**Lecture Plan of ANALOG INTEGRATED CIRCUITS & TECHNOLOGY**

EC-303 ANALOG INTEGRATED CIRCUITS & TECHNOLOGY

L T P C Fifth Semester ECE,

3 1 0 4 Pre-requisite- EC-210, EC-202 and EC-203

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| Topic | Lectures | Mapping with Cos,  | POs |
| Introduction of the subject | 1 | CO1,  | PO1 |
| Overview of IC fabrication Technology: Electronic Grade Silicon preparation | 1,2 | CO1,CO2, | PO1 |
| Czochralski technique of crystal growth, wafer preparation and identification, | 2,3 | CO1,CO2 | PO9 |
| Oxidation, Epitaxy: Molecular beam Epitaxy | 3,4,5 | CO1,CO2 | PO9 |
| Vapour phase Epitaxy | 6 | CO1,CO2 | PO9 |
| diffusion, ion implantation, deposition | 7 | CO1,CO2 | PO9 |
| NMOS, CMOS fabrication | 8,9 | CO2 | PO9 |
| BiCMOS Technology | 10 | CO2 | PO9 |
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| Introduction to IC: Difference between discrete circuits and integrated circuits, | 11 | CO3,CO4 | PO2 |
| IC biasing of common MOS and BJT amplifier configurations, | 12,13 | CO3,CO4 | PO2 |
| Switched capacitor filters | 14 | CO3,CO4 | PO2 |
| Current sources and Active load | 15,16 | CO3,CO4 | PO2 |
| Two transistor MOS current source, Current steering, | 17,18 | CO3,CO4 | PO2 |
| Cascode current source, Wilson current source, | 19 | CO3,CO4 | PO2 |
| Differential And Operational Amplifier | 20,21 | CO3,CO4 | PO2 |
| Basics of differential amplifier, Differential amplifier with passive load, | 22, 23 | CO3,CO4 | PO2 |
| Differential amplifier with active load, Calculation of common mode gain | 24, 25 | CO3,CO4 | PO2 |
| differential mode gain and CMRR using π model | 26, 27 | CO3,CO4 | PO2 |
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| Two stage CMOS Op-Amp, Calculation of common mode gain | 28,29 | CO3,CO4 | PO2 |
| differential mode gain and CMRR of two stage CMOS Op-Amp using π model | 30 | CO3,CO4 | PO2 |
| Problem with more gain stages, , output stage | 31,32 | CO3,CO4,CO6 | PO2 |
| Importance of negative feedback in Op-Amp. | 33,34 | CO3,CO4 | PO2 |
| Non ideal effects in Op-Amp: Practical Op-Amp Parameters, Finite Open-Loop Gain, Offset Voltage, | 35 | CO3,CO4 | PO2 |
| Input Bias Current, Finite Slew rate, Additional Non ideal Effects | 36,37 | CO3,CO4 | PO2 |
| Analog Multipliers: Introduction, Log-Antilog single quadrant multipliers | 38 | CO3,CO4,CO5 | PO3 |
| Emitter coupled two quadrant multipliers, Gilbert four quadrant current multiplier, Current to voltage conversion | 39 | CO3,CO4,CO5 | PO3 |
| Complete four quadrant voltage multiplier, | 40 | CO3,CO4,CO5 | PO3 |

 Content of Syllabus

 Overview of IC fabrication Technology: Electronic Grade Silicon preparation, Czochralski technique of crystal growth, wafer preparation and identification, Oxidation, Epitaxy: Molecular beam Epitaxy, Vapour phase Epitaxy, diffusion, ion implantation, deposition, NMOS, CMOS fabrication and BiCMOS Technology.

Introduction to IC: Difference between discrete circuits and integrated circuits, IC biasing of common MOS and BJT amplifier configurations, Switched capacitor filters. Current sources and Active load: Introduction, Two transistor MOS current source, Current steering, Cascode current source, Wilson current source, Active loads. Differential And Operational Amplifier: Basics of differential amplifier, Differential amplifier with passive load, Differential amplifier with active load, Calculation of common mode gain, differential mode gain and CMRR using π model,

Two stage CMOS Op-Amp, Calculation of common mode gain, differential mode gain and CMRR of two stage CMOS Op-Amp using π model, Problem with more gain stages, output stage, Importance of negative feedback in Op-Amp. Non ideal effects in Op-Amp: Practical Op-Amp Parameters, Finite Open-Loop Gain, Offset Voltage, Input Bias Current, Finite Slew rate, Additional Non ideal Effects.

Analog Multipliers: Introduction, Log-Antilog single quadrant multipliers, Emitter coupled two quadrant multipliers, Gilbert four quadrant current multiplier, Current to voltage conversion, Complete four quadrant voltage multiplier, Applications of multipliers in various communication networks.

**Text/Reference books:**

 1. Microelectronics: Circuit Analysis and Design, Donald A Neamen, McGraw-Hill Education(4th edition) 2. Microelectronic Circuits, Adel S. Sedra and Kenneth C. Smith, Oxford University Press (7th edition) 3. Design of Analog CMOS Integrated Circuits, Behzad Razavi, Tata McGraw Hill 4. Analog Electronics with Op-Amps, A.J. Peyton and V. Walsh, Cambridge University Press 5. Analysis and Design of Analog ICs, Gray and Meyer, Wiley India Pvt Ltd 6. Silicon VLSI Technology, Plummer, Deal and Griffin, Prentice Hall

**Course Outcome**:

The graduates will be able to:

CO1:Understand the fundamental concepts and areas of applications for the Integrated Circuits.

CO2: Demonstrate a clear understanding of CMOS fabrication flow and technology scaling.

CO3: Demonstrate the ability to design practical circuits that perform the desired operations.

CO4: Analyze important types of integrated circuits of day-to-day requirements.

CO5: Understand the differences among theoretical, practical &amp; simulated results in integrated circuits

CO6: Choose the appropriate integrated circuit modules to build a given application