

Integrated Circuits and its Applications

COURSE OBJECTIVE: The objective of this course is to deal with integrated circuits which are imperative and versatile requirement in today's electronics. Operational amplifier is a device which is used in various electronics application, such as summer, integrator and differentiator and so on. This course comprehends the introduction of various IC's such as IC-741, TL082, and IC-555 timer. The course also deals with the analysis and design of circuits including analog signal processing using linear ICs.

COURSE CONTENTS:

Feedback Amplifier and Oscillators: Concept of feedback and their types, Amplifier with negative feedback and its advantages. Feedback Topologies.

Oscillators: Concept of Positive feedback, Classification of Oscillators, Barkhausen criterion, Types of oscillators: RC oscillator, RC Phase Shift, Wien Bridge Oscillators. LC Oscillator: Hartley, Colpitt's, Clapp and Crystal oscillator.

Introduction to integrated circuits: Advantages and characteristic parameters of IC's, basic building components, data sheets,

Operational Amplifier: Differential amplifier and analysis, Configurations- Dual input balanced output differential amplifier, Dual input Unbalanced output differential amplifier, Single input balanced output differential amplifier, Single input Unbalanced output differential amplifier. Introduction of op-amp, Block diagram, characteristics and equivalent circuits of an ideal op- amp, Power supply configurations for OP-AMP.

Characteristics of op-amp: Ideal and Practical, Input offset voltage, offset current, Input bias current, Output offset voltage, thermal drift, Effect of variation in power supply voltage, common-mode rejection ratio (CMRR), Slew rate and its Effect, PSRR and gain bandwidth product, frequency limitations and compensations, transient response, analysis of TL082 datasheet.

OP-AMP applications: Inverting and non-inverting amplifier configurations, Summing amplifier, Integrators and differentiators, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log/ Antilog amplifier, Triangular/rectangular wave generator, phase-shift oscillators, Wein bridge oscillator, analog multiplier-MPY634, VCO, Comparator, Zero Crossing Detector.

OP-AMP AS FILTERS: Characteristics of filters, Classification of filters, Magnitude and frequency response, Butterworth 1st and 2nd order Low pass, High pass and band pass filters, Chebyshev filter characteristics, Band reject filters, Notch filter; all pass filters, self-tuned filters, AGC, AVC using op-AMP.

TIMER: IC-555 Timer concept, Block pin configuration of timer. Monostable, Bistable and Astable Multivibrator using timer 555-IC, Schmitt Trigger, Voltage limiters, Clipper and clampers circuits, Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifiers, Voltage-to-current converter, Current-to-voltage converter.

Voltage Regulator: simple OP-AMP Voltage regulator, Fixed and Adjustable Voltage Regulators, Dual Power supply, Basic Switching Regulator and characteristics of standard regulator ICs.

COURSE OUTPUT:

Upon successful completion of this course students will be able to understand the working of different integrated circuits, their pin configurations and about their applications. Students will also be able to understand the performance of ICs on practical basis.

TEXT BOOKS:

1. Ramakant A. Gaikward, "OP- Amp and linear Integrated circuits" Third edition- 2006, Pearson.
2. B. Visvesvara Rao Linear Integrated Circuits Pearson.
3. <http://www.nptelvideos.in/2012/11/analog-ics.html>

REFERENCES:

1. David A. Bell: Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition, 2010.
2. D. Roy Choudhury: Linear Integrated Circuits New Age Publication.
3. B. Somanathan Nair: Linear Integrated Circuits analysis design and application Wiley India Pvt. Ltd.
4. Maheshwary and Anand: Analog Electronics, PHI.
5. S. Salivahanan, V S Kanchana Bhaaskaran: Linear Integrated Circuits”, second edition, McGraw Hill.
6. Gray Hurst Lewis Meyer Analysis and design of analog Integrated Circuits fifth edition Wiley India.
7. Robert F. Coughlin, Frederick, F. Driscoll: Operational Amplifiers and Linear Integrated Circuits, sixth edition, Pearson.
8. Millman and Halkias: Integrated electronics, TMH.
9. Boylestad and Nashelsky: Electronic Devices and Circuit Theory, Pearson Education.
10. Sedra and Smith: Microelectronics, Oxford Press.

List of Experiments

Apparatus Required – Function Generator, TL082, MPY634/ASLK Pro, Power Supply, Oscilloscopes, connecting wires, bread board.

1. To determine voltage gain and frequency response of inverting and non-inverting amplifiers using IC-741.
2. To measure offset voltages, bias currents, CMRR, Slew Rate of OPAMP using IC-741.
3. To design an instrumentation amplifier and determine its voltage gain using IC-741.
4. To design op-amp integrator (low pass filter) and determine its frequency response.
5. To design op-amp differentiator (high pass filter) and determine its frequency response.
6. To design Analog filters – I and II and analyse its characteristics.
7. To design Astable, Monostable and Bistable multi vibrator using IC-555 and analyse its characteristics.
8. Automatic Gain Control (AGC) Automatic Volume Control (AVC).