ECE111: Analog Electronics

Programme: B.Tech. (ECE) Year: 1st Semester: II
Course: Core for ECE, MME and CCE Credits: 3 Hours: 40

Learning Objective:

This course serves as an intermediate analog electronic course. The course offers a comprehensive range of fundamental electronic device and circuit topics. The specific materials relate to analog electronics including diodes, bipolar-junction transistors (BJT), Operational Amplifiers (Op-Amps), basic single and multistage amplifier configurations, and integrated circuits using 555. This course in analog electronics offers analysis and design of analog electronic circuits, both discrete and integrated, required for an electronics engineer.

Course Outcomes (COs):

CO1	To learn the basics semiconductors and characteristics of PN diodes
CO2	To learn different design techniques and practical applications of PN diode
CO3	To learn fundamentals and analysis of transistors and design practical amplifiers using it
CO4	To learn designing techniques and practical applications of transistors oscillators and Op-Amp filter circuits.
CO5	To learn designing techniques and practical applications of 555 times as multivibrators and fundamentals of ADC and DAC.

Course Topics	Lecture Hours		
Unit-I Fundamentals Of Diode	**Total Lectures (08)**		
1.1. Basic Concepts: Intrinsic and Extrinsic Semiconductors, Drift and Diffusion Currents, Working of open diode and voltage applied diode circuits. Static and dynamic resistance, Diode's equivalent circuit, Transition and Diffusion capacitance.	**04**	**CO1**	
1.2. Diode Characteristics: Volt-Ampere characteristics, temperature dependence of V-I characteristics, Reverse Breakdown, Transient behavior of PN diode.	**02**		
1.3. Breakdown and other concepts: Zener and Avalanche breakdown, Load-line concept, piecewise linear diode model.	**02**		
Unit-II Diode Circuits	**Total Lectures (05)**		
2.1. Rectifiers: Half-wave rectifier, Full-wave rectifier and Bridge Rectifiers.	**01**	**CO1**	

2.2. Signal conditioning circuits: Clipping and clamping circuits.	**02**	**CO2**	
2.3. Special Diodes: Details of Zener Diode, Schottky, Varactor diode, Photo Diodes, and Light Emitting Diodes (LEDs).	**01**		
2.4. Diode Applications: Peak detector, Regulated DC power supply using Zener diode.	**01**		
Unit-III Bipolar Junction Transistors	**Total Lectures (12)**		
3.1. Transistor Fundamentals: NPN & PNP transistors, structure, typical doping, Eber-Moll model of transistor. NPN transistor and its modes of operation, Current components. Current gains: alpha (α) and beta (β). DC load line concept in BJT (V-I characteristics). Operating point (Q point) determination in BJT.	**03**	**CO3**	
3.2. Transistor as an amplifier: CE, CB and CC configuration. DC and AC analysis of single stage CE, CC and CB amplifiers.	**02**		
3.3. Biasing Techniques: Fixed bias (base bias), Collector feedback bias, Fixed bias with emitter resistor (emitter bias), Voltage divider biasing or emitter bias, Voltage divider with AC bypass capacitor.	**03**		
3.4. Small signal analysis of BJT: Small signal analysis of different biasing circuits using r_e model.	**02**		
3.5. Multistage Amplifiers: Cascade and Cascode connections, Darlington connections.	**02**		
Unit-IV Oscillators	**Total Lectures (04)**		
4.1. Oscillator concepts and basic circuit: Positive feedback concept, Barkhausen criterion for oscillation.	**01**	**CO4**	
4.2. Oscillator circuits: Design and analysis of RC Phase shift, Wien bridge oscillator, Hartley, Colpitts, and Crystal Oscillator.	**03**		
Unit-V Active Filter Circuits Using Op-Amp	**Total Lectures (04)**		
5.1. Basics of Filters: Ideal and approximate responses of different filters.	**01**	**CO4**	
5.2. Filter approximations: Sallen-key topology, Filter designs using Butterworth, Chebyshev, inverse Chebyshev, Elliptical and Bessel approximations.	**03**		
Unit-VI 555 Timer	**Total Lectures (03)**		
6.1. 555 Details: 555 Timer internal circuit diagram and design details.	**02**	**CO5**	
6.2. Multivibrator Circuits: Design and analysis of astable, mono-stable and bi-stable multivibrators using 555.			
6.3. Other 555 circuits: Zero crossing detector, Schmitt trigger.	**01**		
Unit-VII DAC and ADC	**Total Lectures (04)**		

7.1. D/A converters: DAC characteristics resolution, output input equations, Weighted resistor, R2R network	**02**	**CO5**	
7.2. A/D converter: ADC characteristics, flash ADC, Dual slope, Successive approximation, Tracking ADC.	**02**		
Total Lecture Hours	**40**		

Textbook & References Books

Text Books:

1. A.P. Malvino, "*Principles of Electronics"*, Tata McGraw Hill
2. A.S. Sedra & K.C. Smith, "*Microelectronic Circuits"*, Oxford
3. Jacob Millman & Christos C. Halkias, "*Integrated Electronics"*, Tata McGraw Hill

Reference Books:

1. Robert Boylestad, "*Electronic Devices and Circuit Theory"*, Pentice Hall
2. R.J Smith & R.C Dorf, "*Circuits, Devices and Systems"*, John Wiley & Sons

Evaluation Method

Item	Weightage (%)
Quiz	**20**
Midterm	**30**
Final Examination	**50**

Attendance: ***Students with less than 75% attendance will get a penalty of 1 grade.***

Mid Semester Exam: It will have 30% weightage on the overall marks in the course.

End Semester Exam: This exam will have 50% weightage of the overall marks in the course. Each unit in end semester examination will carry weightage proportional to the lecture hours.