

Devi Ahilya University, Indore, India Institute of Engineering & Technology				III Year B.E. (Electronics and Telecommunication)			
Subject Code & Name	Instructions Hours per Week			Credits			
	L	T	P	L	T	P	Total
ETR6E1 LINEAR INTEGRATED CIRCUITS	3	1	2	3	1	1	5
Duration of Theory Paper: 3 Hours							

Learning Objective: In-depth knowledge of Operational Amplifier including its circuit analysis, design and application.

Prerequisite: Analysis using R-parameter and feedback concept.

COURSE CONTENTS

UNIT I

Operational Amplifier Fundamentals: Amplifier Fundamentals, The Operational Amplifier ,Basic Op Amp Configurations, Ideal and practical Op Amp Circuit Analysis and characteristics ,Positive and Negative Feedback , Feedback in Op Amp Circuits , The Return Ratio and Blackman’s Formula , Op Amp Powering. Circuits with Resistive Feedback: Current-to-Voltage Converters, Voltage-to-Current Converters, Current Amplifiers, Difference Amplifiers, Instrumentation Amplifiers, Instrumentation Applications, Transducer Bridge Amplifiers. CMRR, offset error voltage and current.

UNIT II

Active filters I: The Transfer Function, First-Order Active Filters, Standard Second-Order Responses, *KRC* Filters, Multiple-Feedback Filters, State-Variable and Biquad Filters, Sensitivity.Active filters II: Filter Approximations, Cascade Design, Generalized Impedance Converters,Direct Design, The Switched Capacitor, Switched-Capacitor Filters, and Universal SC Filters

UNIT III

Static Op Amp Limitation: Simplified Op Amp Circuit Diagrams, Input Bias and Offset Currents, Low-Input-Bias-Current Op Amps, Input Offset Voltage, Low-Input-Offset-Voltage Op Amps, Input Offset Error and Compensation Techniques, Input Voltage Range/Output Voltage Swing, Maximum Ratings. Dynamic Op Amp limitation: Open-Loop Frequency Response, Closed-Loop Frequency Response, Input and Output Impedances, Transient Response,Effect of Finite GBP on Integrator Circuits, Effect of Finite GBP on Filters, Current-Feedback Amplifiers.

UNIT IV

Stability: The Stability Problem, Phase and Gain Margin Measurements, Frequency Compensation of Op Amps, Op Amps Circuits with a Feedback Pole, Input-Lag and Feedback-Lead Compensation, Stability in CFA Circuits.

UNIT V

Designing- Adder, Subtractor, Integrator, Differentiator, Voltage follower, Comparator, Zero Crossing detector, Schmitt trigger, Peak Detector. Signal Generator: Sin wave generator, multivibrators, triangular and saw tooth wave generator, Log/Antilog amplifiers.

Learning Outcome:

After learning the course the students should be able to:

- Understand op-amp's basic construction, characteristics, parameter limitations, various configurations and other applications of op-amp.
- Analyze and design basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators, and data converters

BOOKS RECOMMENDED:

- [1] Millman & Halkias - Integrated Electronics, Tata McGraw Hill.
- [2] Franco-Design with Operational Amplifiers & Analog Integrated Circuits, TMH
- [3] Schilling & Belove-Electronic Circuit, Discrete & Integrated , TMH
- [4] Gayakwad R.A- Op-Amps and Linear IC's, Pearson .
- [5] Coughlin and Driscoll – Operational Amplifier and Linear Integrated Circuits – Pearson Education Asia.

List of Practical Assignments:

- 1) To measure the gain of inverting & non-inverting amplifier.
- 2) To analyze the voltage transfer characteristics of op-amp.
- 3) To study the inverting adder & subtractor configuration of op-amp.
- 4) To study the non- inverting adder & subtractor configuration of op-amp.
- 5) To study the differentiator configuration of op-amp.
- 6) To study the integrator configuration of op-amp.
- 7) To study the low pass & high pass filter.
- 8) To study the band pass & band reject filter.
- 9) To study the zero crossing detector.
- 10) To analyze the performance of comparator.