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| **ECX513** | **Linear Integrated Circuits** | **L-T-P: 3-0-0; Total 42 Lectures** |

**Prerequisites:**1. Elements of Electronics Engineering

**Course Objectives:**

 To introduce the basic building blocks of linear integrated circuits.

 To learn the applications of operational amplifier.

 To introduce the theory of Filters and PLL.

 To learn the theory of OTA.

 To introduce the concepts of waveform generation and introduce some special function ICs.

**Course Outcomes:**

Upon Completion of the course, the students will be able to:

 Design linear and non-linear applications of op – amps.

 Design Filters using op-amp

 Design Amplifier using OTA.

 Design Filters using OTA

 Analyse performance of special function ICs.

Topics Covered:

**Unit I: Operational Amplifiers: (8 Lectures)**

Current mirror and current sources, BJT Differential amplifier with active loads. Basic information about operational amplifiers, Ideal Operational Amplifier, General operational amplifier stages and internal circuit diagrams of IC 741, DC and AC performance characteristics, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Instrumentation amplifier.

**Unit II: Comparators and converters (8 Lectures)**

Basic comparator, Zero crossing detector, Schmit Trigger, Voltage limiters, V to F and F to V converters, Clippers and clampers, Peak detector, sample and hold circuit, A to D and D to A converters.

**Unit III: Active Filters: (8 Lectures)**

Low-pass, high-pass, band-pass and Band elimination filter. Butterworth filters. Universal active filters. Switched capacitor filters- resistor realization, switched capacitor integrator, switched capacitor filter ICs.

**Unit IV: Phase Locked Loop (PLL): (4 Lectures)**

 Operation of the basic PLL, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL.

**Unit V: Operational Trans-conductance Amplifier (OTA): (7 Lectures)**

Internal structure, transfer characteristics, inverting amplifier, voltage source, current source, tunable resistor, sample and hold circuit**,** realization of Positive and negative grounded impedance and floating impedance, OTA-C Oscillators and filters. Operational Trans-conductance Impedance Amplifier (OTA) and its application in Realization of impedances, NIC, NII and GIE, Oscillators and filters.

**Unit VI: Waveform generators and special function linear ICs: (7 lectures)**

Multi-vibrators using op-Amp 741: Astable, Mono-stable. Triangular wave generator, Saw-tooth wave generator, IC Voltage regulators, Three terminal fixed and adjustable voltage regulators, IC 723 general purpose regulator, switching regulator.

**Text Books:**

1. Roy Choudhury. D., Shail Jain, “Linear Integrated Circuits”, New Age International Publications, 4th Edition, 2010.

2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 3rd Edition, Tata McGraw-Hill, 2007.

**Reference Books:**

1. Gayakwad. A. R., “Op-Amps & Linear IC’s”, PHI, 4th Edition, 2004.

2. Robert F. Coughlin, Frederick F. Driscoll, “Operational Amplifiers & Linear Integrated Circuits”, PHI 6th Edition.

Edition, 2001

3. B.S.Sonde, “System design using Integrated Circuits” , 2 nd Edition, New Age Pub, 2001

4. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 2005.

5. Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Prentice Hall of India, 1996.

6. William D. Stanley, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education, 2004.