

Course <b>Code</b>	Course Name	Course Structure	
<b>EAEP07</b>	<b>Microelectronic Circuits and applications</b>	L-T-P	3-0-2
<p>COURSE OUTCOME (CO): After completing the course, the students should be able to:</p> <p>CO-1: Describe the Small signal high frequency models of BJT and MOS transistors use them in the high and low frequency analysis of single-stage amplifiers</p> <p>CO-2: Analyze differential and multi-stage amplifiers involving BJTs and MOSFETs</p> <p>CO-3: Understand and describe the linear and nonlinear applications of op-amps and OTAs including filters, linear impedances etc.</p> <p>CO-4: Understand and elaborate the importance of negative feedback amplifier topologies and their characteristic features along with relevant analysis of also the positive feedback in the realization of sinusoidal oscillators</p> <p>CO-5: Understand and describe power amplifiers and their realization involving power BJTs and Power MOSFETs.</p>			
Unit No	Topics		
Unit 1	Review of large signal (DC) and small signal (AC) models of BJTs and MOSFETs. High frequency models of BJT and MOSFET, Biasing techniques in integrated circuit (IC) amplifiers, High frequency response of CS and CE amplifiers with passive and active loads, high frequency response of CG and CB amplifiers with active loads, CS and CE amplifiers with source de-generation, Source follower and emitter follower, low frequency response of CE, CB, CC, CE with RE, CS, CG, CD and CS with Rs amplifiers.		
Unit 2	Multi-stage amplifiers using MOSFETs and BJTs, Cascode amplifier, Darlington pair, Differential and multi-stage amplifiers: MOS differential pair and its DC and small signal operation. BJT/MOS differential pair, ideal and Non-ideal characteristics of differential amplifiers, Differential amplifiers with active load.		
Unit 3	Block diagram representation of OP-Amp and OTA: Linear and non-linear applications of Operational amplifiers: amplifiers (inverting, non-inverting, differential), mathematical operations (summer/subtractor, integrator, differentiator), 1st-order and second-order filters, impedance realizations, linear applications of OTA.		
Unit 4	Non-linear applications of Op- Amp: multiplier, divider, log/antilog, squarer/square-rooter etc, exponential, Rectangular, Triangular, sawtooth waveform generators, 555 timer IC and their applications, Phase-locked loop and its application, function generator ICs		
Unit 5	Feedback amplifiers and Sinusoidal oscillators: General feedback structure, Properties of negative feedback, Four basic feedback topologies, Loop gain, Stability problem, Basic principle of sinusoidal oscillators, RC phase shift and Wien bridge oscillators, LC and crystal oscillators. Output stages		

	and power amplifiers: Class A, Class B, Class AB output amplifier stages, Class C amplifiers, Power BJTs, MOS power transistor, Discrete and IC power amplifiers
<b><u>References:</u></b> <ol style="list-style-type: none"> <li>1. Adel S. Sedra and K. C. Smith; Microelectronic Circuits, New York: Oxford University Press, 1998.</li> <li>2. P. R. Gray, P. J. Hurst, S. H. Lewis Meyer; Analysis and Design of Analog Integrated Circuits, Fourth Edition 2009.</li> <li>3. Jacob Millman and Arvin Grabel; Microelectronics, McGraw-Hill, Inc., 1995.</li> <li>4. Behzad Razavi; Design of Analog CMOS integrated circuits, McGraw Hill, 2001</li> <li>5. PE Allen and DR Holberg; CMOS Analog Circuit Design, Oxford University Press, 2002</li> </ol>	

### **Suggested List of Experiments:**

1. Evaluation of the performance of BJT Wilson Current mirror
2. Evaluation of the performance of MOS Cascode Current mirror
3. Evaluation of the performance of a Cascode amplifier
4. BJT-based differential amplifier with active load (and current source biasing)
5. MOS differential amplifier
6. Evaluation of the performance of a two-stage CMOS op-amp
7. Study of the properties of negative feedback amplifiers (implementation of series-series, series-parallel, parallel-series and parallel-parallel topologies)
8. BJT-based RC phase shift oscillator
9. Op-amp-based Wien-bridge oscillator
10. Study of Colpitts and Hartley Oscillators
11. Study of class AB push-pull amplifier
12. Applications of IC 555 Timer