

25UECT402	ELECTRONIC CIRCUITS II	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble: This course introduces the fundamentals of analog electronic circuits with emphasis on operational amplifiers and their applications for designing and analyzing signal generation and processing systems used in communication, instrumentation, control, and power electronics.

Prerequisite: 25UECT302 Electronic Circuits - I

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

CO	Course Outcomes	Knowledge Level
CO1	Apply concepts of operational amplifiers, differential amplifiers, and current mirror circuits to determine their performance parameters.	K3 Apply
CO2	Apply negative feedback concepts to design and analyze Op-Amp circuits.	K3 Apply
CO3	Describe the working principles of oscillators, multivibrators, active filters, and voltage regulators.	K2 Understand
CO4	Illustrate the operation and applications of timer circuits, Phase Locked Loops, ADCs, and DACs.	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	2	-	-	2	-	-	-	-	3	3	1
CO2	3	3	2	-	-	-	-	-	-	-	3	3	2
CO3	3	2	2	-	-	2	-	-	-	-	3	3	2
CO4	3	2	2	-	-	2	-	-	-	-	3	3	3
Avg	3	2.5	2	-	-	2	-	-	-	-	3	3	2

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

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
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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)

Operational Amplifiers: Introduction to operational amplifiers with emphasis on the 741 IC, block representation, ideal characteristics, ideal and practical parameter values of the 741 IC. Analysis of the equivalent circuit model, open-loop operation, input-output voltage characteristics, and frequency response behaviour.

Differential Amplifiers: BJT-based differential amplifier configurations. Examination of DC operating conditions and transfer characteristics. AC analysis- differential gain, common-mode gain, Common Mode Rejection Ratio (CMRR), input and output impedances, overall voltage gain, and biasing using constant current sources.

Current Mirror Circuits: Principle and operation of current mirrors including basic two-transistor current mirror, Wilson current mirror, and Widlar current mirror configurations.

Module - 2 (14 Hrs)

Fundamentals of negative feedback topologies: voltage-series, voltage-shunt, current-series, and current-shunt configurations. Analysis of op-amp circuits employing voltage-series and voltage-shunt feedback techniques, concept of virtual ground.

Applications of Op-Amps: Study of various linear and nonlinear op-amp circuits including summing amplifiers, unity gain buffer, differential and instrumentation amplifiers, voltage-to-current and current-to-voltage converters, integrators, differentiators, precision rectifiers, comparators, Schmitt triggers, and logarithmic/antilogarithmic amplifiers.

Module - 3 (14 Hrs)

Principles and operation of sinusoidal oscillators such as phase shift and Wien bridge oscillators. Generation of non-sinusoidal waveforms -triangular and sawtooth waveforms. Analysis of astable and monostable multivibrator circuits.

Overview of active filters and their advantages compared to passive filters. Design and analysis of first-order and second-order low-pass, high-pass, band-pass, and band-stop filters.

Study of fixed and variable voltage regulator circuits. Detailed analysis of IC 723-low-voltage and high-voltage applications, methods for current enhancement and current protection mechanisms.

Module - 4 (14 Hrs)

Timer and VCO: Timer IC 555 - functional diagram, astable and monostable operations, Basic concepts of Voltage Controlled Oscillator.

Phase Locked Loop: Basic building block, Operation, Closed loop analysis, Lock and capture range, Applications of PLL, PLL IC565.

Data Converters: Digital to Analog converters, Specifications, Weighted resistor type and R-2R Ladder type. Analog to Digital Converters: Specifications, Flash type and Successive approximation type.

Text Books:

1. Choudhury, D. R., & Jain, S. B. (2018). *Linear integrated circuits* (5th ed.). New Age International.
2. Stanley, W. D. (1984). *Operational amplifiers with linear integrated circuits* (4th ed.). Pearson Education.
3. Millman, J., Halkias, C. C., & Parikh, C. D. (2018). *Integrated electronics: Analog and digital circuits and systems* (2nd ed.). McGraw-Hill Education.

Reference Books:

1. Clayton, C. G. (2005). *Operational amplifiers*. Butterworth-Heinemann (Elsevier). (5th ed.).
2. Gayakwad, R. A. (2015). *Op-amps and linear integrated circuits* (4th ed.). Prentice Hall of India.
3. Bell, D. A. (2011). *Operational amplifiers and linear integrated circuits* (3rd ed.). Oxford University Press.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	25UECT402
Course Name	ELECTRONIC CIRCUITS II
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 ideal characteristics of Opamp?	3	1	L2
2.	Explain slew rate. Solve the equation for maximum input	3	1	L3

	frequency at which an undistorted signal is obtained in terms of slew rate?			
3.	Describe the concept of virtual ground in inverting amplifier.	3	2	L2
4.	Explain the four negative feedback configurations with diagrams.	3	2	L2
5.	Implement a RC Phase Shift Oscillator for a frequency of oscillation of 5 KHz using 741.	3	3	L3
6.	Explain the circuit diagram of an astable multivibrator using op-amp and write down the expression of frequency of oscillation.	3	3	L2
7.	Describe the functional diagram of 555 timer IC.	3	4	L2
8.	Explain the terms (i) Capture range and (iii) Lock range of PLL.	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.	An electronic engineer is developing a dual-input balanced output differential amplifier for a communication system to amplify the difference between two input signals while rejecting common noise. The amplifier uses matched transistors and identical load resistors to ensure symmetry and proper operation. Apply the principles of differential amplifiers to determine the expressions for the voltage gain, input resistance, and output resistance of the given configuration.	9	1	L3

OR

10.	Explain the circuit diagram of Wilson current mirror. Compute the expression for its current gain.	9	1	L2
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Module II

Qn No.	Question	Marks	CO	BL
11.	A circuit designer is working on a signal processing system that requires compressing a wide range of input voltages into a smaller dynamic range. For this purpose, a logarithmic amplifier using an op-amp is employed. The circuit consists of an input resistor R and a diode (or BJT) in the feedback path, having reverse saturation current I_s , emission coefficient η , and thermal voltage V_T . Apply the principles of op-amp and diode characteristics to obtain the expression for the output voltage V_o in terms of the input voltage V_{in} and the given parameters.	9	2	L3

OR

12.	An engineer is developing a voltage–shunt feedback amplifier using an op-amp for a signal conditioning application. The amplifier is characterized by an open-loop gain A , input resistance R_i , and output resistance R_o . To improve stability and performance, a feedback network with feedback factor β is incorporated. Apply the principles of feedback amplifiers to determine the expressions for the closed-loop voltage gain, input resistance, and output resistance of the system.	9	2	L3
Module III				
Qn No.	Question	Marks	CO	BL
13.	Describe the transfer function of a second order Butterworth low pass filter.	9	3	L2
OR				
14.	Explain the circuit diagram of a Wein bridge oscillator using op-amp and derive the expression for frequency of oscillations.	9	3	L2
Module IV				
Qn No.	Question	Marks	CO	BL
15.	Explain the block diagram and pin diagram of VCO IC 566 and elaborate the working.	9	4	L2
OR				
16.	Explain with necessary figure, the working of a 3-bit flash ADC	9	4	L2
