit.

Final Demonstration and Presentation (5 Marks):

Assessment shall be based on demonstration of working system, clarity of explanation, presentation quality, and technical understanding.

Project Quality, Innovation, and Technical Merit (3 Marks):

Evaluation shall consider originality, technical depth, innovation in design, and overall quality of implementation.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

(STC 2025 SCHEME)

Course Code	**25UEET303**
Course Name	**ELECTRONIC DEVICES AND CIRCUITS**
Max. Marks: 40	**Duration: 2 Hours**

Part A *(Answer all questions. Each question carries 2 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1	A power supply exhibits excessive ripple in its output. Identify the rectifier parameter responsible for this condition.	2	1	L2
2	A silicon diode in a rectifier circuit is replaced by a germanium diode.Identify the change in output voltage	2	1	L2
3	A MOSFET has V_{GS}=6V, threshold voltage V_T=2V, and K=0.5mA/V^2. Determine the drain current.	2	2	L3
4	Compare the applications of CE, CB and CC configurations in electronic circuits.	2	2	L2
5	An integrator circuit uses R=100 kΩ and C=0.1 μF. Determine the time constant.	2	3	L3
6	A non-inverting amplifier uses R_f=90 kΩ and R_1=10kΩ. Compute the closed-loop gain.	2	3	L3
7	A 555 astable circuit produces a period of 2 ms. Find the frequency of oscillation	2	4	L3
8	Compare Hartley and Colpitts oscillators.	2	4	L2
Part B (*Answer any one full question from each Module. Each carry 6 marks*)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9.a.	Explain the V–I characteristics of a PN junction diode and distinguish between forward and reverse bias operations.	3	1	L2

9.b.	Describe the operation of clipping and clamping circuits with suitable waveforms.	3	1	L2
	OR			
10.	Explain the operation of a full-wave rectifier with suitable waveforms and performance characteristics.	6	1	L2
	Module II			
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.	Apply the h-parameter equivalent circuit to obtain the expressions for A_v, Z_i, and Z_o of a CE amplifier.	6	2	L3
	OR			
12.	An enhancement NMOS transistor is used as a switch with V_{DD}=12V, R_D=2kΩ V_T=2V. Determine: (i) The state of the MOSFET for V_{GS}=1V (ii) The drain current for V_{GS}=5V (iii) The drain voltage when the MOSFET is ON.	6	2	L3
	Module III			
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.	An op-amp integrator has R=100kΩ and C=0.05μF. A square wave of 5 V is applied. Determine: a) The time constant. b) The output waveform. c) The application of the circuit.	6	3	L3
	OR			
14.	Three sensors produce outputs of 1 V, 2 V and 3 V. The summed output is amplified by a non-inverting amplifier of gain 5. Compute: a) Output of the summing circuit. b) Final output voltage. c) Suitable op-amp applications employed.	6	3	L3
	Module IV			
Qn No.	**Question**	**Marks**	**CO**	**BL**
15. a	An astable multivibrator has R_A=10kΩ, R_B=20kΩ and C=0.01μF. Determine: a) Charging time. b) Discharging time. c) Frequency of oscillation.	3	4	L3
15.b	A Colpitts oscillator employs C_1=100pF, C_2=200pF and	3	4	L3

	L=50μH. Find: a) The equivalent capacitance. b) The frequency of oscillation.			
OR				
16.	Determine the expression for the frequency of oscillation of an RC phase-shift oscillator.	6	4	L3

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25UHUT001	ECONOMICS FOR ENGINEERING PRACTICES	Category	L	T	P	R	Credit	Year of Introduction
		HMC	2	0	0	0	2	2025

Preamble: This syllabus covers the fundamentals of Microeconomics, Macroeconomics, and Engineering Economics. It bridges economic theory with practical engineering and management, teaching students to apply analytical tools to scarcity, market dynamics, and financial decision-making.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Understand the fundamentals of various economic issues using laws and learntheconceptsofdemand,supply,elasticityandproductionfunction.	K2 Understand
CO2	Developdecisionmakingcapabilitybyapplyingconceptsrelatingtocostsandrevenue,andacquireknowledgeregardingthefunctioningof firms in different market situations.	K3 Apply
CO3	Outline the macroeconomic principlesof monetary and fiscal systems and national income.	K2 Understand
CO4	Makeuseofthepossibilitiesofvalueanalysisandengineering,andtake investment decisions through capital budgeting techniques.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	0	0	-	2	2	-	-	-	-	1	2
CO2	3	3	2	0	1	2	-	-	1	1	3	2	3
CO3	2	2	0	0	-	3	3	1	-	-	2	1	2

CO4	**3**	**3**	**3**	**2**	**2**	**-**	**2**	**1**	**1**	**1**	**3**	**2**	**3**
Avg	**2.75**	**2.5**	**2.5**	**2**	**1.5**	**2.3**	**2.3**	**1**	**1**	**1**	**2.6**	**1.5**	**2.5**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*		*		*
CO2	*	*	*	*	*	*	*	*	
CO3	*	*	*	*	*		*	*	*
CO4	*	*	*	*	*	*		*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (7 Hours)

Nature and significance of economics, Basiceconomicproblems–ProductionPossibilityCurve–Utility–Lawof diminishingmarginalutility–Demand:Factorsdeterminingdemand–Law of Demand – Demand curve- Price elasticity of demand- measurement of price elasticity and its applications – Supply: factors determining supply - Lawofsupply–Supplycurve-Equilibriumpricedetermination-Changesin demand and supply and its effects on equilibrium price and quantity. Production: Production function, Factors of Production- Cobb-Douglas Production Function

Module 2 (7 Hours)

Cost:Costconcepts–Privatecostandsocialcost–Sunkcost–Opportunity cost-Explicitandimplicitcost–Shortruncostcurves–Longrunaveragecost curve -Revenue concepts – Break-even point. Taxation-Direct and indirect taxes-principles of Taxation, GST.Market: Market: different market structures and market equilibrium –Kinkeddemand model-E-commerce, Stock market-SENSEX, NIFTY, Mutual Funds & ETFs (Concepts Only)

Module 3 (7 Hours)

National income: Concepts (GDP, GNP and NNP-Basic problems)– Final goods and Intermediate goods - Methods of Estimation –output method – expenditure method--Difficulties in the measurement of national income.International trade, terms of Trade, Gain from International Trade, Free Trade vs. Protection**.**Dumping, and Balance of Payment. Inflation:CausesandEffects–MeasurestoControlInflation-Monetaryand Fiscal policies – Repo and reverse repo rate. Role of Science, Engineering and Technology In economic Development

Module 4 (7 Hours)

Value Analysis and value Engineering: Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure.Capital Budgeting: Time value of money - Net Present Value Method - BenefitCostRatio–InternalRateofReturn-–Payback–AccountingRateof Return.

Text Books:

1. Geetika,PiyaliGhosh and Chodhury, ManagerialEconomics, TataMcGrawHill,2015
2. H.G.Thuesen,W.J. Fabrycky, EngineeringEconomy, PHI, 1966.
3. R.Paneerselvam: EngineeringEconomics, PHI, 2012.
4. IMPandey,FinancialManagement, VikasPublishing House ,2015

Reference Books:

1 Leland Blank P.E, AnthonyTarquinP.E., EngineeringEconomyMcGrawHill, 7th edition.
2. KhanM.Y, IndianFinancialSystem, TataMcGrawHill, 2011.
3. DonaldG.Newman, Jerome P. Lavelle, EngineeringEconomicsand analysis,Engg.Press,Texas, 2002.
4. ChanS.Park, Contemporary Engineering Economics, PrenticeHallofIndia Ltd, 2001.
5. PrasannaChandra, FinancialManagement:Theory and Practice, McGrawHill, 2007.

END SEMESTER EXAMINATION - MODEL QUESTION PAPER

(STC 2025 SCHEME)

Course Code	**25UHUT001**
Course Name	**ECONOMICS FOR ENGINEERING PRACTICES**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A

(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Explain is the Opportunity Cost principle	3	1	L2
2	Briefly explain the Cobb-Douglas Production Function	3	1	L2
3	Distinguish between Sunk Cost and Incremental Cost.	3	2	L2
4	Interpret the law of diminishing marginal utility using a real-world consumer scenario.	3	2	L3
5	Define Reverse Repo Rate and its impact on money supply.	3	3	L2
6	Define Exchange Value in Value Engineering?	3	3	L2
7	Explain the concept of Payback Period in project evaluation.	3	4	L2
8	Describe the financial meaning of the Internal Rate of Return (IRR) in capital budgeting decisions.	3	4	L3

Part B

(*Answer any one full question from each Module. Each carries 9 marks*)

Module I

Qn No.	Question	Marks	CO	BL
7(a)	Illustrate the Law of Diminishing Marginal Utility with a schedule and diagram.	5	1	L2
(b)	Explain the effect of an increase in Consumer Income on the equilibrium price and quantity of a normal good.	4	1	L2
	OR			
8(a)	When the price of a machine part is ₹500, the supply is 100 units. When the price increases to ₹600, the supply rises to 150 units. Calculate the Price Elasticity of Supply and	5	1	L2

	interpret the result.			
(b)	Discuss the three stages of the Law of Variable Proportions.	4	1	L2
MODULE II				
9(a)	Comparethe features of Perfect Competition and Monopoly markets.	5	2	L2
(b)	A firm has a Fixed Cost of ₹20,000 and a Variable Cost of ₹50 per unit. If the selling price is ₹100 per unit, calculate the Break-even Point in units.	4	2	L3
OR				
10(a)	Explain the Kinked Demand Curve model and why it leads to price rigidity in an Oligopoly.	5	2	L2
(b)	Differentiate between Private Cost and Social Cost using the example of industrial pollution.	4	2	L3
MODULE III				
11(a)	Discuss the Difficulties in the Measurement of National Income in a developing economy.	5	3	L2
(b)	From the data given below estimate GNPmp, GNPfc and NNPmp and National income. GDPmp 5000(in 100 billion), NFIA = -50, indirect tax =70, subsidy =30, depreciation=30.	4	3	L2
OR				
12(a)	Explain Demand-Pull Inflation? Suggest two Fiscal Policy measures to control it.	5	3	L2
(b)	Explain the difference between Final Goods and Intermediate Goods with examples.	4	3	L2
MODULE IV				
13(a)	Describe the Aims and Advantages of applying Value Engineering in a construction project.	5	4	L3
(b)	Explain Use Value? How does it differ from Esteem Value?	4	4	L2
OR				
14(a)	An engineering project requires an initial investment of ₹5,000. The estimated annual cash inflows for 4 years are ₹2,000, ₹1,800, ₹1,600, and ₹1,400. If the discount rate is 8%, calculate the Net Present Value (NPV).	5	4	L3
(b)	State the decision rule for the Benefit-Cost Ratio (BCR) method.	4	4	L2

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25UHUT002	SUSTAINABILITY AND ETHICS IN ENGINEERING	Category	L	T	P	R	Credit	Year of Introduction
		HMC	2	0	0	0	2	2025

Preamble: This course is designed to cultivate a holistic perspective in engineering students by integrating professional integrity, social equity, and environmental stewardship. In an era of rapid technological advancement and climate volatility, technical expertise alone is insufficient; the modern engineer must be a morally conscious decision-maker.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Explain fundamental ethical theories to resolve moral dilemmas in personal and professional contexts.	K2 Understand
CO2	Outline philosophical perspectives of environmental ethics to protect biodiversity and manage urban environmental impacts.	K2 Understand
CO3	Develop strategies for Zero Waste and Circular Economy to mitigate disruptions in the hydrological cycle and resource depletion.	K3 Apply
CO4	Illustrate the importance of Renewable Energy technologies in combating the climatecrisis in relation to Environmental Regulations and the Sustainable Development Goals(SDGs).	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	-	2	-	3	2	2	-	1	2
CO2	-	-	-	-	-	3	-	2	3	2	-	2	2
CO3	1	1	2	-	-	2	3	-	-	-	-	2	3

CO4	2	2	3	2	2	2	3	1	-	2	2	3	3
Avg	**1.5**	**1.5**	**2.5**	**2**	**2**	**2.25**	**3**	**2**	**2.5**	**2**	**2**	**2.5**	**2.5**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK 5	WK 6	WK 7	WK8	WK9
CO1	*				*		*		
CO2	*				*		*		
CO3	*	*	*	*	*		*		*
CO4	*	*	*	*	*	*	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (7 Hours)

Fundamentals of ethics -Moral Relativism vs. Objectivity. Consequentialism. Deontology Metaethics. Personal vs. professional ethics, CivicVirtue, Respect for others, Profession and Professionalism, Plagiarism, case studies, Technology and digital revolution, Cybertrust and cybersecurity, High technologies: connecting people and places- Managing conflict, Confidentiality, Codes of Ethics. BasicconceptsinGenderStudies, gender,genderspectrum: gender stereotypes, Gender disparity and discrimination in education, Ethical values and practices in connection withgenderGenderpolicyand women/transgenderempowermentinitiatives.

Module 2 (7 Hours)

Introduction to Environmental Ethics: key philosophical theories (anthropocentrism, biocentrism, ecocentrism).DeepEcology.Intrinsic value.Sustainable Engineering Principles: Definition and scope, triple bottom line, life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: AnoverviewofvariousecosystemsinKerala/India,and its significance. Landscape and Urban Ecology: Principles of landscape ecology,Urbanizationanditsenvironmentalimpact, Moral Extensionism

Module 3 (7 Hours)

Hydrologyand Water Management: water cycle, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Differences between linear and circular economies, AI-Driven Energy Optimization**,** Digital Twins**,** Bio-Engineering & Biomimicry**,** Carbon Capture and Storage (CCS)**,** Mobility and Sustainable Transportation: Basic tenets of a Sustainable Transportation design, Integratedmobilitysystems,E-Mobility.

Module 4 (7 Hours)

Renewable Energy and Sustainable Technologies:(solar, wind, hydro, biomass), Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Ethical considerations in environmental policy-making.CaseStudiesandFutureDirections:Analysisofreal-world case studies, Emerging trends and future directions in environmental ethics andsustainability,Discussion on the role of engineers in promoting a sustainable future. The Sustainable Development Goal 17.

Text Books:

1. Whitbeck, C. (2011). Ethics in engineering practice and research (2nd ed.). Cambridge University Press.
2. Oakley, J. (2006). Virtue ethics and professional roles. Cambridge University Press.
3. Bakshi, B. R. (2019). Sustainable engineering: Principles and practice. Cambridge University Press.
4. Martin, M. W., &Schinzinger, R. (2014). Ethics in engineering (4th ed.). Tata McGraw-Hill Education.
5. Ahlawat, A. (2019). Sustainable development goals: Directive principles for sustainable India by 2030. Notion Press.

Reference Books:

1. Parmar, R. K. (2025). Green technology and sustainable development (1st ed.). ISBN-13 publication.
2. Kosanam, N. (2023). Beyond carbon: Responsible ways to restore ecological balance. ISBN-13 publication.

END SEMESTER EXAMINATION - MODEL QUESTION PAPER

(STC 2025 SCHEME)

Course Code	**25UHUT002**
Course Name	**SUSTAINABILITY AND ETHICS IN ENGINEERING**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1.	Differentiate between Moral Relativism and Objectivity in the context of professional decision-making.	3	1	L2
2.	Outline the key differences between personal ethics and professional ethics for a practicing engineer.	3	1	L2
3.	Explain the concept of 'Intrinsic Value' within environmental philosophy frameworks.	3	2	L2
4.	Summarise the three core pillars that constitute the 'Triple Bottom Line' of sustainability	3	2	L2
5.	Describe the engineering definition and operational importance of maintaining 'Environmental Flow' in river systems.	3	3	L2
6.	Differentiate between a Linear Economy and a Circular Economy using a conceptual pipeline breakdown.	3	3	L2
7.	Describe the challenges faced by coastal infrastructure in Kerala due to the ongoing climate crisis.	3	4	L2
8.	Outline the overarching objective of Sustainable Development Goal 17 regarding global partnerships.	3	4	L2
	Part B (*Answer any one full question from each Module. Each carry 9 marks*)			
	Module I			
Qn No.	**Question**	**Marks**	**CO**	**BL**
9	Describe the key principles of Consequentialism and Deontology. Explain their relevance in assessing a	9	1	L2

	workplace confidentiality conflict in engineering practice.			
	OR			
10	Explain the role of gender policies and empowerment initiatives in addressing structural discrimination within educational institutions.	9	1	L2
	Module II			
Qn No.	**Question**	**Marks**	**CO**	**BL**
11	Describe the key environmental philosophical theories of Anthropocentrism, Biocentrism, and Ecocentrism and their influence on modern industrial development policies.	9	2	L2
	OR			
12	Explain the key phases of Life Cycle Analysis (LCA) and the sustainability indicators used to evaluate the environmental performance of engineering products.	9	2	L2
	Module III			
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.a	A town experiences frequent water shortages during summer. Apply the concepts of the water cycle and environmental flow to suggest suitable water management measures.	5	3	L3
13.b	Describe the concept of Carbon Capture and Storage (CCS) as a climate mitigation strategy.	4	3	L2
	OR			
14.a	A residential colony generates a large amount of household waste. Apply the principles of Zero Waste to recommend two strategies for reducing waste generation.	5	3	L3
14.b	Explain the concept of AI-driven energy optimization and its significance in sustainable development.	4	3	L2
	Module IV			
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.a	A coastal community is vulnerable to sea-level rise and flooding. Apply engineering solutions to improve its climate resilience.	5	4	L3
15.b	Summarize the opportunities and challenges associated with renewable energy adoption in India.	4	4	L2
	OR			
16.a	A proposed industrial project is located near a sensitive ecosystem. Apply environmental policy and ethical principles to identify key considerations before project	5	4	L3

	approval.			
16.b	Explain the importance of emerging sustainable technologies in achieving environmental sustainability.	4	4	L2

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25UEEL305	ELECTRICAL MEASUREMENTS LAB	Category	L	T	P	R	Credit	Year of Introduction
		PCL	0	0	3	0	2	2025

Preamble: This course aims to train students in the use of measuring instruments and transducers for physical parameter measurement, while developing their skills in planning, preparing, and implementing basic instrumentation systems through team-based activities.

Prerequisite: MAI205 Measurements and Instrumentation

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

CO	Course Outcomes	Knowledge Level
CO1	Apply voltage-current phasor relationships in RLC circuits and execute the verification of DC network theorems.	K3 Apply
CO2	Determine power in single-phase and three-phase circuits using various methods.	K3 Apply
CO3	Determine calibration characteristics, electrical parameters of meters, and magnetic characteristics of electrical devices.	K3 Apply
CO4	Implement the analysis of transducer characteristics and develop simulation models using modern simulation tools.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	1	1	1	-	-	-	-	3	2
CO2	3	2	-	2	1	1	1	-	-	-	-	3	2
CO3	3	2	-	3	2	2	2	-	-	-	-	3	2

CO4	2	2	3	2	3	2	-	-	-	-	-	2	3
AVG	2.75	2	2	2.25	1.75	1.5	1.33	-	-	-	-	2.75	2.25

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK 5	WK 6	WK 7	WK8	WK9
CO1	*	*	*	*	*	*	*	*	*
CO2	*	*	*	*	*	*	*	*	*
CO3	*	*	*	*	*	*	*	*	*
CO4	*	*	*	*	*	*	*	*	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark distribution:

Total Marks	CIE Marks	ESE marks	ESE Duration
100	50	50	3 Hours

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

Expt. No.	Experiments (Any 12 experiments mandatory)
1	Verification of Superposition theorem. *
2	Verification of a) Thevenin's theorem and maximum power transfer theorem.* b) Calculation of Norton's equivalent circuits(calculation only)
3	Determination of impedance, admittance and power factor in RLC series/ parallel circuit and to study the effect of reactive components on power factor.
4	3-phase power measurement using one-wattmeter and two-wattmeter methods, and determination of reactive/apparent power drawn.*
5	Resistance measurements using Wheatstone's bridge and extension of range of voltmeters.
6	Extension of instrument range using instrument transformers (CT and PT).
7	Calibration of 1-phase Energy meter at various power factors and phantom loading (minimum 3 conditions) *.
8	Calibration of 3-phase Energy meter using standard wattmeter

9	Determination of B-H curve μ -H curve and μ -B curve of a magnetic specimen.
10	Measurement of self inductance, Mutual inductance and Coupling coefficient of a 1-phase transformer.
11	Determination of characteristics of Thermal sensors: Thermistor, Thermocouple and RTD*.
12	Calibration of meters (Ammeter/Voltmeter) using Potentiometers.
13	Determination of characteristics of LVDT
14	Simulation of circuits using software platforms like PSpice/LT spice / MATLAB / Multisim etc.*
Advanced Experiment	
	Determination of insulation resistance and earth resistance.

Continuous Assessment (25 Marks)

1. Conduct of Experiments (10 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

2. Lab Reports and Record Keeping (5 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports.
- Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

3. Viva Voce (10 Marks)

- Ability to explain the experiment, results and underlying principles based on their theoretical knowledge

- Final Marks Averaging: The final marks for, conduct of experiments, viva, and records are the average of all the experiments performed in the lab.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

Text Books:

1. Sawhney, A. K. (2012). *A course in electrical and electronic measurements and instrumentation*. Dhanpat Rai Publishers.
2. Gupta, J. B. (2014). *A course in electrical and electronic measurement and instrumentation*. S. K. Kataria & Sons.
3. Kalsi, H. S. (2019). *Electronic instrumentation*. Tata McGraw-Hill.

25UEEL306	ELECTRONICS CIRCUITS LAB	Category	L	T	P	R	Credit	Year of Introduction
		PCL	0	0	3	0	2	2025

Preamble:This laboratory course provides practical exposure to fundamental analog electronic circuits using discrete components and integrated circuits. Students construct, test and analyze waveform shaping circuits, amplifier circuits, Op-Amp applications, oscillators and timer IC circuits.

Prerequisite: 25UEET303 Electronic Devices and Circuits

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

CO	**Course Outcomes**	**Knowledge Level**
CO1	Perform waveform shaping and signal measurement using diode circuits and CRO	K3 Apply
CO2	Implement and demonstrate various op-amp based waveforms in linear applications	K3 Apply
CO3	Construct and demonstrate Op-Amp based nonlinear and oscillator circuits.	K3 Apply
CO4	Implement and examine timer-based multivibrator circuits using 555 IC	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	1	-	-	-	2	2	1	3	2
CO2	3	3	3	2	1	-	-	-	2	2	1	3	3

CO3	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**2**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**2**	**2**	**2**	**3**	**3**
Avg	**2.75**	**2.5**	**2.75**	**2**	**1**	**-**	**-**	**-**	**2**	**2**	**1.5**	**3**	**2.75**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	**WK2**	**WK3**	**WK4**	**WK 5**	**WK 6**	**WK 7**	**WK8**	**WK9**
CO1	*	*	*	*	*	*	-	*	-
CO2	*	*	*	*	*	*	-	*	-
CO3	*	*	*	*	*	*	-	*	-
CO4	*	*	*	*	*	*	-	*	-

WKs Mapped with the course

WK1	**WK2**	**WK3**	**WK4**	**WK5**	**WK6**	**WK7**	**WK8**	**WK9**
*	*	*	*	*	*	-	*	-

SYLLABUS

EXPERIMENT LIST

(Any 10 experiments are mandatory)

FAMILIARISATION

Measurement of current, voltage, frequency and phase shift of signal in a RC network using oscilloscope.

1. Clipping circuit using diodes.
2. Clamping circuits using diodes.
3. Design and set up of inverting and non-inverting amplifier.
4. Op-amps circuits - integrator, and differentiator.
5. Summing and Difference amplifier using Op-amp.
6. Precision rectifier using Op-amp.
7. RC Phase shift Oscillator using Op-amp.
8. Wien Bridge Oscillator using Op-amp.
9. Square wave generation using OPAMPs.

10. Triangular wave generation using OPAMPs.
11. Basic comparator circuits using Op-amp
12. Basic Schmitt trigger circuits using Op-amp
13. Astable multivibrator using 555 IC.
14. Monostable multivibrator using 555 IC

Assessment Pattern

Continuous Assessment (25 Marks)

Continuous assessment evaluates the student's performance during the regular laboratory sessions, emphasizing practical skills, documentation, and conceptual understanding.

1. **Conduct of Experiments (10 Marks)**

Evaluation is based on the student's ability to perform experiments systematically and efficiently.

- Adherence to correct experimental procedures, systematic execution of experiments and compliance with laboratory safety guidelines.
- Ability to handle laboratory instruments and components accurately, precision in observations and effectiveness in troubleshooting during experimentation.
- Active involvement, collaboration, and contribution during group laboratory activities.

2. Lab Reports and Record Keeping (5 Marks)

Evaluation is based on the quality and maintenance of laboratory documentation.

- Clarity, completeness, and accuracy of experimental reports, including proper recording of observations, calculations, analysis, and conclusions.
- Submission of rough and fair records within the stipulated time and maintenance of a neat, well-structured laboratory record.

3. **Viva Voce (10 Marks)**

Evaluation of conceptual understanding and communication skills related to laboratory experiments.

- Ability to explain experimental procedure, working principle, and results.
- Understanding of theoretical concepts associated with the experiment.
- Ability to answer questions related to practical and analytical aspects of the experiment.

Evaluation Pattern for End Semester Examination (50 Marks)

End Semester Examination (50 Marks)

The end semester evaluation assesses the student's ability to independently perform experiments, interpret results, and demonstrate theoretical understanding.

1. Procedure / Preliminary Work / Design (10 Marks)
Evaluation is based on planning and conceptual clarity before performing the experiment.

- Ability to clearly explain the experimental procedure and understand each step involved.
- Preparation and organization of required components, instruments, and experimental setup.
- Logical approach in experimental design, circuit development, or algorithm formulation related to the experiment.

2. Conduct of Experiment / Execution of Work (15 Marks)
Evaluation is based on practical performance during the examination.

- Proper circuit setup and connection.
- Accurate execution of experimental procedure.
- Efficient handling of laboratory instruments and equipment.

3. Result with Valid Inference / Quality of Output (10 Marks)
Evaluation is based on correctness and interpretation of results.

- Precision and correctness of experimental observations and output.
- Ability to analyse results and draw valid technical conclusions.

4. Viva Voce (10 Marks)
Evaluation of student's understanding of experimental concepts.

- Ability to explain procedure, working principle, and results.
- Ability to answer theoretical and practical questions related to the experiment.

5. Record (5 Marks)
Evaluation is based on laboratory documentation submitted during the examination.

- Completeness and accuracy of recorded experiments.
- Clarity, neatness, and systematic presentation of laboratory records.

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	**50**	**50**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 25 marks
Internal Lab exam : 20 marks

Text Books:

1. Paynter, R. T. (2006). *Introductory electronic devices and circuits* (7th ed.). Pearson Education.
2. Boylestad, R. L., & Nashelsky, L. (2009). *Electronic devices and circuit theory* (10th ed.). Pearson Education.
3. Neamen, D. A. (2010). *Electronic circuits: Analysis and design* (3rd ed.). McGraw-Hill Education.

Reference Books:

1. Sedra, A. S., & Smith, K. C. (2015). *Microelectronic circuits* (7th ed.). Oxford University Press.
2. Gayakwad, R. A. (2015). *Op-amps and linear integrated circuits* (4th ed.). Pearson Education.
3. Horowitz, P., & Hill, W. (2015). *The art of electronics* (3rd ed.). Cambridge University Press.

SUSTAINABLE DEVELOPMENT GOALS MAPPING - SEMESTER III

SEMESTER III	SUSTAINABLE DEVELOPMENT GOALS																
Course Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
25UMBT301				✓			✓	✓	✓								
25UEET301				✓			✓		✓		✓	✓					
25UEET302				✓			✓		✓		✓	✓					
25UEET303				✓			✓		✓		✓	✓					
25UAMT304				✓				✓	✓		✓						✓
25UHUT001				✓				✓	✓			✓					✓
25UHUT002				✓	✓	✓	✓				✓	✓	✓		✓	✓	✓
25UEEL305				✓			✓		✓			✓					
25UEEL306				✓			✓		✓			✓					
25MEET301				✓			✓				✓	✓	✓				
25MEET302				✓			✓		✓		✓	✓	✓				

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SEMESTER 4

ELECTRICAL AND ELECTRONICS ENGINEERING

(STC 2025 Scheme)

25UMBT401	PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS	Category	L	T	P	R	Credit	Year of Introduction
		BSC	3	0	0	0	3	2025

Preamble:

This course introduces students to the modern theory of probability and random processes, covering important models of random variables and analysis of random processes. A brief course in numerical techniques familiarizes students with some basic numerical techniques which are especially useful when analytical solutions are hard to find.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Explain the concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	K3 Apply
CO2	Explain the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	K3 Apply
CO3	Interpret random processes using autocorrelation, power spectrum and Poisson process model as appropriate.	K3 Apply
CO4	Apply numerical methods to find solutions of linear system of Equations, ordinary differential equations and Laplace equations.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	1	3	1
CO2	3	2	2	2	-	-	-	-	-	-	1	3	1
CO3	3	2	2	2	-	-	-	-	-	-	1	3	1
CO4	3	2	2	2	-	-	-	-	-	-	1	3	2
Avg	3	2	2	2		-	-	-	-	-	1	3	1.25

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*			*	
CO2	*	*	*	*	*			*	
CO3	*	*	*	*	*			*	
CO4	*	*	*	*	*			*	

WKs mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*			*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (11 Hours)

Random variables, discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Binomial distribution, Poisson distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables.

[Text1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]

Module 2 (11 Hours)

Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables.

[Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2]

Module 3 (10Hours)

Random processes and classification, mean and autocorrelation, wide sense stationary (WSS) processes, autocorrelation and power spectral density of WSS processes and their properties, Poisson process-distribution of inter-arrival times, combination of independent Poisson processes(merging) and subdivision (splitting) of Poisson processes (results without proof).

[Text-2: Relevant topics from sections-8.1-8.5, 8.7, 10.5]

Module 4 (10 Hours)

Newton-Raphson Method, Gauss Elimination Method ,Gauss – Jordan Method, Numerical solution of ordinary differential equations-Euler's method, Modified Euler's method, Runge - Kutta method of 2nd Order, Numerical solution of Laplace equation –Jacobi's Method, Curve Fitting by Method of Least Squares - Straight lines, Parabola.

[Text3: Relevant topics from sections 2.5, 4.2, 7.5, 8.4, 8.5, 9.4]

Textbooks

1.Devore, J. L. (2016). *Probability and statistics for engineering and the sciences* (9th ed.). Cengage Learning.

2.Ibe, O. C. (2005). *Fundamentals of applied probability and random processes*. Elsevier.

3.Sastry, S. S. (2012). *Introductory methods of numerical analysis* (5th ed.). PHI Learning Pvt. Limited.

Reference Books

1 .Papoulis, A., & Pillai, S. U. (2002). *Probability, random variables and stochastic processes* (4th ed.). McGraw-Hill.

2. Palaniammal, S. (n.d.). *Probability and random processes* (3rd ed.). PHI Learning Private Limited.

3. Chapra, S. C., & Canale, R. P. (2021). *Numerical methods for engineers* (8th ed.). McGraw-Hill Education.

END SEMESTER EXAMINATION–MODEL QUESTION PAPER

(STC 2025 SCHEME)

CourseCode	**25UMBT401**
Course Name	**PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS**
Max.Marks:60	**Duration:2.5Hours**

Part A

(Answer all questions. Each question carries 3 marks)

QnNo.	Question	Marks	CO	BL
1	Determine the Binomial distribution for which mean is 5 and variance $\frac{15}{4}$	3	1	L2
2	Find the probability distribution function, if the Random variable X takes thevalues 1, 2, 3, 4 such that $2P(X = 1) = 3P(X = 2) = P(X = 3) = 5\ P(X = 4)$	3	1	L3
3	Find the value of k and Mean for the p d f $f(x) = \begin{cases} kx^2, & 0 < x < 1 \\ 0, & otherwise \end{cases}$	3	2	L2
4	A Random variable X has a Uniform distribution in $(-4, 4)$. Find $(\lvert X \rvert \leq 2)$.	3	2	L3
5	State any three properties of autocorrelation function.	3	3	L2
6	Find the power spectral density of the WSS power process with autocorrelation function $2e^{-\lvert\tau\rvert}.+4e^{-\lvert\tau\rvert}$	3	3	L3
7	Find the positive root of the equation $2x^3 - 3x - 6 = 0$ correct to 4 decimalplaces by Newton - Raphson method.	3	4	L2
8	Use Euler method to compute $y(0.15)$ for $y' = x + y + xy$,	3	4	L2

<table>
<tr><td></td><td>$y(0) = 1$ bytaking $h = 0.15$</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Part B
(Answer any one full question from each Module. Each carry 9 marks)</td></tr>
<tr><td colspan="5">Module I</td></tr>
<tr><td>QnNo.</td><td>Question</td><td>Marks</td><td>CO</td><td>BL</td></tr>
<tr><td>9a</td><td>A random variable X has the following PMF
<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>f(x)</td><td>$\frac{k}{2}$</td><td>$\frac{k}{3}$</td><td>$\frac{k+1}{3}$</td><td>$\frac{2k-1}{6}$</td></tr></table>Find (i) the value of k (ii) mean and variance of X</td><td>5</td><td>1</td><td>L2</td></tr>
<tr><td>b</td><td>In a certain industrial facility, it is known that the probability of an accident on any given day is 0.005 and accidents are independent of each other. Use Poisson distribution to find the probability that in any given period of 400 days (i) therewill be an accident on one day (ii) there are at most three days with an accident?</td><td>4</td><td>1</td><td>L3</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>10a</td><td>Derive mean and variance of Binomial distribution</td><td>5</td><td>1</td><td>L2</td></tr>
<tr><td>b</td><td>The joint distribution of (X,Y) is given by
$(x, y) = (x + y)$; x =0, 1, 2; y = 0, 1, 2, 3.
Find (i) the value of k (ii) the marginal distribution.</td><td>4</td><td>1</td><td>L3</td></tr>
<tr><td colspan="5">Module II</td></tr>
<tr><td>QnNo.</td><td>Question</td><td>Marks</td><td>CO</td><td>BL</td></tr>
<tr><td>11a</td><td>A random variable X has probability density function
$$f(x) = \begin{cases} \frac{3}{4}(1-x^2), & -1 \le x \le 1 \\ 0 & , otherwise \end{cases}$$
Find the mean and variance of $Y = 2X - 3$</td><td>5</td><td>2</td><td>L2</td></tr>
<tr><td>b</td><td>The time in hours required to repair a machine is exponentially distributed with mean 20. What is the probability that the required time (i) exceeds 30 hours? (ii) between 16 hours and 24 hours?</td><td>4</td><td>2</td><td>L3</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td>12a</td><td>Suppose the diameter at breast height of trees of a certain type is normallydistributed with mean 8.8 and standard deviation 2.8 (i) What is the probability thatthe diameter of a randomly selected tree will be at least 10 inches? (ii) What is the probability that the diameter of a randomly selected tree will exceed 20 inches? (iii)What is the probability that the diameter of a randomly selected tree</td><td>4</td><td>2</td><td>L3</td></tr>
</table>

<table>
<tr><td></td><td>will be between5 inches and 10 inches?</td><td></td><td></td><td></td></tr>
<tr><td>b</td><td>The joint PDF of continuous random variable X and Y is given by$f(x) = \begin{cases} kxy\,, 0 < x < 4, 1 < y < 5 \\ 0, \quad otherwise \end{cases}$
Find (i) the value of k (ii)marginal distributions
(iii)Check whether X and Y are independent.</td><td>5</td><td>2</td><td>L2</td></tr>
<tr><td colspan="5">Module III</td></tr>
<tr><th>QnNo.</th><th>Question</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>13. a</td><td>A random process X(t) is defined by X(t) = 3 cos(4t + θ), where θ is uniformly distributed in [0, 2π]. Find the mean, auto correlation and auto covariance.</td><td>5</td><td>3</td><td>L3</td></tr>
</table>

<table>
<tr><td>13. b</td><td>Find the power spectral density function of the WSS process whose autocorrelation function is given by
$R_X(\tau) = \frac{a^2}{\tau}\cos(\omega\tau)$</td><td>4</td><td>3</td><td>L2</td></tr>
<tr><td colspan="4">OR</td><td></td></tr>
<tr><td>14. a</td><td>If X(t) is a WSS process with autocorrelation $R_X(\tau) = \frac{\tau^2+44}{\tau^2+4}$. Find the mean and variance.</td><td>5</td><td>3</td><td>L3</td></tr>
<tr><td>14. b</td><td>Prove that sum of two independent Poisson processes is a Poisson process.</td><td>4</td><td>3</td><td>L2</td></tr>
<tr><td colspan="5">Module IV</td></tr>
<tr><th>QnNo.</th><th>Question</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>15. a</td><td>Use Gauss – Jordan method to solve the system
4x + 3y − z = 6
3x + 5y + 3z = 4
x + y + z = 1</td><td>4</td><td>4</td><td>L3</td></tr>
<tr><td>15. b</td><td>Solve Laplace’s equation $\nabla^2 u = 0$ on 0≤x,y≤1 with boundary conditions u(0,y)=0, u(1,y)=100, u(x,0)=0 and u(x,1)=0. Using a grid with spacing h=0.25, write the finite –difference equations and apply the Jacobi’s method for two iterations starting with all interior values equal to zero.</td><td>5</td><td>4</td><td>L3</td></tr>
<tr><td colspan="4">OR</td><td></td></tr>
<tr><td>16. a</td><td>Use modified Euler’s method to find the value of y at x=0.25 and x=0.5 given $\frac{dy}{dx} = 2xy\,, y(0) = 1$</td><td>5</td><td>4</td><td>L3</td></tr>
<tr><td>16. b</td><td>Fit a parabola of the form $y = ax^2 + bx + c$ to the following data
<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>1.2</td><td>1.7</td><td>2.1</td><td>2.8</td><td>5.9</td></tr></table></td><td>4</td><td>4</td><td>L3</td></tr>
</table>

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25UEET401	ELECTRICAL MACHINES II	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble: The objective of the course is to introduce learners to introduce the construction, operating principles, performance, and applications of synchronous and induction machines, including their characteristics, losses, efficiency, and testing in power and industrial systems.

Prerequisite: 25UEET302 ELECTRICAL MACHINES I.

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

CO	Course Outcomes	Knowledge Level (KL)
CO1	Apply the principles of construction and operation of three-phase induction motors to determine their working and performance characteristics.	K3 Apply
CO2	Explain the operating principles and characteristics of induction generators and single-phase induction motors.	K2 Understand
CO3	Apply the fundamentals of synchronous generators to assess their operation and performance characteristics.	K3 Apply
CO4	Implement the fundamentals of construction and operation of synchronous motors to determine their performance characteristics.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	1	1	-	-	-	3	3	2
CO2	3	2	2	-	1	-	1	-	-	-	3	3	2
CO3	3	2	1	-	1	1	1	-	-	-	3	3	2
CO4	3	2	1	-	2	2	1	-	-	-	3	3	2
Avg	3	2	1.25	-	1.25	1.33	1	-	-	-	3	3	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK 5	WK 6	WK 7	WK8	WK9
CO1	*	*	*	*	*	*	*	*	*
CO2	*	*	*	*	*	*	-	*	*
CO3	*	*	*	*	*	*	*	*	*
CO4	*	*	*	*	*	*	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment/Industrial Visit report : 15 marks

SYLLABUS

Module 1 (14 Hours)

3-phase Induction motor – constructional features, classification, principle of operation, torque equation, torque-slip characteristics, relation between starting torque, maximum torque and full-load torque, numerical problems. Phasor diagram – equivalent circuit, power flow diagram, losses and efficiency, numerical problems. No-load and blocked-rotor tests – circle diagram, numerical problems. Starting of induction motors – types of starters: DOL starter, autotransformer starter, star-delta starter, rotor resistance starter (no design). Braking of induction motors – plugging, dynamic braking, regenerative braking (concepts only). Speed control – stator voltage control, V/f control, rotor resistance control.

Module 2 (14 Hours)

Induction generator – line excited and self-excited induction generators (principle of operation only), torque-slip characteristics for braking, motoring and regeneration, phasor diagram. Single-phase induction motors – double revolving field theory, equivalent circuit, torque-slip characteristics. Types of single-phase induction motors – split-phase, capacitor-start induction-run, permanent capacitor type, shaded pole type – applications.

Module 3 (14 Hours)

Principle of operation of 3-phase alternators, classification, constructional features, types of armature windings, coil-span factor and distribution factor (sinusoidal flux distribution only), EMF equation, numerical problems. Cylindrical rotor synchronous generator – no-load and open-circuit characteristics. Synchronous generator on load – armature reaction, effect of armature reaction, synchronous impedance, equivalent circuit, phasor diagram. Voltage regulation – OC and SC tests, EMF and MMF methods, ZPF test, Potier method, numerical problems.

*One assignment is based on an industrial visit to a generating station. Evaluation is done through the IV report and presentation, focusing on understanding and theory–practice correlation.

Module 4 (14 Hours)

Parallel operation of synchronous generator on infinite bus-bar – conditions and methods of synchronization, V-curves, and inverted V-curves, numerical problems. Salient-pole synchronous generator – two reaction theory, phasor diagram, slip test for determination of Xd and Xq. Power developed (cylindrical rotor and salient-pole type) –power angle characteristics.

Synchronous motor – rotating magnetic field, principle of operation, starting methods, losses and efficiency, V-curves, and inverted V-curves.

Text Books:

1. Bimbra, P. S. (2017). *Electric machines* (2nd ed.). Khanna Publishers.
2. Kothari, D. P., & Nagrath, I. J. (2017). *Electric machines* (5th ed.). Tata McGraw-Hill.
3. Say, M. G. (2002). *The performance and design of AC machines* (3rd ed.). CBS Publishers.

Reference Books:

1. Deshpande, M. V. (2011). *Electrical machines* (Eastern Economy ed.). Prentice Hall India.
2. Gupta, B. R., & Singhal, V. (2010). *Fundamentals of electric machines*. New Age International.
3. Husain, A., & Ashfaq, H. (2002). *Electric machines* (3rd ed.). Dhanpat Rai & Co.
4. Gupta, J. B. (2013). *Theory and performance of electrical machines* (14th ed.). S. K. Kataria & Sons.
5. Langsdorf, A. S. (2001). *Theory of alternating current machinery* (2nd rev. ed.). Tata McGraw-Hill.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25UEET401**
Course Name	**ELECTRICAL MACHINESII**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1.	Explain the torque-slip characteristics of a three-phase induction motor with a neat sketch.	3	1	L2
2.	Describe the purpose of no-load and blocked-rotor tests on a three-phase induction motor.	3	1	L2
3.	Explain the principle of operation of self-excited and line-excited induction generators.	3	2	L2
4.	Describe the applications of split-phase and capacitor-start induction motors.	3	2	L2
5.	Illustrate the significance of coil-span factor and distribution factor in an alternator.	3	3	L3
6.	Use the Open-Circuit (OC) and Short-Circuit (SC) tests to determine the voltage regulation of an alternator.	3	3	L3
7.	Explain the V-curves and inverted V-curves of a synchronous motor	3	4	L2
8.	A salient-pole synchronous generator has direct-axis reactance of 1.5 p.u. and quadrature-axis reactance of 0.9 p.u. Determine the ratio of direct-axis reactance to quadrature-axis reactance.	3	4	L3
Part B (*Answer any one full question from each Module. Each carry 9 marks*)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9.a.	Illustrate the constructional features and principle of operation of a three-phase induction motor and its torque equation.	5	1	L3
9.b.	Describe the methods of starting of induction motors.	4	1	L2
OR				

10.a.	Develop the equivalent circuit and power flow diagram of a three-phase induction motor and explain the various losses occurring in it.	5	1	L3
10.b.	Explain the methods of speed control of induction motors.	4	1	L2
Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a.	Describe the principle of operation and torque-slip characteristics of induction generators in motoring, braking and regenerative regions.	5	2	L2
11.b.	Explain why a single-phase induction motor is not self-starting using the double revolving field theory.	4	2	L2
OR				
12.a.	Explain the role of the auxiliary winding in a split-phase induction motor.	4	2	L2
12.b.	Describe the principle of operation of a self-excited induction generator.	5	2	L2
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13. a.	Demonstrate the constructional features of a three-phase alternator and its EMF equation considering coil-span and distribution factors.	4	3	L3
13. b.	A 3-phase, 50 Hz alternator has 4 poles and 36 slots with 10 conductors per slot. The winding is short-pitched by one slot and flux per pole is 0.05 Wb. Determine the induced EMF per phase.	5	3	L3
OR				
14. a.	Develop the phasor diagram of an alternator under lagging power factor load and explain the effects of armature reaction and synchronous impedance.	4	3	L3
14. b.	Determine the voltage regulation of an alternator using EMF method and MMF method.	5	3	L3
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.a.	Explain the conditions and methods of synchronization of a synchronous generator with an infinite bus-bar.	5	4	L2
15. b.	Develop the power-angle characteristics of cylindrical rotor and salient-pole synchronous machines and compare their performance.	4	4	L3

OR				
16. a.	Explain the principle of operation and starting methods of synchronous motors.	5	4	L2
16. b.	Apply the slip test to determine the direct-axis reactance and quadrature-axis reactance ofa salient-pole synchronous machine.	4	4	L3

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25UEET402	POWER ELECTRONICS	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble:This course introduces students to power semiconductor devices, their characteristics, and switching behavior. It also covers the operation, analysis, and applications of various power converters, enabling students to understand and design efficient power electronic systems for practical electrical and electronic applications.

Prerequisite: IEE 104 Introduction to Electrical and Electronics Engineering

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

CO	Course Outcomes	Knowledge Level
CO1	Apply the operating principles and characteristics of modern power semiconductor devices to analyze controlled rectifier circuits.	K3 Apply
CO2	Apply the principles of AC voltage controllers and DC–DC converters to analyze their performance in practical applications.	K3 Apply
CO3	Apply inverter principles and PWM techniques to determine the performance of power electronic systems.	K3 Apply
CO4	Apply drive schemes and control methods to analyze the operation of AC and DC motor drives.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	2	1	-
CO2	3	3	-	2	-	-	-	-	-	-	2	1	1
CO3	3	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	3	2	2	-	-	-	-	-	-	2	3	3

Avg	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	-	-	*	-
CO2	*	*	*	*	-	-	-	*	-
CO3	*	*	*	*	*	-	-	*	-
CO4	*	*	*	*	*	-	-	*	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	-	-	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	**40**	**60**	**2.5 Hours**

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (14 Hours)

Introduction to Power Electronics: Principle of operation and characteristics of power semiconductor devices: Power diode, Power MOSFET and IGBT – switching characteristics and comparison. SCR: Static and switching characteristics (turn-on and turn-off), di/dt and dv/dt protection, turn-on methods, two transistor analogy. Gate triggering circuits: Requirements of isolation and synchronization in gate drive circuits

Module 2 (14 Hours)

Single-phase controlled rectifiers: Half-wave-controlled rectifier with R load. Fully controlled and half-controlled bridge rectifiers with R, RL and RLE loads – continuous and discontinuous conduction modes – output voltage equations and simple problems. Three-phase controlled rectifiers: Three-phase half-wave-controlled rectifier with R load. Fully controlled and half-controlled bridge converters with RLE load (continuous conduction, ripple-free operation) – output voltage equations – waveforms for various triggering angles.

Module 3(14 Hours)
Voltage Source Inverters (VSI): Single-phase half-bridge and full-bridge inverters with R and RL loads. Three-phase bridge inverter with R load – 120° and 180° conduction modes. Current Source Inverters (CSI): Single-phase capacitor commutated CSI – basic operation. Pulse Width Modulation (PWM) techniques. Modulation index and frequency modulation ratio. DC–DC converters (Choppers): Step-down and step-up choppers. Switching regulators: Buck, Boost and Buck-Boost

Module 4 (14 Hours)

Basic introduction to cycloconverters, definition and working principle. Types of cycloconverters: step-up and step-down, single-phase and three-phase cycloconverters. Basic operation of single-phase cycloconverters with simple configurations. Concept of positive and negative group operation and basic output waveforms.control methods: phase angle control and basic idea of circulating and non-circulating current modes.Basic performance aspects: output frequency range, harmonics, power factor, and efficiency.Applications of cycloconverters in AC drives, heating, and industrial systems.

Text Books:

1. Rashid, M. H. (2014). *Power electronics: Circuits, devices, and applications*. Pearson Education.
2. Hart, D. W. (2010). *Power electronics*. Tata McGraw-Hill Education.
3. Bimbhra, P. S. (2022). *Power electronics*. Khanna Publishers.

Reference Books:

1. Mohan, N., Undeland, T. M., & Robbins, W. P. (2007). *Power electronics: Converters, applications, and design*. Wiley India.
2. Erickson, R. W., & Maksimović, D. (2012). *Fundamentals of power electronics*. Springer.
3. Krein, P. T. (1998). *Elements of power electronics*. Oxford University Press.
4. Umanand, L. (2009). *Power electronics: Essentials and applications*. Wiley India.
5. Singh, M. D., &Khanchandani, K. B. (2008). *Power electronics*. Tata McGraw-Hill.

6. Vithayathil, J. (1995). *Power electronics: Principles and applications*. McGraw-Hill College.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25UEET402**
Course Name	**POWER ELECTRONICS**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A
(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Explain the operating regions of an SCR using its static V–I characteristics, including latching current and holding current.	3	1	L2
2	Describe the requirements of isolation in gate drive circuits.	3	1	L2
3	Differentiate continuous and discontinuous conduction modes in controlled rectifiers.	3	2	L2
4	Explain the ripple-free operation criteria in a three-phase half-controlled bridge converter.	3	2	L2
5	Differentiate between the 120° and 180° conduction modes of a three-phase bridge inverter.	3	3	L2
6	Describe the significance of the modulation index in Pulse Width Modulation (PWM) techniques.	3	3	L2
7	Differentiate between step-up and step-down cyclo - converters	3	4	L2
8	Describe the operation of a single-phase cyclo-converter with the help of a simple block diagram.	3	4	L2

Part B
(*Answer any one full question from each Module. Each carry 9 marks*)

Module I

Qn No.	Question	Marks	CO	BL
9.a	Illustrate the dynamic switching characteristics of a Power MOSFET during its turn-on and turn-off intervals.	5	1	L3

9.b	Explain the two-transistor analogy of an SCR with the necessary equations.	4	1	L2
	OR			
10.a	Illustrate the structural features of power MOSFET with a neat sketch	5	1	L3
10.b	Explain different turn on methods of SCR	4	1	L2
	Module II			
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a	A single-phase fully controlled bridge rectifier is fed from a 230 V, 50 Hz single- phase AC supply. Assuming the firing angle is delayed to $\alpha = 45°$ and the load is highly inductive with a total resistance of 10 Ω. Compute the average output voltage and average output current under continuous conduction	5	2	L3
11.b	Illustrate the input voltage, output voltage, and output current waveforms of a single-phase half-wave-controlled rectifier feeding a purely resistive (R) load.	4	2	L3
	OR			
12.a	Illustrate the output voltage waveforms of three phase fully controlled converter with RLE load for firing angles i) $\alpha = 0^\circ$ and ii) $\alpha = 60^\circ$.	5	2	L3
12.b	A single-phase half-controlled bridge rectifier supplies an RL load from a 230 V, 50 Hz AC source. Determine the load voltage and current waveforms for a firing angle of 60°.	4	2	L3
	Module III			
Qn No.	**Question**	**Marks**	**CO**	**BL**
13. a	A three-phase bridge inverter operates in 180° conduction mode with a balanced R load. Construct the line-to-line output voltage waveforms and calculate the phase voltages.	5	3	L3
13. b	Explain the working principle and operation of a single-phase full-bridge voltage source inverter operating with an RL load.	4	3	L2
	OR			
14. a	A step-down chopper is supplied with 200 V DC and operated at a duty cycle of 0.4. Compute the average output voltage and explain the converter operation.	5	3	L3
14. b	Distinguish a Buck converter and a Boost converter	4	3	

	based on their structural circuit configurations and output voltage expressions.			L2
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15. a	A single-phase step-down cyclo-converter is used to obtain a 10 Hz output from a 50 Hz AC source. Apply the working principle of the cyclo-converter to determine the generation of the low-frequency output waveform using positive and negative converter groups	5	4	L3
15. b	A single-phase cyclo-converter is used to supply a resistive load requiring a lower output frequency than the input supply. Apply the operating principles of the cyclo-converter to determine the firing sequence and firing angles required to obtain the desired output frequency.	4	4	L3
OR				
16. a	A three-phase industrial drive requires a variable-frequency AC supply for speed control. Determine a suitable cyclo-converter configuration to meet the requirement.	5	4	L3
16. b	A cyclo-converter is used to supply a variable-speed AC motor in an industrial drive. Determine the effect of harmonics on the converter performance in terms of output voltage quality, power factor, and efficiency.	4	4	L3

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25UEET403	PULSE AND DIGITAL CIRCUITS	Category	L	T	P	R	Credit	Year of Introduction
		PBL	3	0	0	1	4	2025

Preamble: This course provides a strong foundation in digital electronics, focusing on combinational and sequential logic design techniques widely used in electrical and electronic systems. It introduces students to modern digital design practices through Hardware Description Language (Verilog) for combinational circuits, while emphasizing Finite State Machines (FSM) and Algorithmic State Machine (ASM) charts as systematic design tools for sequential systems. The course prepares students for advanced studies in digital systems, control, embedded systems and VLSI.

Prerequisite: IEE104 Introduction to Electrical & Electronics Engineering

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

CO	Course Outcomes	Knowledge Level
CO1	Explain number systems, Boolean algebra, logic gates and digital codes used in digital electronics.	K2 Understand
CO2	Apply the concept of Boolean algebra, Karnaugh maps and programmable logic devices to design combinational logic circuits.	K3 Apply
CO3	Implement and verify sequential logic circuits using flip-flops, registers, and counters.	K3 Apply
CO4	Illustrate basic ASM and FSM charts and implement simple combinational circuits using Verilog HDL.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	1	1	-	-	-	-	-	-	1	3	1
CO2	3	3	3	2	-	-	-	-	-	-	1	3	2
CO3	3	3	3	2	-	-	-	-	-	-	1	3	2
CO4	3	2	2	2	3	-	-	-	-	-	2	3	2
Avg	3	2.25	2.25	1.75	3	-	-	-	-	-	1.25	3	1.75

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	-	-	*	-
CO2	*	*	*	*	*	-	-	*	-
CO3	*	*	*	*	*	-	-	*	-
CO4	*	*	*	*	*	*	-	*	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	-	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 25 marks
Mini Project : 30 marks

SYLLABUS

Module 1 (16 Hours)
Digital number systems including binary, octal, and hexadecimal systems, base conversions, complements, and signed number representation. Digital codes including BCD, Gray code, and Excess-3 code and their applications. Boolean algebra postulates, laws, and theorems. Boolean expressions, canonical and standard forms, and simplification techniques. Logic gates including basic and universal gates and their implementation.

Module 2 (14 Hours)
Simplification of Boolean functions using algebraic method and Karnaugh maps up to four variables, including don't care conditions. Design and implementation of combinational circuits such as adders, subtractors, multiplexers, demultiplexers, encoders, decoders, comparators, code converters, and parity generator and checker circuits.

Introduction to programmable logic devices including ROM, PLA and PAL Introduction to FPGA architecture, logic blocks and interconnections and role of FPGA in modern digital system implementation.

Module 3 (14 Hours)

Concept of sequential circuits and memory elements. Latches and flip-flops including SR, JK, D, and T flip-flops, triggering methods, characteristic equations, and excitation tables. Flip-flop conversions and applications. Registers and shift registers including serial and parallel data transfer modes. Design and analysis of synchronous and asynchronous counters, timing diagrams and applications of counters in digital systems.

Module 4 (12 Hours)

Concept of finite state machines, state transitions, Moore and Mealy models, state diagrams, and state tables. Representation and design of sequential circuits using FSM.

Algorithmic State Machine (ASM) charts including ASM blocks, decision boxes, conditional output boxes and their use in digital system design.

Introduction to Hardware Description Language, need for HDL in digital design, structure of Verilog modules, ports and data types. Modelling of basic combinational circuits such as logic gates, multiplexers, adders and code converters using Verilog HDL.

Text Books

1. Mano, M. M. (2013). *Digital logic and computer design* (4th ed.). Pearson Education.
2. Floyd, T. L. (2009). *Digital fundamentals* (10th ed.). Pearson Education.
3. Palnitkar, S. (2003). *Verilog HDL: A guide to digital design and synthesis* (2nd ed.). Pearson Education.

Reference Books

1. Mano, M. M., & Ciletti, M. D. (2013). *Digital design with an introduction to Verilog HDL* (5th ed.). Pearson Education.
2. Wakerly, J. F. (2018). *Digital design: Principles and practices* (5th ed.). Pearson Education.
3. Roth, C. H., Kinney, L. L., & John, L. K. (2014). *Fundamentals of logic design* (7th ed.). Cengage Learning.
4. Brown, S., &Vranesic, Z. (2014). *Fundamentals of digital logic with Verilog design* (3rd ed.). McGraw-Hill Education.
5. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2017). *Digital systems: Principles and applications* (12th ed.). Pearson Education.

Project-Based Learning Component

This course incorporates Project-Based Learning (PBL) to enable students to apply digital electronics concepts in the design and implementation of practical digital systems. Students shall identify a relevant digital system design problem based on electrical and electronic engineering applications and prepare a project proposal including problem statement, functional requirements, and design specifications.

Students shall design and develop appropriate solutions using combinational and sequential logic circuits, flip-flops, registers, counters he design shall be implemented using hardware components. The project shall be tested, validated, and demonstrated to verify its functionality and performance.

Suggested Project Topics

Project topics shall involve the design, simulation, and implementation of digital electronic systems such as:

1. Digital clock using counters and display interface
2. Traffic light controller
3. Digital frequency divider using flip-flops and counters
4. Digital voting machine
5. Digital code converter (Binary–Gray, Gray–Binary, BCD converter)
6. Digital lock system
7. LED pattern generator using shift registers
8. Digital alarm or event detection system using counters and logic circuits

Students may also propose other digital system design projects relevant to course outcomes, subject to approval by the course instructor.

Assessment and Evaluation of Project Activity

Sl. No.	Evaluation Component	Marks
1	Project Planning and Proposal	5
2	Progress Presentation and Technical Interaction	4
3	Participation and Team Work	3
4	Circuit Design, Execution, and Implementation	10
5	Final Demonstration and Presentation	5
6	Project Quality, Innovation, and Technical Merit	3
	Total	**30**

Evaluation Guidelines

Project Planning and Proposal (5 Marks):
Assessment shall be based on clarity of problem definition, functional specifications, feasibility, and understanding of digital design concepts.

Progress Presentation and Technical Interaction (4 Marks):
Evaluation shall consider individual contribution, design understanding, and ability to explain design methodology and respond to questions.

Participation and Team Work (3 Marks):
Assessment shall be based on active involvement, collaboration, and individual responsibility in project activities.

Design, Simulation, and Implementation (10 Marks):
Evaluation shall consider correctness of logic design, simulation verification, HDL implementation (if applicable), hardware realization, and proper system operation.

Final Demonstration and Presentation (5 Marks):
Assessment shall be based on demonstration of working system, presentation quality, and technical clarity.

Project Quality, Innovation, and Technical Merit (3 Marks): Evaluation shall consider originality, complexity, innovation, and overall quality of digital system implementation.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

(STC 2025 SCHEME)

Course Code	**25UEET403**
Course Name	**PULSE AND DIGITAL CIRCUITS**
Max. Marks: 40	**Duration: 2 Hours**

Part A
(Answer all questions. Each question carries 2 marks)

Qn No.	Question	Marks	CO	BL
1	Convert the given decimal numbers to equivalent binary a) 125 b) 64	2	1	L2
2	Explain the implementation of NOT gate using NAND gate.	2	1	L2

3	Implement the function $F(A,B,C)=\Sigma(1,3,5,7)$ using a 4:1 multiplexer.	2	2	L3
4	Implement a half adder using basic logic gates and determine the outputs for all possible input combinations.	2	2	L3
5	A serial input 1101 is applied to a shift register. Determine the register contents after four clock pulses.	2	3	L3
6	Compare synchronous and asynchronous counters.	2	3	L2
7	Determine the output for A=1,B=1 and C=0 assign Y = A ? (B&C):(B|C);	2	4	L3
8	Compare Moore and Mealy machines.	2	4	L2

Part B

(*Answer any one full question from each Module. Each carry 6 marks*)

Module I

Qn No.	**Question**	**Marks**	**CO**	**BL**
9.a.	Using Boolean laws, show that: $A'BC+ABC+AB'C=AC+A'BC$	3	1	L2
9.b.	Convert the following: a) Convert $(25)_{10}$ into binary. b) Convert $(101101)_2$ into decimal. c) Convert $(47)_{10}$ into BCD code. d) Convert $(1010)_2$ into Gray code. e) Convert Gray code (1101)(1101)(1101) into binary. f) Convert $(2F)_{16}$ into decimal.	3	1	L2
OR				
10.a	Convert the given function into canonical SOP form F(A,B,C,D)=AB+CD	3	1	L2
10.b	Convert the following: a) Convert (94)10into hexadecimal. b) Convert (3A)16 into binary. c) Convert (65)10 into BCD. d) Convert (37)10 into Excess-3 code. e) Convert binary (101101)2 into Gray code. f) Convert Gray code (1110)(1110)(1110) into binary.	3	1	L2

Module II

Qn No.	Question	Marks	CO	BL
11.a	Minimize the Boolean function using a 4-variable K-map, $F(A,B,C,D)=\Sigma(0,2,5,7,8,10,13,15)$	3	2	L3
11.b	A digital system performs addition and comparison of two binary numbers, A=1010 and B=0111 Determine: a) Sum using a parallel adder. b) Comparator outputs.	3	2	L3
OR				
12.	Implement the following functions using a PLA: $F1(A,B,C)=\Sigma(1,3,5,7)$ $F2(A,B,C)=\Sigma(0,2,4,6)$	3	2	L3
12.b	Minimize the following using a 4-variable K-map: $F(A,B,C,D)=\Sigma(0,2,4,6,8,10,12,14)$	3	2	L3
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.	Design a 4 bit down counter using JK flip flop	6	3	L3
OR				
14.	Design a MOD-10 asynchronous counter using JK flip-flops and determine the counting sequence.	6	3	L3
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.	Apply the Mealy model to detect the sequence **1101** and determine the state transitions and outputs	6	4	L3
OR				
16.	Develop the ASM chart for a traffic light controller having three states and determine the output conditions.	6	4	L3

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25UEEL404	ELECTRICAL MACHINES -1 LAB	Category	L	T	P	R	Credit	Year of Introduction
		PCL	0	0	3	0	2	2025

Preamble:This laboratory course provides hands-on experience in testing and evaluating the performance of DC machines and transformers, helping students to understand characteristics, losses, efficiency, voltage regulation, and practical electrical energy conversion.

Prerequisite: 25UEET302 Electrical Machines I

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

CO	Course Outcomes	Knowledge Level (KL)
CO1	Apply standard laboratory testing procedures to determine the voltage build-up and load characteristics of DC generators.	K3 Apply
CO2	Apply experimental techniques to study the operating and performance characteristics of DC motors under varying load conditions	K3 Apply
CO3	Perform appropriate tests to determine efficiency, losses, and dynamic parameters of DC machines.	K3 Apply
CO4	Apply laboratory testing methods to assess the operating characteristics of single-phase and three-phase transformers.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	1	1	1	-	1		1	3	1
CO2	3	2	1	2	-	-	1	-	1		1	3	-
CO3	3	2	-	2	-	1	1	-	1		1	3	-
CO4	3	2	-	2	1	-	1	-	1		1	2	3
Avg	3	2	1	2	1	1	1	-	1		1	2.75	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	*	*	*	*
CO2	*	*	*	*	*	-	-	*	*
CO3	*	*	*	*	-	-	*	*	*
CO4	*	*	*	*	*	*	-	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	-	-	-	*	-

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	50	50	3 Hours

Attendance	Preparation / Pre-Lab Work, Viva and Timely completion of Lab Reports / Record	Internal Examination	Total
5	25	20	50

Procedure / Preparatory Work / Design / Algorithm	Conduct of Experiment / Execution / Troubleshooting	Result with Valid Inference / Quality of Output	Viva Voce	Record	Total
10	15	10	10	5	50

Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
Endorsement by External Examiner: The external examiner shall endorse the record.

Continuous Assessment (25 Marks)
1. Conduct of Experiments (10 Marks)
• Procedure and Execution
• Skill Proficiency
• Teamwork

2. Lab Reports and Record Keeping (5 Marks)
• Quality of Reports
• Timely Submission

3. Viva Voce (10 Marks)

• Ability to explain experiments and underlying principles

Final Marks Averaging: The final marks are the average of experiments conducted in the lab.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure / Preliminary Work / Design / Algorithm (10 Marks)
2. Conduct of Experiment / Execution of Work (15 Marks)
3. Result with Valid Inference / Quality of Output (10 Marks)
4. Viva Voce (10 Marks)
5. Record (5 Marks)

Expt. No.	**EXPERIMENTS**
	PART A – DC MACHINES
1	Open circuit characteristics of DC shunt generator (CO1) Objectives: a. Predetermine the OCC at different speeds b. Determine the critical field resistance c. Determine the maximum voltage built up with given shunt field resistance d. Determine the critical speed for a given shunt field resistance
2	Load test on DC shunt generator (CO1) Objectives: Determine the external and internal characteristics
3	Brake test on DC shunt motor (CO2) Objectives: Plot the following characteristics: a. Performance characteristics b. Electrical characteristics c. Mechanical characteristics
4	Brake test on DC series motor (CO2) Objectives: Plot the following characteristics: a. Performance characteristics b. Electrical characteristics c. Mechanical characteristics
5	Load test on DC compound generator (CO1) Objectives: a. Plot the load characteristics when cumulatively compounded b. Plot the load characteristics when differentially compounded
6	Hopkinson’s test on DC shunt machine (CO3) Objectives: a. Predetermine the efficiency while DC machine is acting as generator and motor b. Plot the efficiency curves while DC machine is acting as generator and motor
7	Hopkinson’s test on a pair of DC machines (CO3) Objectives: Determine the efficiency of the DC machine while working as a motor and generator under various load conditions

8	Retardation test on a DC machine (CO3) Objectives: a. Separate the hysteresis, eddy current, friction and windage losses b. Find the moment of inertia of the rotating system
9	Separation of losses in a DC shunt motor (CO3) Objectives: Separate the hysteresis, eddy current, friction and windage losses by conducting no-load tests at different excitations
	PART B – TRANSFORMERS
10	OC and SC tests on single-phase transformer (CO4) Objectives: 1. Predetermine the voltage regulation and efficiency at different loads and power factors 2. Determine the equivalent circuit referred to LV side and HV side 3. Plot the voltage regulation vs power factor curves at full-load and half full-load 4. Plot the efficiency curve at unity p.f. and 0.5 p.f. 5. Determine the power factor at which the voltage regulation is zero 6. Determine the load at which maximum efficiency occurs and the maximum efficiency
11	Load test on single-phase transformer (CO4) Objectives: Determine the voltage regulation and efficiency at different loads and at unity power factor
12	Separation of losses in a single-phase transformer (CO4) Objectives: a. Separate the hysteresis and eddy current losses using voltage and frequency control b. Plot losses Vs frequency curves at normal voltage and different frequencies c. Plot losses Vs frequency curves at different frequencies keeping V/f constant
13	Efficiency and regulation test on single-phase transformer (CO4) Objectives: a. Predetermine voltage regulation and efficiency at different loads and power factors b. Determine the equivalent circuit referred to LV and HV side
14	Parallel operation of two dissimilar single-phase transformers (CO4) Objectives: a. Determine the load sharing while operating in parallel b. Verify the load sharing using transformer impedances
15	OC and SC tests on three-phase transformer (CO5) Objectives: a. Predetermine voltage regulation and efficiency at different loads and power factors b. Determine the per phase equivalent circuit
16	Scott connection (CO4) Objectives: Convert 3-phase AC supply into 2-phase AC and conduct load test to study performance
NOTE: A minimum of TWELVE experiments are mandatory out of the sixteen	

listed.

Text Books

1. Bimbra, P. S. (2011). *Electrical machinery* (7th ed.). Khanna Publishers.
2. Theraja, B. L. (2005). *A textbook of electrical technology*. S. Chand & Company.
3. Kothari, D. P., & Nagrath, I. J. (2017). *Electric machines* (5th ed.). Tata McGraw-Hill.

Reference Books

1. Say, M. G. (2002). *The performance and design of AC machines* (3rd ed.). CBS Publishers.
2. Langsdorf, A. S. (2001). *Theory of alternating current machinery* (2nd rev. ed.). Tata McGraw-Hill.

<table>
<tr><td rowspan="2">25UEEL405</td><td rowspan="2">DIGITAL AND POWER ELECTRONICS LAB</td><td>Category</td><td>L</td><td>T</td><td>P</td><td>R</td><td>Credit</td><td>Year of Introduction</td></tr>
<tr><td>PCL</td><td>0</td><td>0</td><td>3</td><td>0</td><td>2</td><td>2025</td></tr>
</table>

Preamble: This laboratory course provides practical exposure to the fundamental concepts of digital and power electronics through implementation and testing of basic electronic circuits.

Prerequisite:25UEET403 - Pulse and Digital Circuits, 25UEET402 - Power Electronics

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

CO	Course Outcomes	Knowledge Level
CO1	Realize and verify combinational logic circuits using Boolean algebra, logic gates, standard ICs, and multiplexers.	K3 Apply
CO2	Design, implement and analyze sequential logic circuits using flip-flops, counters, shift registers and perform digital circuit implementation using Verilog	K3 Apply
CO3	Demonstrate and verify the operation of SCR, MOSFET, and IGBT, and implement basic triggering and gate driver circuits using hardware and simulation	K3 Apply
CO4	Implement and simulate controlled rectifiers, AC voltage controllers, and DC–DC converters and observe the effect of firing angle and duty cycle on output waveforms.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	2	-	-	-	2	2	1	3	2
CO2	3	3	3	2	2	-	-	-	2	2	1	3	3
CO3	3	2	-	2	-	-	-	-	2	2	1	3	1
CO4	2	2	3	2	-	-	-	-	2	2	2	3	2
Avg	2.5	2.25	2.67	2	2				2	2	1.25	3	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	*	-	*	-
CO2	*	*	*	*	*	*	-	*	-
CO3	*	*	*	*	-	-	-	*	-
CO4	*	*	*	*	*	-	-	*	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	-	*	-

Assessment Pattern

Continuous Assessment (25 Marks)

Continuous assessment evaluates the student's performance during the regular laboratory sessions, emphasizing practical skills, documentation, and conceptual understanding.

1. **Conduct of Experiments (10 Marks)**

Evaluation is based on the student's ability to perform experiments systematically and efficiently.

- Procedure and Execution:
  Adherence to correct experimental procedures, systematic execution of experiments, and compliance with laboratory safety guidelines.

- Skill Proficiency:
  Ability to handle laboratory instruments and components accurately, precision in observations, and effectiveness in troubleshooting during experimentation.

- Teamwork and Participation:
  Active involvement, collaboration, and contribution during group laboratory activities.

2. Lab Reports and Record Keeping (5 Marks)

Evaluation is based on the quality and maintenance of laboratory documentation.

- Quality of Reports:
  Clarity, completeness, and accuracy of experimental reports, including proper recording of observations, calculations, analysis, and conclusions.

- Timely Submission and Organization:
  Submission of rough and fair records within the stipulated time and maintenance of a neat, well-structured laboratory record.

3. **Viva Voce (10 Marks)**

Evaluation of conceptual understanding and communication skills related to laboratory experiments.

- Ability to explain experimental procedure, working principle, and results.

- Understanding of theoretical concepts associated with the experiment.

- Ability to answer questions related to practical and analytical aspects of the experiment.

Evaluation Pattern for End Semester Examination (50 Marks)

End Semester Examination (50 Marks)

The end semester evaluation assesses the student's ability to independently perform experiments, interpret results, and demonstrate theoretical understanding.

1. Procedure / Preliminary Work / Design (10 Marks)

Evaluation is based on planning and conceptual clarity before performing the experiment.

- Procedure Understanding and Description:
  Ability to clearly explain the experimental procedure and understand each step involved.

- Preliminary Work and Planning:
  Preparation and organization of required components, instruments, and experimental setup.

- Design Logic:
  Logical approach in experimental design, circuit development, or algorithm formulation related to the experiment.

2. Conduct of Experiment / Execution of Work (15 Marks)

Evaluation is based on practical performance during the examination.

- Proper circuit setup and connection.
- Accurate execution of experimental procedure.
- Efficient handling of laboratory instruments and equipment.

3. Result with Valid Inference / Quality of Output (10 Marks)

Evaluation is based on correctness and interpretation of results.

- Accuracy of Results:
  Precision and correctness of experimental observations and output.
- Analysis and Interpretation:
  Ability to analyse results and draw valid technical conclusions.

4. Viva Voce (10 Marks)

Evaluation of student's understanding of experimental concepts.

- Ability to explain procedure, working principle, and results.
- Ability to answer theoretical and practical questions related to the experiment.

5. Record (5 Marks)

Evaluation is based on laboratory documentation submitted during the examination.

- Completeness and accuracy of recorded experiments.
- Clarity, neatness, and systematic presentation of laboratory records.

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	50	50	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	: 5 marks
Continuous Assessment Test	: 20 marks
Continuous Assessment Assignment	: 25 marks

SYLLABUS

EXPERIMENT LIST

PART A – DIGITAL ELECTRONICS

(Any 8 experiments - mandatory)

Pre-lab assignment: Familiarization of Logic Gates, Identification of typical logic ICs, Interpreting IC datasheets.

1. Half adder & Full adder using gates.
2. Half subtractor & Full subtractor using gates.
3. 4-bit adder/subtractor & BCD adder using IC 7483.
4. BCD to decimal decoder and BCD to 7-segment decoder & display
5. Study of multiplexer IC and realization of combinational circuits using multiplexers.
6. Realization of RS, T, D & JK flip flops using gates.
7. Design of synchronous up, down & modulo-N counters.
8. Realization of 4-bit serial IN serial OUT registers using flip flops.
9. Design of ring counter and Johnson's counter using IC 7495
10. VHDL implementation of : - a) half adder & full adder
    b) half subtractor & full subtractor

Textbooks:

1. Mano, M. M., & Ciletti, M. D. (2013). *Digital design* (5th ed.). Pearson Education.

2. Leach, D. P., Malvino, A. P., & Saha, G. (2015). *Digital principles and applications* (8th ed.). McGraw-Hill Education.

3. Floyd, T. L. (2015). *Digital fundamentals* (11th ed.). Pearson Education.

Reference Books:

1. Roth, C. H., Jr., & Kinney, L. L. (2014). *Fundamentals of logic design* (7th ed.). Cengage Learning.

2. Tocci, R. J., Widmer, N. S., & Moss, G. L. (2011). *Digital systems: Principles and applications* (11th ed.). Pearson Education.

3. Palnitkar, S. (2003). *Verilog HDL: A guide to digital design and synthesis* (2nd ed.). Pearson Education.

PART B
POWER ELECTRONICS

HARDWARE EXPERIMENTS

1.Static characteristics of SCR

2.R and RC firing scheme for SCR control

3. Line Synchronised Triggering Circuits of SCR

4. AC Voltage Controller.

5. Gate Driver Circuits for MOSFET/IGBT

SIMULATION EXPERIMENTS:

1. Simulation of Single Phase Half-Wave Controlled Rectifier (R Load)
2. Simulation of Single Phase Fully Controlled Bridge Rectifier
3. Simulation of Single Phase AC Voltage Controller (TRIAC / Anti-parallel SCR)
4. Simulation of buck/boost/buck-boost converters
5. Simulation of RC Triggering Circuit for SCR

Textbooks

1. Rashid, M. H. (2014). *Power electronics: Circuits, devices, and applications*. Pearson Education.
2. Hart, D. W. (2010). *Power electronics*. Tata McGraw-Hill Education.
3. Bimbhra, P. S. (2022). *Power electronics*. Khanna Publishers.

References

1. Mohan, N., Undeland, T. M., & Robbins, W. P. (2007). *Power electronics: Converters, applications, and design*. Wiley India.
2. Erickson, R. W., & Maksimović, D. (2012). *Fundamentals of power electronics*. Springer.
3. Krein, P. T. (1998). *Elements of power electronics*. Oxford University Press.

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SEMESTER 4

ELECTRICAL AND ELECTRONICS ENGINEERING

(STC 2025 Scheme)

ELECTIVE COURSES

25UEET411	RENEWABLE ENERGY SOURCES	Category	L	T	P	R	Credit	Year of Introduction
		PEC	3	0	0	0	3	2025

Preamble: This course provides an understanding of the current energy scenario, energy sources, and their utilization, while addressing present and future energy needs. It also covers the principles of renewable energy conversion systems and emphasizes the importance of energy conservation for sustainable development.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Describe the environmental aspects of renewable energy resources in comparison with various conventional energy systems.	K2 Understand
CO2	Apply the principles of solar energy to identify and use the components involved in electrical energy production.	K3 Apply
CO3	Explain the concept of biomass energy resources and the conversion principles of tidal energy.	K2 Understand
CO4	Apply the concepts of renewable thermal energy and green energy to identify suitable energy sources for different applications..	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	1	1	-	-	-	2	3	2
CO2	3	3	-	-	-	2	1	-	-	-	2	3	3
CO3	3	3	-	-	-	2	2	-	-	-	2	3	3
CO4	3	3	-	-	-	1	2	-	-	-	2	3	2

Avg	3	3	-	-	-	1.5	1.5	-	-	-	2	3	2.5

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	-	-	*	*	*
CO2	*	*	*	*	-	-	*	*	*
CO3	*	*	*	*	-	-	*	*	*
CO4	*	*	*	*	-	-	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	-	-	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (11 Hours)

Introduction: Principles of renewable energy; energy and sustainable development, fundamentals and social implications. Worldwide renewable energy availability, renewable energy availability in India, types of renewable energy.

Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind (numerical problems); major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS Horizontal axis- single, double and multi-blade system. Vertical axis - Savonius and Darrieus types.

Module 2 (11 Hours)

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements - Pyrheliometers, Pyranometer, Sunshine

Recorder. Solar Thermal systems: concentrating and non-concentrating collectors- Flat plate collectors; Solar tower electric power plant. Photovoltaic system for electric power generation – Classification of PV system -Principle of Solar cell, advantages, disadvantages and applications of solar photovoltaic system.

Module 3 (10 Hours)

Biomass Energy: Introduction; Principle of biomass energy generation - Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome type biogas plant; Urban waste to energy conversion; Biomass gasification (Downdraft). Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, classification of tidal power plants - harnessing tidal energy, advantages and limitations.

Module 4 (10 Hours)

Ocean Thermal Energy Conversion: Principle of working, classification, OTEC power stations in the world, environmental impacts associated with OTEC. Introduction to geothermal energy

Green Energy: Introduction, Fuel cells: Classification of fuel cells Hydrogen energy; Operating principles, Zero-energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem

associated with hydrogen energy.

Text Books:

1. G. D. Rai. (2023). *Non-conventional energy sources* (4th ed.). Khanna Publishers.
2. Thomas E. Kissell., David M. Buchla., & Thomas L. Floyd. (2017). *Renewable energy systems*. Pearson.
3. G. S. Sawhney. (2012). *Non-conventional energy resources*. PHI Learning.

Reference Books:

1. Tiwari, G. N. (2002). *Solar energy: Fundamentals, design, modelling and applications*. Narosa Publishers.
2. Earnest, J., &Wizelius, T. (2011). *Wind power plants and project development*. PHI Learning.
3. Sab, S. L. (1995). *Renewable and novel energy sources*. MI Publications.
4. Sawhney, G. S. (2012). *Non-conventional energy resources*. PHI Learning.
5. Tiwari, G. N. (2002). *Solar energy: Fundamentals, design, modelling and applications*. CRC Press.
6. Saigh, A. A. M. (Ed.). (1977). *Solar energy engineering*. Academic Press.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25UEET411**
Course Name	**RENEWABLE ENERGY SYSTEMS**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A
(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Describe the relationship between energy and sustainable development.	3	1	L2
2	Differentiate between Horizontal Axis Wind Turbines (HAWT) and Vertical Axis Wind Turbines (VAWT).	3	1	L2
3	Apply the concept of solar radiation estimation to explain why inclined solar panels are preferred over horizontal panels in many installations.	3	2	L3
4	Select a suitable solar collector (concentrating or non-concentrating) for a given application and justify your choice.	3	2	L3
5	Illustrate the working of a fixed dome biogas plant with a neat sketch.	3	3	L2
6	Outline the fundamental characteristics of tidal power.	3	3	L2
7	Apply the principles of open-cycle and closed-cycle OTEC systems to identify their suitable applications.	3	4	L3
8	Demonstrate the production of hydrogen using the electrolysis method.	3	4	L3

Part B

(Answer any one full question from each Module. Each carry 9 marks)				
Module 1				
9	Explain the different types of renewable energy sources and their significance in meeting future energy demands.	9	1	L2
OR				
10	Derive the expression for power available in wind and explain the factors influencing wind power generation.	9	1	L2
Module II				
11	A flat plate collector of area 4 m^2 receives solar radiation of 850 W/m^2. If the collector efficiency is 50%, compute the useful heat output and explain the working of the collector.	9	2	L3
OR				
12	A PV array consists of 10 modules, each rated at 250 W. Compute the total power output of the array and discuss its application in a standalone solar power system.	9	2	L3
Module III				
13	Describe the principle and operation of biomass gasification. Explain the working of a downdraft gasifier with a neat diagram.	9	3	L2
OR				
14	Explain the classification of tidal power plants and describe the working of each type with suitable diagrams.	9	3	L2
Module IV				
15	Apply the working principle of Ocean Thermal Energy Conversion (OTEC) to explain the operation of an OTEC power plant and classify different OTEC systems with neat sketches.	9	4	L3
OR				

16	Demonstrate the application of fuel cells and hydrogen energy technologies in implementing zero-energy concepts for sustainable energy systems.	9	4	L3

25UEET412	**MATHEMATICS FOR MACHINE LEARNING**	**Category**	**L**	**T**	**P**	**R**	**Credit**	**Year of Introduction**
		PEC	**3**	**0**	**0**	**0**	**3**	**2025**

Preamble: This course introduces the mathematical foundations of basic Machine Learning concepts, enabling learners to understand, develop, and analyze ML systems effectively.

Prerequisite: Nil

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

CO	**Course Outcomes**	**Knowledge Level**
CO1	Make use of the concepts, rules and results about linear equations, matrix algebra, vector spaces, eigenvalues & eigenvectors and orthogonality & diagonalization to solve computational problems	K3 Apply
CO2	Perform calculus operations on functions of several variables and matrices, including partial derivatives and gradients	K3 Apply
CO3	Utilize the concepts, rules and results about probability, random variables, additive & multiplicative rules, conditional probability, probability distributions and Bayes' theorem to find solutions of computational problems	K3 Apply
CO4	Train Machine Learning Models using unconstrained and constrained optimization methods	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**3**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
CO2	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**

CO3	**3**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
CO4	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**
Avg	**3**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2.5**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	*	-	-	-
CO2	*	*	*	*	-	*	-	-	-
CO3	*	*	*	*	*	*	-	-	-
CO4	*	*	*	*	-	*	-	-	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	-	-	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks

Continuous Assessment Test : 20 marks

Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (10 Hours)

LINEAR ALGEBRA: Systems of Linear Equations – Matrices, Solving Systems of Linear Equations. Vector Spaces –Vector Spaces, Linear Independence, Basis and Rank. Linear Mappings – Matrix Representation of Linear Mappings, Basis Change, Image and Kernel.

Module 2 (10 Hours)

ANALYTIC GEOMETRY, MATRIX DECOMPOSITIONS: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Orthogonal Projections – Projection into One Dimensional Subspaces, Projection onto General Subspaces, Gram-Schmidt Orthogonalization. Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation.

Module 3 (11 Hours)

VECTOR CALCULUS: Differentiation of Univariate Functions - Partial Differentiation and Gradients, Gradients of Vector Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients. Back propagation and Automatic Differentiation – Gradients in Deep Network, Automatic Differentiation. Higher Order Derivatives- Linearization and Multivariate Taylor Series

Module 4 (11 Hours)

Probability and Distributions: Construction of a Probability Space - Discrete and Continuous Probabilities, Bayes' Theorem. Summary Statistics and Independence – Gaussian Distribution - Conjugacy and the Exponential Family - Change of Variables/Inverse Transform. Optimization: Optimization Using Gradient Descent - Gradient Descent With Momentum. Constrained Optimization and Lagrange Multipliers - Convex Optimization - Linear Programming - Quadratic Programming

Text Books:

1. Deisenroth, M. P., Faisal, A. A., & Ong, C. S. (2020). *Mathematics for machine learning*. Cambridge University Press.
2. Strang, G. (2006). *Linear algebra and its applications* (4th ed.). Thomson Brooks/Cole.

Reference Books:

1. . Boyd, S., & Vandenberghe, L. (2018). *Introduction to applied linear algebra: Vectors, matrices, and least squares*. Cambridge University Press

2. Axler, S. (2015). *Linear algebra done right* (3rd ed.). Springer.

3.Bishop, C. M. (2006). *Pattern recognition and machine learning*. Springer.

4.Boyd, S., & Vandenberghe, L. (2004). *Convex optimization*. Cambridge University Press.

5. Schölkopf, B., & Smola, A. J. (2002). *Learning with kernels: Support vector machines,*

regularization, optimization, and beyond. MIT Press.
6. MacKay, D. J. C. (2003). *Information theory, inference, and learning algorithms*. Cambridge University Press.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25UEET412**
Course Name	**MATHEMATICS FOR MACHINE LEARNING**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A
(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Apply the definition of a linear mapping to find $T(1,2)$ if $T(x,y)=(x+y,x-y)$	3	1	L3
2	Apply matrix representation to obtain the matrix corresponding to the transformation $T(x,y)=(2x,3y)$	3	1	L3
3	Execute the Gram–Schmidt orthogonalization procedure to obtain an orthonormal basis from the vectors (1,0) and (1,1).	3	2	L3
4	Compute an orthonormal basis from the vectors (1,0) and (1,1) using the Gram–Schmidt process.	3	2	L3
5	Compute the partial derivatives of $f(x,y)=x^2y+3xy^2$.	3	3	L3

6	Use linearization to approximate the value of $f(x,y)=x^2+y^2$ at (2.1,1.9) about the point (2,2).	3	3	L3
7	Use Bayes' theorem to find the probability that a manufactured item is defective if it is selected from a machine with known defect rates.	3	4	L3
8	Compute the probability density of a Gaussian random variable with mean 0 and variance 1 at x=0.	3	4	L3
Part B ***(Answer any one full question from each Module. Each carry 9 marks)***				
Module I				
9	Apply matrix methods to solve the following system of linear equations and determine whether the system has a unique solution: $x+y+z=6, 2x+3y+z=11, x+2y+3z=14$.	9	1	L3
OR				
10	Implement the principles of linear transformations to find the matrix representation, image, and kernel of $T(x,y)=(2x+y,x-y)$.	9	1	L3
Module II				
11	Implement the Gram–Schmidt orthogonalization process to construct an orthonormal basis for the subspace spanned by the vectors (1,1,0), (1,0,1), (0,1,1).	9	2	L3
OR				
12	Compute the orthogonal projection of the vector (3,2,1) onto the subspace spanned by (1,0,1) and (1,1,0).	9	2	L3
Module III				
13	Compute the gradient and Hessian matrix of $f(x,y)=x^2+xy+y^2$. Hence determine the second-order derivatives.	9	3	L3
OR				

14	Use the multivariate Taylor series to obtain the second-order approximation of $f(x,y)=\ln(1+x+y)$ about the point (0,0).	9	3	L3
Module IV				
15	Implement the inverse transform method to generate samples from the exponential distribution with parameter λ.	9	4	L3
OR				
16	Compute the optimal solution of the quadratic programming problem Minimize $f(x)=x^2+2x+5$.	9	4	L3

****

25UEET413	ELECTRICAL MATERIAL SCIENCE	Category	L	T	P	R	Credit	Year of Introduction
		PEC	3	0	0	0	3	2025

Preamble: By integrating theoretical knowledge with practical applications, this course enables students to select appropriate materials for electrical and electronic components, design reliable devices, and understand the limitations and performance of materials under different operating conditions.

Prerequisite: IEE 104 Introduction to Electrical and Electronics Engineering

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

CO	Course Outcomes	Knowledge Level
CO1	Apply the properties of conducting and semiconductor materials to select suitable materials for electrical and electronic applications.	K3 Apply
CO2	Apply the principles of dielectric and insulating materials to evaluate their performance in electrical engineering applications.	K3 Apply
CO3	Apply knowledge of dielectric breakdown mechanisms to analyze insulation failure in gases, liquids, solids, and vacuum systems	K3 Apply

CO4	Apply the properties of magnetic, superconducting, and solar energy materials, and use material characterization techniques to assess their engineering applications	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	1	3	2
CO2	3	3	1	1	-	-	-	-	-	-	1	3	2
CO3	3	3	2	2	-	-	-	-	-	-	1	3	2
CO4	3	2	2	1	-	-	-	-	-	-	1	2	3
Avg	3	2.5	1.5	1.25	-	-	-	-	-	-	1.3	2.75	2.25

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	-	-	*	-
CO2	*	*	*	*	*	-	-	*	-
CO3	*	*	*	*	*	-	-	*	-
CO4	*	*	*	*	*	-	-	*	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	-	-	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance	: 5 marks
Continuous Assessment Test	: 20 marks
Continuous Assessment Assignment	: 15 marks

SYLLABUS

Module 1 (10 Hours)

Conducting Materials-Electrical conductivity – factors affecting conductivity-Dependence of conductivity on:-Temperature-Composition and impurities-Materials for electrical applications:-Low resistivity materials-High resistivity materials-Materials used in electrical machines-Resistance materials-Contact materials-Solder materials. Semiconductor Materials-Intrinsic and extrinsic semiconductors-Semiconductor materials and properties-Silicon-Germanium. Advanced Semiconductor Materials- Compound semiconductors: Gallium Arsenide (GaAs)-Cadmium Sulphide (CdS)

Module 2 (11 Hours)

Dielectric Materials-.Dielectric polarization mechanisms: Electronic polarization-Ionic polarization-Orientation polarization-Space charge polarization-Classification of dielectric materials-Clausius-Mosotti relation. Insulating Materials- Classification of insulating materials. Properties of insulating materials: Electrical properties-Thermal properties-Mechanical properties-Chemical properties. Common Insulating Materials-Solid insulating materials: Inorganic insulators (ceramics, mica, glass)-Organic insulators (paper, rubber, plastics)-Liquid insulators: Transformer oil-Gaseous insulators:-Air-SF6 gas.

Module 3 (10 Hours)

Dielectric Breakdown in Gases-Townsend breakdown mechanism-Streamer mechanism. Breakdown in Liquid Dielectrics-Suspended particle theory-Cavitation theory. Breakdown in Solid Dielectrics-Intrinsic breakdown-Electro-mechanical breakdown-Thermal breakdown. Ageing and Failure of Insulators-Factors influencing ageing: Electrical stress-Thermal stress-Environmental conditions. Transformer Oil Testing and Treatment: Importance of transformer oil-Basic testing methods-Oil treatment methods

Module 4 (11 Hours)

Magnetic Materials for Electrical Applications: Soft magnetic materials: Silicon steel-Ferrites-Hard magnetic materials: Permanent Magnets-Applications in: Electrical machines-Transformers-Relays-Instruments. Superconducting Materials: Basic concept of superconductivity-Types of superconductors:-Type I-Type II-Characteristics:-Critical temperature-Critical field-Applications

Solar Energy Materials: Photo-thermal conversion-Solar selective coatings-Photovoltaic conversion-Solar cell materials:-Silicon-Cadmium sulphide-Gallium arsenide-Organic solar cells.Emerging and Next-Generation Battery Materials- Sodium-ion battery materials: Sodium Iron Phosphate ,Prussian Blue compounds. Nano-materials: Graphene, Carbon Nanotubes (CNT), MXenes. Thermal management materials: Phase Change Materials (PCM), ceramic insulation materials. Introduction to solid-state battery and lithium-metal battery materials.

Text Books

1. Dekker, A. J. (2014). *Electrical engineering materials*. Prentice Hall of India / Pearson Education.
2. Solymar, L., Walsh, D., & Syms, R. R. A. (2018). *Electrical properties of materials*. Oxford University Press.
3. Bhattacharya, S. K. (2022). *Electrical engineering materials*. S. K. Kataria & Sons.

Reference Books

1. Hummel, R. E. (2000). *Electronic properties of materials*. Springer.
2. Fulay, P., & Lee, J.-K. (2016). *Electronic, magnetic, and optical materials*. CRC Press.
3. Martinez-Vega, J. (2010). *Dielectric materials for electrical engineering*. Wiley.
4. Kittel, C. (2019). *Introduction to solid state physics*. Wiley India.
5. Ashcroft, N. W., & Mermin, N. D. (2003). *Solid state physics*. Cengage Learning.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25UEET413**
Course Name	**ELECTRICAL MATERIAL SCIENCE**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**

1	Explain the effect of temperature on the electrical conductivity of conducting materials.	3	1	L2
2	Differentiate intrinsic and extrinsic semiconductors with suitable examples.	3	1	L2
3	Describe the various dielectric polarization mechanisms.	3	2	L2
4	Classify insulating materials with suitable examples.	3	2	L2
5	Explain the Townsend breakdown mechanism in gases.	3	3	L2
6	Explain the factors influencing ageing of insulating materials.	3	3	L2
7	Compare soft magnetic materials and hard magnetic materials.	3	4	L2
8	Explain the significance of critical temperature in superconductors	3	4	L2
Part B (*Answer any one full question from each Module. Each carry 9 marks*)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9.a	Compare low resistivity materials and high resistivity materials used in electrical engineering applications with respect to their properties and applications.	6	1	L2
9.b	Explain the properties and applications of Gallium Arsenide (GaAs) and Cadmium Sulphide (CdS).	3	1	L2
OR				
10.a	Summarize the effect of composition and impurities on the conductivity of conducting materials with suitable examples.	6	1	L2
10.b	Describe the properties of Silicon and Germanium as semiconductor materials.	3	1	L2
Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a	Explain the Clausius–Mosotti relation and describe the relationship between dielectric constant and molecular polarizability.	5	2	L2
11.b	Explain the electrical and thermal properties of	4	2	L2

	insulating materials.			
OR				
12.a	Describe the various dielectric polarization mechanisms with suitable illustrations.	5	2	L2
12.b	Describe the properties and applications of transformer oil as a liquid insulating material.	4	2	L2
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13. a	Demonstrate the breakdown mechanisms in gaseous, liquid, and solid dielectrics.	5	3	L3
13. b	Explain the importance of transformer oil testing and treatment methods.	4	3	L2
OR				
14. a	Apply the suspended particle theory and cavitation theory to determine the causes of breakdown in liquid dielectrics.	5	3	L3
14. b	Describe the effects of electrical stress and thermal stress on the ageing of insulators.	4	3	L2
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15. a	Determine the type of superconductor suitable for MRI magnets and power transmission applications based on the characteristics of Type I and Type II superconductors.	6	4	L3
15. b	Explain the applications of soft magnetic materials and hard magnetic materials in electrical machines, transformers, relays, and measuring instruments.	3	4	L2
OR				
16. a	A satellite manufacturer needs a high-efficiency solar cell. Determine the most suitable solar cell material for the application, with stating its reason.	6	4	L3
16. b	Describe the importance of nanomaterials and biomaterials in emerging electrical engineering applications.	3	4	L2

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25UEET414	ILLUMINATION TECHNOLOGY	Category	L	T	P	R	Credit	Year of Introduction
		PEC	3	0	0	0	3	2025

Preamble: This course introduces modern illumination engineering principles and lighting system design for residential, commercial, and industrial applications. It covers light sources, photometric measurements, indoor and outdoor lighting design, and energy-efficient lighting technologies. The course enables students to design and evaluate lighting systems using modern tools and industrial standards.

Prerequisite: IEE104 Introduction to Electrical & Electronics Engineering

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

CO	Course Outcomes	Knowledge Level
CO1	Explain illumination principles, photometric quantities, and modern light sources.	K2 Understand
CO2	Apply photometric laws and measurement techniques in lighting systems.	K3 Apply
CO3	Apply standard methods and tools to design the indoor and industrial lighting systems.	K3 Apply
CO4	Apply outdoor, energy-efficient, and smart lighting concepts in industrial applications.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	1	-	-	-	1	2	1
CO2	3	3	2	1	-	-	1	-	-	-	1	2	2
CO3	3	3	3	1	3	-	2	-	-	-	1	3	3
CO4	3	2	3	-	-	1	3	-	-	-	1	3	3
Avg	3	2.5	2.25	1	3	1	1.75	-	-	-	1	2.5	2.25

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	-	-	*	*
CO2	*	*	*	*	*	-	-	*	*
CO3	*	*	*	*	*	*	-	*	*
CO4	*	*	*	*	*	-	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1(12 Hours)

Nature of light, electromagnetic spectrum, and vision. Types of illumination: natural and artificial lighting. Photometric quantities: luminous flux, intensity, illumination, luminance, and efficiency. Quality of lighting, glare, shadow, reflection, colour rendering, and stroboscopic effect.

Electric light sources: incandescent, halogen, fluorescent, mercury vapour, sodium vapour, metal halide, and LED lamps. Modern trends in lighting: solid-state lighting, smart lighting, and industrial lighting applications. Types of luminaires and lighting systems: direct, indirect, semi-direct, and semi-indirect lighting.

Module 2 (10 Hours)

Photometric definitions and units: lumen, candle power, illumination, luminance, and lamp efficiency. Laws of illumination: inverse square law and cosine law.

Illumination from point, linear, and surface sources. Polar curves and light distribution characteristics. Measurement of light using lux meter, integrating sphere, and goniophotometer.

Module 3 (10 H Hours)

Lighting design concepts: utilisation factor, maintenance factor, uniformity ratio, and reflection factor. Illumination requirements for residential, commercial, and industrial facilities.

Selection of lamps and luminaires for industrial environments. Illumination calculation using lumen method. Layout design and mounting considerations. Indian standards and recommended illumination levels for industrial buildings, workshops, and offices.

Introduction to lighting design software tools such as DIALux and Relux.

Module 4 (10 Hours)

Street lighting systems: types, arrangements, and design considerations. Flood lighting for industrial areas, yards, and sports facilities. Tunnel and area lighting.

Energy-efficient lighting systems and energy conservation techniques. Smart lighting systems using sensors such as motion sensors, occupancy sensors, and photo sensors. Introduction to lighting control systems and industrial lighting automation.

Textbooks

1. Jain, V. K. (2014). *Fundamentals of illumination engineering* (2nd ed.). S. Chand & Company Ltd.
2. Gupta, J. B. (2015). *Utilization of electric power and electric traction* (10th ed.). S. Chand & Company Ltd.
3. Partab, H. (2013). *Art and science of utilization of electrical energy* (3rd ed.). Dhanpat Rai & Sons.

Reference Books

1. Illuminating Engineering Society. (2011). *IES lighting handbook* (10th ed.). Illuminating Engineering Society of North America.
2. Philips Lighting BV. (2016). *Philips lighting manual* (6th ed.). Philips International.
3. General Electric Company. (2013). *GE lighting handbook*. General Electric.
4. Barnes, J. R. (2012). *Lighting design and installation handbook*. McGraw-Hill Education.
5. Phillips, D. (2000). *Lighting modern buildings*. Architectural Press (Elsevier).

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

(STC 2025 SCHEME)

Course Code	**25UEET414**
Course Name	**ILLUMINATION TECHNOLOGY**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A

(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Explain the nature of light and its dual characteristics.	3	1	L2
2	Compare natural lighting and artificial lighting with suitable examples.	3	1	L2
3	A point source having an intensity of 400 cd is placed 6 m above a working plane. Determine the illumination	3	2	L3

	directly below the source.			
4	A room is illuminated by a lamp of intensity 250 cd at a point located 3 m away and inclined at 45°. Determine the illumination using the cosine law.	3	2	L3
5	A lighting installation has a utilisation factor of 0.6 and maintenance factor of 0.8. Compute the combined correction factor.	3	3	L3
6	A workshop uses a luminaire with a maintenance factor of 0.75 and utilisation factor of 0.65. Determine the effective lumen output for a lamp producing 6000 lm.	3	3	L3
7	A motion sensor switches OFF the lighting after 8 minutes of inactivity. Find the total energy saved if a 120 W lamp remains OFF for 5 hours.	3	4	L3
8	An occupancy sensor reduces the operating duration of a 150 W lamp from 10 hours to 6 hours. Compute the daily energy saved.	3	4	L3

Part B

(*Answer any one full question from each Module. Each carry 9 marks*)

Module I

Qn No.	Question	Marks	CO	BL
9.a.	Explain the characteristics of good illumination and the factors influencing lighting quality.	5	1	L2
9.b.	Compare direct, semi-direct, indirect, and diffused lighting systems.	4	1	L2
	OR			
10.a	Classify the various defects in lighting systems.	5	1	L2
10.b	Compare the characteristics of different luminaires used in lighting installations.	4	1	L2

Module II

Qn No.	Question	Marks	CO	BL
11.a	A lamp produces 2400 lm and is supplied with 30 W. Determine: a) Luminous efficacy. b) Efficiency if maximum efficacy is 683 lm/W.	5	1	L3

	c) Flux produced for 50 W input.			
11.b	Two lamps having intensities of 300 cd and 500 cd are placed 4 m above a working plane. Find the total illumination at a point directly below the lamps.	4	1	L3
OR				
12.	A lighting installation uses two lamps: Lamp A = 400 cd and Lamp B = 600 cd. Both are mounted 5 m above a working plane. Find the total illumination at a point midway between them.	5	2	L3
12.b	A lux meter records 150 lux at 2 m and 38 lux at another location. Determine: a) The distance of the second location. b) Verify the inverse square law.	4	2	L3
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.	A room has the following illumination values, Maximum illumination = 600 lux and Minimum illumination = 420 lux. Determine the following: a) Uniformity ratio. b) Suitability for office lighting.	9	3	L3
OR				
14.	An industrial shed requires 250 lux over an area of 400 m^2. Available lamps - Metal halide lamp: 12000 lm and LED lamp: 15000 lm. Compute the number of lamps required for both cases using UF = 0.6 and MF = 0.75	9	3	L3
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.	A tunnel lighting system uses 50 luminaires, each rated at 120 W. The lighting operates for 12 hours per day. Find: a) Daily energy consumption. b) Monthly energy consumption. c) Energy cost at ₹8 per kWh.	9	4	L3
OR				
16.	An automated lighting system uses Motion sensor delay	9	4	L3

	= 10 minutes, Lamp rating = 100 W and Inactive duration = 4 hours/day. Compute: a) Daily energy saved. b) Monthly energy saved. c) Annual energy savings.				

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25UEET415	ELECTRONIC INSTRUMENTATION	Category	L	T	P	R	Credit	Year of Introduction
		PEC	3	0	0	0	3	2025

Preamble: This course introduces the fundamentals of electronic instrumentation used for measurement, monitoring, and control in electrical and industrial systems. It covers sensors and transducers, signal conditioning, data acquisition, and signal transmission techniques. The course also provides an overview of PLC and industrial automation systems, enabling students to apply instrumentation concepts in electrical and industrial applications.

Prerequisite: IEE104 Introduction to Electrical & Electronics Engineering

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

CO	Course Outcomes	Knowledge Level
CO1	Explain the principles and characteristics of sensors, transducers, and electronic measurement systems.	K2 Understand
CO2	Apply signal conditioning techniques and instrumentation circuits for sensor interfacing.	K3 Apply
CO3	Apply data acquisition and signal transmission methods in electronic instrumentation systems.	K3 Apply
CO4	Apply PLC and industrial instrumentation concepts in monitoring and control applications.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	2	-	-	-	-	-	-	-	1	2	2
CO3	3	2	2	-	-	-	-	-	1	-	1	2	3
CO4	3	2	2	-	1	-	-	-	1	1	2	3	3
Avg	3	2.25	2	-	1	-	-	-	1	1	1.25	2	2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	-	-	-	*	-
CO2	*	*	*	*	*	-	-	*	-
CO3	*	*	*	*	*	-	-	*	-
CO4	*	*	*	*	*	*	-	*	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	-	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (11 Hours)

Introduction to electronic instrumentation systems and measurement concepts. Classification of sensors and transducers. Static and dynamic characteristics such as accuracy, sensitivity, linearity, and response time. Resistive transducers including potentiometer, strain gauge, RTD, and thermistor. Inductive transducers including LVDT and proximity sensors. Capacitive transducers for displacement measurement. Piezoelectric and Hall effect sensors. Introduction to MEMS sensors, accelerometers, and intelligent sensors used in electrical and industrial applications.

Module 2 (10 Hours)

Need for signal conditioning in instrumentation systems. Wheatstone bridge and differential measurement techniques. Signal conversion circuits including voltage-to-current and current-to-voltage converters. Instrumentation amplifiers and isolation amplifiers.

Analog filters including low-pass, high-pass, and band-pass filters. Introduction to signal interfacing and noise reduction techniques.

Module 3 (11 Hours)

Basic elements of data acquisition systems. Analog-to-digital conversion and digital measurement concepts. Signal transmission methods including analog and digital techniques. Introduction to telemetry systems. Multiplexing techniques including TDM and FDM. Digital display, recording, and data logging systems.

Module 4 (10 Hours)

Introduction to process instrumentation systems. Programmable Logic Controller (PLC) architecture, input-output modules, and basic control functions.

Introduction to ladder logic, timers, and counters. Overview of SCADA and distributed control systems (DCS). Applications in industrial automation and electrical engineering systems.

Text Books

1. Kalsi, H. S. (2010). *Electronic instrumentation* (3rd ed.). McGraw-Hill Education.
2. Sawhney, A. K. (2012). *Electrical and electronic measurements and instrumentation*. Dhanpat Rai Publications.
3. Patranabis, D. (2003). *Sensors and transducers* (2nd ed.). PHI Learning.

Reference Books

1. Doebelin, E. O., & Manik, D. N. (2011). *Measurement systems: Application and design* (6th ed.). McGraw-Hill Education.

2. Pallas-Areny, R., & Webster, J. G. (2001). *Sensors and signal conditioning* (2nd ed.). Wiley India.
3. Bolton, W. (2015). *Programmable logic controllers* (6th ed.). Elsevier.
4. Bentley, J. P. (2005). *Principles of measurement systems* (4th ed.). Pearson Education.
5. Liptak, B. G. (2003). *Instrument engineers' handbook*. CRC Press.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

(STC 2025 SCHEME)

Course Code	**25UEET415**
Course Name	**ELECTRONIC INSTRUMENTATION**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A

(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Differentiate sensors and transducers with suitable examples.	3	1	L2
2	Compare static and dynamic characteristics of measuring instruments.	3	1	L2
3	Determine the output voltage of a Wheatstone bridge having $R_1=100\Omega, R_2=100\Omega, R_3=120\Omega, R_4=100\Omega$ with a supply voltage of 10 V.	3	2	L3
4	Compare instrumentation amplifiers and isolation amplifiers.	3	2	L2
5	Distinguish TDM and FDM multiplexing techniques.	3	3	L2
6	A telemetry system transmits data at 1200 bps. Determine the number of bits transmitted in 10 seconds	3	3	L3
7	Compare SCADA and DCS used in industrial	3	4	L2

	automation.			
8	Develop a ladder logic program using a counter to count five objects.	3	4	L3

Part B

(*Answer any one full question from each Module. Each carry 9 marks*)

Module I

Qn No.	**Question**	**Marks**	**CO**	**BL**
9.a.	Compare potentiometer, strain gauge, RTD, and thermistor with respect to construction, principle, and applications.	5	1	L2
9.b.	Explain the static and dynamic characteristics of transducers such as accuracy, sensitivity, linearity, and response time	4	1	L2
	OR			
10.a	Explain the concept of intelligent sensors and their applications in modern industrial systems.	5	1	L2
10.b	Describe the construction and working principle of capacitive transducers used for displacement measurement.	4	1	L2

Module II

Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a	A band-pass filter has fL=500 Hz and fH=5kHz. Determine: a) Bandwidth. b) Center frequency.	5	2	L3
11.b	Explain the construction and operation of Wheatstone bridge circuits used for measurement	4	2	L2
	OR			
12.a	A current-to-voltage converter uses Rf=5kΩ Determine the output voltage for an input current of: a) 1 mA b) 2 mA c) 5 mA	5	2	L3

12.b	Explain the construction, operation, and applications of isolation amplifiers.	4	2	L2
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13. a	Explain the basic elements and operation of a data acquisition system.	3	3	L2
13.b	An 8-bit ADC has a full-scale voltage of 5 V.Determine: a)Resolution. b) Quantization level corresponding to 3.2 V. c) Quantization error.	6	3	L3
OR				
14. a	Explain the principles of telemetry and its industrial applications.	3	3	L2
14.b	A telemetry system transmits data at 2400 bps continuously for 15 minutes. Determine: a) Total bits transmitted. b) Total bytes transmitted. c) Data transmitted in kilobytes.	6	3	L3
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15. a	Explain the features and applications of distributed control systems (DCS).	3	4	L2
15.b	Develop a ladder logic diagram for the START-STOP control of a motor using push buttons.	6	4	L3
OR				
16. a	Explain the role of SCADA in industrial monitoring and supervisory control.	3	4	L2
16.b	Develop a ladder logic program to operate two lamps simultaneously using a single switch	6	4	L3

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SUSTAINABLE DEVELOPMENT GOALS MAPPING - SEMESTER IV

SEMESTER IV	**SUSTAINABLE DEVELOPMENT GOALS**																
Course Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
25UMBT401				✓			✓		✓								
25UEET401				✓			✓		✓		✓	✓					
25UEET402				✓			✓		✓		✓	✓					
25UEET403				✓			✓		✓		✓	✓					
25UEEL404				✓			✓		✓			✓					
25UEEL405				✓			✓		✓		✓	✓	✓				
25UEET411				✓			✓		✓		✓	✓	✓				
25UEET412				✓			✓		✓		✓	✓	✓				
25UEET413				✓			✓		✓		✓	✓	✓				
25UEET414				✓			✓				✓	✓	✓				
25UEET415			✓	✓			✓		✓		✓	✓					
25MEET401				✓			✓		✓		✓	✓	✓				
25MEET402				✓			✓		✓		✓	✓	✓				
25HEET401				✓			✓		✓		✓	✓					

25HEET402				✓			✓		✓		✓	✓	✓				

Minor Basket I
(Electrical System Design)

25MEET301	BASICS OF ILLUMINATION SCIENCE AND LIGHTING DESIGN	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: This course aims to introduce students to the principles of illumination engineering and lighting design, focusing on practical considerations and design aspects for both indoor and outdoor lighting applications.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Apply the concepts of light, vision, colour, lighting quality, and various lighting systems in indoor and outdoor environments.	K3 Apply
CO2	Explain photometric quantities, laws of illumination, lighting calculation methods, and Indian standard recommendations for illumination levels.	K2 Understand
CO3	Explain different lamp technologies and lighting sources, including their characteristics, evolution, and application in aesthetic and special lighting.	K2 Understand
CO4	Apply illumination design principles to develop simple interior and exterior lighting layouts using standard design parameters and computer-aided tools.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	1
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2

CO3	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO4	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**
Avg	**2.75**	**2.5**	**2**	**1.66**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1.75**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	-	-	-	-
CO2	*	*	*	*	*	-	-	*	-
CO3	*	*	*	*	*	-	-	*	-
CO4	*	*	*	*	*	*	-	*	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	-	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (14 Hours)

Sources of light - Day light, artificial light sources - energy radiation, visible spectrum of radiation. Quality of lighting- visual comfort, visual performance, safety, shadow, glare, reflection, colour rendering, colour appearance and stroboscopic effect.

Lighting systems- direct, indirect, semi direct, semi-indirect, Lighting schemes-ambient, task, accent lighting. General and localized - Artificial lighting as substitute to natural light. Good Practices in Lighting.

Module 2 (14 Hours)

Measurement of light:Luminous flux, Luminous intensity, Lumen, Illuminance, Luminance, Candle power- M.H.C.P, M.S.C.P - Lamp efficiency. Concept of polar curve - Laws of illumination - Inverse square law and Lambert's Cosine law. Lighting calculations- Point by point method and Average Lumen method. Indian standard recommendation and standard practices for illumination levels in various areas.

Module 3 (14 Hours)

Light sources:Different types of lamps and its evolution - Incandescent lamp - Fluorescent Lamp, Compact Fluorescent Lamp (CFL). Sodium Vapour lamp, Metal halide Lamps, Argon Neon lamps for signboards. Introduction to LED Lighting.

Special Features of Aesthetic Lighting:Monument and statue lighting, Sports lighting, Hospital lighting, Auditorium lighting, Facade Lighting, Retail Lighting.

Module 4 (14 Hours)

Design of Interior Lighting:Interior Lighting Design Standards - Maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it - Illumination required for various work planes, Space to mounting height ratio (SHR) - DLOR and ULOR

Design of Outdoor Lighting:Street Lighting design- Flood lighting- Beam angle- Selection of lamp and projector.Computer Aided Lighting design:Role of computers in design - Softwares used for lighting design.

Text Books:

1. Pritchard, D. C. (2014). *Lighting* (6th ed.). Routledge.
2. Lindsey, J. L., & Dunning, S. C. (2015). *Applied illumination engineering* (3rd ed.). Fairmont Press.
3. Matthews, J. (1993). *Introduction to the design and analysis of building electrical systems*. Springer.

Reference Books:

1.Giridharan, M. K. (2016). *Electrical systems design* (2nd ed.). I K International Publishers.

2.Ganslandt, R., & Hofmann, H. (1997). *Handbook of lighting*. ERCO Edition.

3.Matthews, J. (1993). *Introduction to the design and analysis of building electrical systems*. Springer.

4.CIBSE. (2018). *SLL lighting handbook*. Chartered Institution of Building Services Engineers.

5.Cayless, M. A. (1996). *Lamps and lighting*. Routledge.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25MEET301**
Course Name	**BASICS OF ILLUMINATION SCIENCE AND LIGHTING DESIGN**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A
(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1.	Describe the basic concepts of light and explain the visible spectrum of radiation.	3	1	L2
2.	Explain the factors affecting the quality of lighting and the characteristics of good lighting.	3	1	L2
3.	Explain luminous flux, luminous intensity and illuminance.	3	2	L2
4.	Describe the inverse square law and Lambert's cosine law of illumination.	3	2	L2
5.	Explain the construction and characteristics of fluorescent and CFL lamps	3	3	L2
6.	Describe the applications of LED lighting in modern illumination systems.	3	3	L2
7.	Explain the significance of maintenance factor and coefficient of utilisation in lighting design.	3	4	L2
8.	Describe the role of computer-aided tools in lighting design.	3	4	L2

Part B
(*Answer any one full question from each Module. Each carry 9 marks*)

Module I

Qn No.	Question	Marks	CO	BL
9.	Determine the appropriate light source for different applications by considering the factors affecting lighting	9	1	L3

	quality.			
	OR			
10.	Design a suitable lighting scheme for a given indoor or outdoor environment using appropriate lighting systems and good lighting practices.	9	1	L3
	Module II			
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a.	Explain the concept of polar curves and discuss their importance in illumination engineering.	5	2	L2
11.b.	Describe the point-by-point method and average lumen method used in lighting calculations.	4	2	L2
	OR			
12.a.	Explain the factors influencing illumination levels and discuss the Indian standard recommendations for illumination in various areas.	5	2	L2
12.a.	Compare the point-by-point method and average lumen method of lighting calculations.	4	2	L2
	Module III			
Qn No.	**Question**	**Marks**	**CO**	**BL**
13. a.	Explain the construction, working and characteristics of incandescent and fluorescent lamps.	5	3	L2
13. b.	Compare sodium vapour lamps and metal halide lamps based on their characteristics and applications.	4	3	L2
	OR			
14. a.	Describe the special lighting requirements of hospitals and auditoriums.	5	3	L2
14. b.	Explain the aesthetic considerations involved in monument and facade lighting.	4	3	L2
	Module IV			
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.a.	Apply the principles of interior lighting design to propose an energy-efficient lighting scheme for a commercial building considering SHR, coefficient of utilisation and maintenance factor.	6	4	L3
15. b.	Apply the concept of SHR to decide whether luminaires spaced 9 m apart can be mounted at a height of 5 m if the recommended SHR is 1.5.	3	4	L3
	OR			

16. a.	An office room of dimensions 15 m × 10 m requires an illumination level of 300 lux. The coefficient of utilisation is 0.6 and the maintenance factor is 0.75. Determine the total lumen output required.	6	4	L3
16. b.	Determine the Uniformity Ratio of a lighting installation when the average illuminance is 300 lux and the minimum illuminance is 200 lux.	3	4	L3

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25MEET401	ELECTRIC POWER SUPPLY AND DISTRIBUTION SYSTEMS	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: This course provides fundamental understanding of electric power supply and distribution systems, including generation, transmission, distribution, and modern power system technologies.

Prerequisite: IEE104 Introduction to Electrical & Electronics Engineering.

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

CO	Course Outcomes	Knowledge Level
CO1	Explain the types, components, and characteristics of electrical power systems.	K2 Understand
CO2	Apply symmetrical components, load flow, and fault analysis techniques to analyze faults and harmonic effects in power systems.	K3 Apply
CO3	Apply microgrid architecture, control, protection, and stability concepts to analyze microgrid operation and grid integration.	K3 Apply
CO4	Explain energy storage and smart grid concepts, and apply basic integration and automation principles in modern power systems.	K2 Understand

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	-	-	-	-	2	-	-	-	-	2	1
CO2	3	3	-	2	-	-	-	-	-	-	-	3	2
CO3	2	3	2	2	-	-	2	-	-	-	-	3	3

CO4	**2**	**2**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**2**	**2**
Avg	**2.5**	**2.25**	**1.5**	**1.66**	**-**	**-**	**2.33**	**-**	**-**	**-**	**-**	**2.5**	**2**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	-	-	-	-	*
CO2	*	*	*	*	-	-	-	*	-
CO3	*	*	*	*	*	-	-	*	*
CO4	*	*	*	*	*	-	-	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	-	-	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment: 15 marks

SYLLABUS

Module 1 (15 Hours)

Types of electrical power systems, components of power systems, power system characteristics.
Electrical power generation methods and technologies: Conventional power generation, renewable energy sources (solar, wind, geothermal). AC/DC transmission and distribution systems: Advantages and disadvantages of AC and DC transmission, high voltage AC and DC transmission, sub-transmission, and distribution systems

Module 2 (12 Hours)

Symmetrical components, sequence impedance, fault analysis, symmetrical fault analysis, unsymmetrical fault analysis. Load flow equations. Harmonic analysis: Harmonic sources, harmonics in power systems, power system harmonics standards, harmonic mitigation techniques.

Module 3 (14 Hours)

Types of microgrids and their applications: Types of microgrids, microgrid topologies, microgrid control and protection, microgrid planning and design. Control and protection of microgrids: Microgrid control, microgrid protection, microgrid stability, microgrid reliability. Integration of microgrids with the grid: Integration of microgrids with the main grid, microgrid interconnection, microgrid power quality, microgrid market integration.

Module 4 (15 Hours)

Energy storage systems, applications of energy storage systems, energy storage system design and analysis, energy storage system control and management. Smart grid concepts, communication technologies for the smart grid, smart grid applications, smart grid security. Future trends in electrical power supply systems, energy systems integration, energy systems optimization, energy systems automation.

Text Books:

1. Ned Mohan. (2012). *Electric power systems: A first course*. Wiley India.
2. J. Duncan Glover., Thomas Overbye., &Mulukutla S. Sarma. (2008). *Power system analysis and design* (4th ed.). Cengage Learning.
3. V. K. Mehta., & Rohit Mehta. (2005). *Principles of electric power systems* (3rd ed.). S. Chand Publishing.

Reference Books:

1. Ned Mohan. (2012). *Electric power systems: A first course*. John Wiley & Sons.
2. F. C. Chan. (1994). *Electric power distribution systems* (3rd ed.). McGraw-Hill.
3. K. R. Padiyar. (2004). *Power system dynamics: Stability and control*. Anshan Ltd..
4. Turan Gonen. (2014). *Electric power distribution engineering* (3rd ed.). CRC Press.
5. James Momoh. (2012). *Smart grid: Fundamentals of design and analysis*. Wiley-IEEE Press.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25MEET401**
Course Name	**ELECTRIC POWER SUPPLY AND DISTRIBUTION SYSTEMS**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A

(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1.	Explain the components of an electrical power system and their functions.	3	1	L2
2.	Describe the advantages and disadvantages of AC and DC transmission systems.	3	1	L2
3.	A three-phase system experiences a line-to-ground fault. Determine the sequence networks required for fault analysis.	3	2	L3
4.	A power system is affected by harmonics generated by nonlinear loads. Select suitable harmonic mitigation techniques for improving power quality.	3	2	L3
5.	Select a suitable microgrid topology for supplying power to a remote village and justify your choice.	3	3	L3
6.	Determine the importance of microgrid protection and stability in grid-connected operation.	3	3	L3
7.	Explain the applications of energy storage systems in modern power systems.	3	4	L2
8.	Describe the communication technologies employed in smart grid systems.	3	4	L2

Part B

(*Answer any one full question from each Module. Each carry 9 marks*)

Module I

Qn No.	Question	Marks	CO	BL
9.a.	Explain the types of electrical power systems and their characteristics.	5	1	L2

9.b.	Describe conventional and renewable methods of electrical power generation.	4	1	L2
OR				
10.a.	Explain the various components of an electrical power system and their functions.	5	1	L2
10.b.	Describe high-voltage AC and DC transmission systems and their applications.	4	1	L2
Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a.	Apply symmetrical components to develop the sequence networks for unsymmetrical fault analysis.	5	2	L3
11.b.	Determine the significance of sequence impedance in fault studies.	4	2	L3
OR				
12.a.	Develop the load flow equations and explain their role in power system analysis.	4	2	L3
12.b.	Select suitable harmonic mitigation techniques for reducing harmonic distortion in power systems and justify your selection.	5	2	L3
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13. a.	Classify the different types of micro grids and select suitable applications for each.	4	3	L3
13. b.	Determine the factors affecting micro grid planning and design.	5	3	L3
OR				
14. a.	Apply micro grid control and protection concepts to analyze micro grid stability and reliability.	5	3	L3
14. b.	Determine the issues associated with the integration of micro grids with the main grid.	4	3	L3
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.a.	Explain the design and control requirements of energy storage systems.	6	4	L2
15. b.	Describe the applications of energy storage systems in power systems.	3	4	L2
OR				

16. a.	Explain the concepts and applications of smart grids with suitable examples.	5	4	L2
16. b.	Describe future trends in electrical power supply systems, emphasizing energy systems integration and automation.	4	4	L2

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Minor Basket II
(Sustainable Energy Systems)

25MEET302	SUSTAINABLE ENERGY SOURCES	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: This course introduces current and emerging energy systems, their extraction, conversion, and applications, with emphasis on meeting regional and global energy needs sustainably and enhancing awareness of sustainability issues.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Explain the concept and need of sustainability.	K2 Understand
CO2	Apply the working principles of solar photovoltaic and wind energy systems to generate electrical energy.	K3 Apply
CO3	Explain the concept of energy production from ocean, geothermal and hydropower	K2 Understand
CO4	Apply the principles of biomass energy conversion to produce energy for practical applications.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	2	3	2	-	-	1	2	-
CO2	3	2	1	-	-	2	3	-	-	-	1	2	1
CO3	3	2	1	-	-	2	3	-	-	-	1	2	1
CO4	3	2	1	-	-	2	3	-	-	-	1	2	1
Avg	3	2	1	-	-	2	3	2	-	-	1	2	1

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	-	*	-	*
CO2	*	*	*	*	*	-	*	-	*
CO3	*	*	*	*	*	-	*	-	*
CO4	*	*	*	*	*	-	*	-	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	-	*	-	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (13 Hours)

Introduction and Energy Fundamentals- Sustainability, Need and concept of sustainability, Social, environmental and economic sustainability concepts, Sustainable development, Challenges for sustainable development-Increasing energy demand and climate change

General classification of energy- Conventional and non-conventional, Global and Indian energy sources, Environmental aspects of energy utilization, Energy planning, Renewable energy sources, potentials, achievements and applications

Module 2 (13 Hours)

Solar Energy- Solar radiation, Solar thermal systems-Flat plate and concentrating collectors, Solar desalination, Solar Pond, Solar dryers, Solar cookers, Solar thermal electric power plant, Solar photovoltaic conversion, Merits, and limitations of solar energy

Wind Energy – Availability of wind energy, Site characteristics, Wind turbine types, Wind power plants, Merits and limitations of wind energy Carbon footprint, global uptake, and future possibilities for solar and wind energy

Module 3 (15 Hours)

Production of ocean, geothermal and hydro energy-Ocean thermal electrical conversion, Tidal energy conversion Geothermal energy conversion -Hydropower-Global and Indian scenario - Positive and negative attributes of hydropower-Electricity from hydropower - Small hydro plants.

Carbon footprint, global uptake and future possibilities for ocean, geothermal and hydropower.

Module 4 (15 Hours)

Energy production from biomass and wastes-Biomass resources, Biomass conversion technologies- direct combustion, pyrolysis, biomass gasification, Biogas production, Bioethanol, Biodiesel, Hydrogen as fuel, Biohydrogen production, Storage of hydrogen, Carbon footprint, global uptake and future possibilities for bioenergy.

Fuel cells-types and applications.

Case Studies – Sustainability assessment of conventional energy systems, Sustainability assessment of alternative energy systems.

Text Books:

1. Boyle, G. (2012). *Renewable energy* (3rd ed.). Oxford University Press.
2. Bansal, N. K., Kleemann, M., & Meliss, M. (1990). *Renewable energy sources and conversion technology*. Tata McGraw-Hill.
3. Rai, G. D. (2011). *Non-conventional energy sources*. Khanna Publishers.

Reference Books:

1. Johnson, G. L. (1995). *Wind energy system*. Prentice Hall Inc.
2. Earnest, J., &Wizelius, T. (2015). *Wind power plants and project development* (2nd ed.). PHI Learning Pvt. Ltd.
3. Rai, G. D. (1995). *Solar energy utilization*. Khanna Publishers.
4. Sayigh, A. A. M. (1977). *Solar energy engineering*. Academic Press.
5. Abbasi, S. A., & Abbasi, N. (2001). *Renewable energy sources and their environmental impact*. Prentice Hall of India.
6. Khan, B. H. (2009). *Non-conventional energy resources*. Tata McGraw-Hill.

7. Sawhney, G. S. (2012). *Non-conventional energy resources*. PHI Learning

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25MEET302**
Course Name	**SUSTAINABLE ENERGY SOURCES**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A
(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Classify energy sources into conventional and non-conventional categories with examples.	3	1	L2
2	Summarize the role of energy planning in sustainable development.	3	1	L2
3	Apply the principle of solar desalination for freshwater production.	3	2	L3
4	Demonstrate the operation of a flat plate collector used in solar thermal applications.	3	2	L3
5	Explain the principle of geothermal energy conversion.	3	3	L2
6	Describe the features of small hydro power plants.	3	3	L2
7	Apply the principle of biomass gasification to produce useful energy.	3	4	L3
8	Demonstrate the application of flywheel energy storage in power systems.	3	4	L3

Part B
(Answer any one full question from each Module. Each carry 9 marks)

Module I

9	Explain the environmental impacts associated with energy utilization and discuss measures for sustainable energy use.	9	1	L2
OR				
10	Interpret the relationship between sustainability, energy utilization, climate change, and renewable energy development.	9	1	2
Module II				
11	Apply the operating principles of various wind turbine types to evaluate their performance in wind energy conversion.	9	2	L3
OR				
12	Demonstrate the significance of carbon footprint, global uptake, and future possibilities of solar and wind energy technologies for sustainable development.	9	2	L3
Module III				
13	Describe the working of tidal energy conversion systems and discuss their advantages and limitations.	9	3	L2
OR				
14	Explain the working principles of OTEC, tidal energy conversion, and geothermal energy conversion systems.	9	3	L2
Module IV				
15	Execute the selection of flywheel, compressed air, battery, and pumped hydro energy storage systems based on their characteristics and applications.	9	4	L3
OR				
16	Implement the production processes of biogas, bioethanol, and biodiesel for renewable energy applications.	9	4	L3

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25MEET402	RENEWABLE ENERGY IN POWER GRIDS	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: This course introduces the fundamentals of integrating renewable energy sources with power grids and the basic principles of power converter circuits used in renewable energy systems.

Prerequisite: Nil

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

CO	Course Outcomes	Knowledge Level
CO1	Explain the basic concepts of Distributed Generation and Microgrids.	K2 Understand
CO2	Apply the knowledge of Distributed Energy Resources to select suitable DERs for microgrid applications.	K3 Apply
CO3	Apply the knowledge of microgrid issues and DG integration impacts to assess power quality problems in a microgrid.	K3 Apply
CO4	Apply the working principles of DC-DC converters to optimize power conversion in solar photovoltaic applications.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	2	2	-	-	-	1	2	1
CO2	3	3	2	-	-	2	3	-	-	-	1	2	2
CO3	3	3	2	2	-	2	3	-	-	-	2	3	2
CO4	3	3	3	2	3	1	2	-	-	-	2	3	3

Avg	**3**	**2.75**	**2**	**2**	**3**	**1.75**	**2.5**	**-**	**-**	**-**	**1.5**	**2.50**	**2**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	-	*	*	-	*
CO2	*	*	*	*	*	*	*	-	*
CO3	*	*	*	*	*	*	*	*	*
CO4	*	*	*	*	*	*	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	-	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (13 Hours)

Distributed generation and Microgrid concept – Distributed generation, Need for integration of Distributed Energy Resources, Active distribution network, Concept of Microgrid, A typical Microgrid configuration, Technical and economic advantages of Microgrid, Challenges and disadvantages of Microgrid development, Dynamic interactions of Microgrid with main grid.

Module 2 (13 Hours)

Distributed energy resources – Introduction, Combined heat and power (CHP) systems, Wind energy conversion systems (WECS), Solar photovoltaic (PV) systems, Small-scale hydroelectric power generation.

Protection Issues for Microgrids – Introduction, Islanding: separation from utility, Different islanding detection methods, Major protection issues of stand-alone Microgrid - Microgrid distribution system protection, Protection of micro sources.

Module 3 (15 Hours)

Impact of DG Integration on Power Quality – Introduction, Power Quality Disturbances- Transients, Voltage sags and swells, Over-voltages and under-voltages, Outage, Harmonic distortion, Voltage notching, Flicker, Electrical noise, Power quality sensitive customers, Existing power quality improvement technologies, Impact of DG Integration.

Module 4 (15 Hours)

DC-DC converters for distributed generation – Power Devices: The ideal switch, Characteristics of ideal switches, Types of Power Semiconductor Devices - Power ratings. Block diagram of solar photovoltaic system, Types of solar PV system-stand-alone operation and grid integrated solar PV system, Need for DC-DC converters, Buck, Boost and Buck-Boost topologies.

Voltage Source Inverters – Single phase half bridge, full bridge and three phase bridge Voltage Source Inverters-square wave operation, PWM inverters, Grid connected inverters.

Text Books:

1. Keyhani, A. (2019). *Design of smart power grid renewable energy systems* (3rd ed.). Wiley Publications.
2. Erickson, R. W., & Maksimovic, D. (2022). *Fundamentals of power electronics* (3rd ed.). Springer.
3. Dugan, R. C., Granaghan, M. F., & Beaty, H. W. (2017). *Electrical power system quality* (2nd ed.). McGraw-Hill.

Reference Books:

1. Momoh, J. (2015). *Smart grid: Fundamentals of design and analysis*. Wiley-IEEE Press.
2. Teodorescu, R., Liserre, M., & Rodriguez, P. (2011). *Grid converters for photovoltaic and wind power systems* (1st ed.). Wiley Publications.
3. Rashid, M. H. (2014). *Power electronics: Circuits, devices and applications* (4th ed.). Prentice Hall of India.
4. Bausiere, R., Labrique, F., &Seguier, G. (2013). *Power electronic converters: DC–DC conversion*. Springer.

5. Bimbhra, P. S. (2018). *Power electronics* (6th ed.). Khanna Publishers.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)

Course Code	**25MEET402**
Course Name	**RENEWABLE ENERGY IN POWER GRIDS.**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A
(Answer all questions. Each question carries 3 marks)

Qn No.	**Question**	**Marks**	**CO**	**BL**
1	Explain the need for integration of Distributed Energy Resources (DERs).	3	1	L2
2	Summarize the economic advantages of Microgrid systems.	3	1	L2
3	Examine how Distributed Energy Resources (DERs) contribute to microgrid operation.	3	2	L3
4	Demonstrate the application of small-scale hydroelectric generation in distributed power systems.	3	2	L3
5	Evaluate the impact of transients on power quality in a distribution system with distributed generation.	3	3	L3
6	Analyze how flicker influences the operation of electrical loads.	3	3	L3
7	Analyze the role of DC-DC converters in solar photovoltaic systems.	3	4	L3
8	Demonstrate the operation of a stand-alone solar PV system using a block diagram.	3	4	L3

Part B
(Answer any one full question from each Module. Each carry 9 marks)

Module I				
9	Illustrate the components of a Microgrid and explain the function of each component with a suitable diagram.	9	1	L2
OR				
10	Explain the relationship between Distributed Generation, Active Distribution Networks, and Microgrids in modern power systems.	9	1	L2
Module II				
11	Demonstrate the principles of Combined Heat and Power (CHP) systems and analyze their role in distributed energy generation.	9	2	L3
OR				
12	Apply microgrid protection techniques to ensure safe operation under grid-connected and islanded modes.	9	2	L3
Module III				
13	Analyze the impact of distributed generation integration on power quality in modern distribution networks.	9	3	L3
OR				
14	Apply suitable technologies to improve power quality in a distribution network affected by distributed generation integration.	9	3	L3
Module IV				
15	Demonstrate the operation of a three-phase bridge voltage source inverter and analyze its applications in distributed generation systems.	9	4	L3
OR				
16	Evaluate the performance of DC-DC converters and voltage source inverters in solar photovoltaic power conversion and grid integration systems.	9	4	L3