

25UECT302	ELECTRONIC CIRCUITS - I	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble: This course develops fundamental knowledge of electronic devices and circuits, focusing on their principles of operation, analysis, and practical applications. It enables students to understand circuit behavior, evaluate performance characteristics, and apply electronic systems in engineering practice.

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 biasing concepts to analyze BJT and MOSFET circuits and design linear and non-linear wave shaping circuits.	K3 Apply
CO2	Perform small-signal analysis of BJT and MOSFET amplifiers using hybrid- π models.	K3 Apply
CO3	Apply feedback principles to analyze amplifier topologies and determine operating conditions of sinusoidal oscillators.	K3 Apply
CO4	Apply design principles to analyze power amplifiers and linear voltage regulators.	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	3	2	2	-	-	-	-	-	2	3	3
CO2	3	3	2	2	2	-	-	-	-	-	2	3	2
CO3	3	3	3	2	2	-	-	-	-	-	3	3	3
CO4	3	3	3	2	2	-	-	-	-	-	3	3	3
Avg	3	3	2.75	2	2	-	-	-	-	-	2.5	3	2.75

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 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks

Continuous Assessment Test : 20 marks

Continuous Assessment Assignment/Industrial Visit/Training Report : 15 marks

SYLLABUS

Module 1 (14 hrs)

Linear and Non-Linear Wave Shaping Circuits: RC differentiating and integrating circuits, Analysis of First order RC low pass and high pass filters. Positive, negative and biased Diode Clipping and Clamping circuits.

Transistor Biasing: Need for biasing, bias stabilization, concept of AC and DC load lines, operating point, stability factor, BJT and MOSFET biasing circuits.

Module 2 (14 hrs)

Design of BJT RC-coupled CE amplifier with frequency response, Small-signal analysis using hybrid- π model for mid-frequency and low-frequency regions. High-frequency BJT equivalent circuits and Miller effect. Multistage BJT amplifiers, effect of cascading on overall gain and bandwidth, and Small-signal evaluation of the BJT cascode amplifier employing the hybrid- π model. Design of the MOSFET CS amplifier and its mid-frequency small-signal analysis using the hybrid- π model, including CS stage with current-source load and diode-connected load.

Module 3 (14 hrs)

General feedback configuration of feedback amplifiers, effect of negative and positive feedback on gain, bandwidth, noise, and distortion. Feedback topologies and analysis of discrete BJT circuits under voltage-series and voltage-shunt feedback.

Classification and conditions for oscillation in Sinusoidal oscillators, operating principles and design relations of Hartley and Crystal oscillators, and analysis of the Wien bridge oscillator.

Module 4 (14 hrs)

Classification of Power amplifiers, transformer-coupled Class A amplifier, push-pull Class B and Class AB amplifiers, complementary symmetry Class B and Class AB amplifiers with efficiency and distortion considerations. Series and shunt Linear voltage regulators, operation and design aspects, load and line regulation, short-circuit protection, and foldback current limiting.

An industrial visit or short-term training program in a reputed Electronics and Communication Engineering industry or organization to provide students with practical exposure to real-world engineering practices is highly appreciable.

Text Books:

1. Boylestad, R. L., & Nashelsky, L. (2019). *Electronic devices and circuit theory* (12th ed.). Pearson.
2. Sedra, A. S., Smith, K. C., Carusone, A. C., & Gaudet, V. (2020). *Microelectronic circuits* (8th ed.). Oxford University Press.
3. Bogart, T. F., Beasley, J. S., & Rico, G. (2019). *Electronic devices and circuits* (7th ed.). Pearson.

Reference Books:

1. Razavi, B. (2015). *Fundamentals of microelectronics* (2nd ed.). Wiley.
2. Bell, D. A. (2008). *Electronic devices and circuits* (5th ed.). Oxford University Press.
3. Gopakumar, K. (2023). *Analysis and design of electronic circuits* (1st ed.). OWL Books.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	25UECT302
Course Name	ELECTRONIC CIRCUITS - 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.	A fixed-bias network is used to establish the operating point of a transistor amplifier. Describe the operation of the circuit and explain the limitations that affect its practical use.	3	1	L2
1.	A signal-conditioning circuit requires an op-amp integrator to process a 20 V peak-to-peak square wave of frequency 1.5 kHz. Design the integrator circuit by selecting suitable values of R and C, and verify that the chosen components satisfy the condition for proper integration.	3	1	L3

1.	Describe the Miller effect in transistor amplifiers and explain its significance on the high-frequency performance of amplifiers.	3	2	L2
1.	A multistage audio amplifier employs RC coupling to achieve the desired gain. With a neat circuit diagram, determine the contribution of each component to the overall operation of the amplifier and show the signal flow between stages.	3	2	L3
1.	A feedback oscillator is designed to generate a stable output waveform. Describe the Barkhausen criteria and discuss how these conditions ensure sustained oscillations.	3	3	L2
1.	A voltage-series negative feedback amplifier is used in an audio signal amplifier to improve stability and impedance characteristics. The amplifier has an open-loop voltage gain of $A = 500$, input resistance of $3\text{k}\Omega$, output resistance of $20\text{k}\Omega$, and feedback factor $\beta = 0.01$. Calculate the closed-loop voltage gain A_f , input resistance with feedback R_{if} , and output resistance with feedback R_{of} .	3	3	L3
1.	An audio power amplifier is designed to provide efficient amplification with improved output quality. Describe the characteristics of Class AB operation that make it suitable for practical amplifier applications.	3	4	L2
1.	A regulated DC power supply operates under varying input voltage and load conditions. Determine the line regulation and load regulation characteristics of the power supply, and illustrate their significance in maintaining a stable output voltage.	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
1.	A signal-processing circuit requires a sine-wave input to be restricted within the voltage limits of $+3\text{ V}$ and -4 V . Design a suitable slicer circuit using ideal diodes and determine the resulting output waveform and transfer characteristics.	9	1	L3

OR

1.	An RC differentiator is used in a wave-shaping circuit to produce output pulses corresponding to sudden changes in the input waveform. Derive the design equation and show that the output voltage is proportional to the rate of change of the input voltage.	9	1	L3
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Module II

Qn No.	Question	Marks	CO	BL
1.	A transistor amplifier is required to provide voltage amplification in the mid-frequency range. Using the hybrid- π small-signal model, determine the expressions for the input impedance, output impedance, and mid-band voltage gain of the common-emitter amplifier.	9	2	L3

OR

1.	A MOSFET common-source amplifier uses a diode-connected load to obtain voltage amplification in an integrated circuit. Using the small-signal model, derive the expressions for voltage gain, input resistance, and output resistance of the common-source amplifier with diode-connected load.	9	2	L3
Module III				
Qn No.	Question	Marks	CO	BL
13. a	A feedback network is introduced in an amplifier to improve overall performance. Determine how negative feedback affects gain, bandwidth, stability, and distortion in the amplifier.	4	3	L3
13. b	A Wien bridge oscillator is used to generate a stable sinusoidal waveform in an audio-frequency signal generator. Draw its circuit and derive the expression for the frequency of oscillation.	5	3	L3
OR				
14. a	A voltage amplifier uses voltage-series negative feedback to improve its input and output impedance characteristics. Draw the block diagram of voltage-series feedback topology and derive the expressions for net input impedance and output impedance.	5	3	L3
14. b	A crystal oscillator is used in a communication system to generate a highly stable frequency reference. With the necessary circuit diagram, illustrate the operation of the crystal oscillator and show the role of the crystal in frequency stabilization.	4	3	L3
Module IV				
Qn No.	Question	Marks	CO	BL
15. a	A DC power supply is required to maintain a constant output voltage even when the load current varies. With the necessary circuit diagram, illustrate the working of a shunt voltage regulator.	4	4	L3
15. b	A Class B audio amplifier delivers a 20 V peak output signal to a 16 Ω speaker using a 30 V DC supply. Determine the input power, output power, and circuit efficiency of the amplifier.	5	4	L3
OR				
16. a	An audio output stage uses a complementary pair of transistors to drive a speaker load efficiently. Draw the circuit of a complementary-symmetry push-pull amplifier and illustrate its working.	4	4	L3
16. b	A complementary-symmetry Class B push-pull power amplifier operates with supply voltages of +12V and -12V and drives an 8 Ω load. Calculate the maximum input power, maximum output power, and maximum efficiency of the amplifier.	5	4	L3