

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)

	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 (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
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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 $R=100\text{ k}\Omega$ and $C=0.1\text{ }\mu F$. Determine the time constant.	2	3	L3
6	A non-inverting amplifier uses $R_f=90\text{ k}\Omega$ and $R_1=10\text{ k}\Omega$. 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 $V_{DD}=12V$, $R_D=2\text{ k}\Omega$, $V_T=2V$. Determine: (i) The state of the MOSFET for $V_{GS}=1V$ (ii) The drain current for $V_{GS}=5V$	6	2	L3

	(iii) The drain voltage when the MOSFET is ON.			
Module III				
Qn No.	Question	Marks	CO	BL
13.	An op-amp integrator has $R=100k\Omega$ and $C=0.05\mu F$. 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 $R_A=10k\Omega$, $R_B=20k\Omega$ and $C=0.01\mu F$. 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 $L=50\mu H$. Find: a) The equivalent capacitance. b) The frequency of oscillation.	3	4	L3
OR				
16.	Determine the expression for the frequency of oscillation of an RC phase-shift oscillator.	6	4	L3
