

**Syllabus**

**Introduction to Electronic Circuits:**

**Diode & wave shaping circuits:(8L + 2T)**

Different rectifier circuits, ripple factor, efficiency, TUF, PIV, power supply filters, clipper and clamper circuits, peak detector, voltage multiplier. RC filter response for non-sinusoidal signals, compensated attenuator.

**BJT circuits:(8L + 3T)**

Biasing and stability analysis: fixed bias, collector to base feedback bias, emitter bias, voltage divider bias, transistor as a switch, AC analysis: modeling (re, hybrid equivalent, and hybrid  $\pi$  models), expressions for input impedance, output impedance, voltage gain, current gain for different configurations including emitter follower with different biasing circuits, DC bias with voltage negative feedback, effects of source and load resistance, two-port system approach-combination networks: Darlington pair, cascade and cascode configurations, current mirror circuits. Frequency response: Low frequency and high frequency response, Miller effect, brief overview on multistage amplifier, frequency effects and square wave testing.

**FET circuits:(7L +2T)**

Biasing: fixed bias, self-bias, voltage divider bias, common drain, common gate configurations AC analysis: Modeling (small signal model), expressions for input impedance, output impedance, voltage gain for different configurations like fixed bias, self-bias, voltage divider bias, common drain, common gate configurations Frequency response: low frequency and high frequency response, Miller effect .

**OPAMP circuits: (8L + 3T)**

Basics, differential amplifier circuit, concept of open loop and closed loop gain, DC offset and frequency parameters, slew rate, differential and common mode operation , applications: inverting and non-inverting amplifier, transresistance amplifier, transconductance amplifier, log and antilog amplifier, adder, subtractor, multiplier, divider, buffer, differentiator and integrator, rectifier clipper and clamper circuits, peak detector.

**Regulated Power Supply:(5L + 2T)**

Voltage regulation, Zener diode & IC regulator, regulation factor, filter circuit's discrete transistor voltage regulation (series and shunt), switching regulators, switch mode power supply.

**Course Outcomes:** After completion of the course student will be able to:

CO:1. classify diode models and apply those in different diode circuits ( $K_3$ )

CO:2. understand RC filter response for non-sinusoidal signals ( $K_2$ )

CO:3. understand and analyze different DC and AC equivalent circuits to realize BJT and FET amplifiers. ( $K_4, A_1$ )

CO:4. explain characteristics of op-amp and apply them in various analog electronic circuits. ( $K_3$ )

CO:5. design filters, amplifiers and voltage regulators. ( $K_5$ )

**ANALOG CIRCUITS-I Ex/ET/PC/B/T/215**  
**4Pds/Wk Credit-4 (36L+12T)**

**Weightages and targets of COs**

**Text books:**

1. J. Millman, C. Halkias and S. Jit, "Electronic Devices and Cicuits", Tata McGraw-Hill, 4th edition, 2015.
2. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits-Theory and applications", seventh Edition , 2017
3. Ramakant A. Gayakwad, "Op-amps and Linear Integrated Circuits", Prentice Hall, 4th Edn

**Reference books:**

1. D. A. Neaman, "Electronic Circuits: Analysis And Design", 3rd Edition", Tata McGraw-Hill, 2010
2. Donald Schilling and Charles Belove, "Electronic Circuits: Discrete & Integrated", Tata McGraw-Hill Education 2002
3. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory " Pearson; 10 edition 2009

**CO-PO Mapping: (3 – Strong, 2 – Moderate and 1 – Weak)**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2	PS O3
<b>CO1</b>	3	1			1							1	1		
<b>CO2</b>	3	1										1	1		
<b>CO3</b>	2	3	1		1							1	1		
<b>CO4</b>	3	1			1							1	1		
<b>CO5</b>	2	2	3	1	1	1	2		1	1	1	2	2		

**Content delivery methods**

- Class room lecture (chalk and board) (D1)**
- Visual presentation (D2)**
- Tutorial (D3)**
- Simulations (D6)**
- Discussion/brainstorming, (D7)**

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**4Pds/Wk Credit-4 (36L+12T)**

**LECTURE PLAN:**

S. No.	Topics to be Covered	No. of Classes	Teaching Learning Methods	COs Covered	Remarks
1	Analog Circuit: Introduction to Electronic Circuits	1	Lecture	CO1	
2	Diode & Wave Shaping Circuits	8	Lecture	CO1, CO2	
3	Diode & Wave Shaping Circuits (Tutorial)	2	Tutorial	CO1, CO2, CO5	
4	BJT Circuits	8	Lecture	CO3	
5	BJT Circuits (Tutorial)	3	Tutorial	CO3, CO5	
6	FET Circuits	7	Lecture	CO3	
7	FET Circuits (Tutorial)	2	Tutorial	CO3, CO5	
8	Op-Amp Circuits	8	Lecture	CO4	
9	Op-Amp Circuits (Tutorial)	3	Tutorial	CO4,CO5	
10	Regulated Power Supply	5	Lecture	CO4	
11	Regulated Power Supply (Tutorial)	2	Tutorial	CO4,CO5	

**Unit 1: Analog Circuit: Introduction to Electronic Circuits (1 Lecture)**

**Lectures:**

1. Introduction to basic analog electronic circuits and their significance.

**Unit 2: Diode & Wave Shaping Circuits (8 Lectures + 2 Tutorials)**

**Lectures:**

1. Different types of rectifier circuits: half-wave, full-wave center-tap, and bridge rectifiers.
2. Analysis of rectifier circuits: ripple factor, efficiency, transformer utilization factor (TUF), peak inverse voltage (PIV).
3. Power supply filters: capacitor-input filters.
4. Clipper and clamper circuits: positive and negative clippers, biased and unbiased clamper circuits.
5. Peak detector and voltage multiplier circuits.
6. Low pass RC filter response for non-sinusoidal signals

7. High pass RC filter response for non-sinusoidal signals
8. Compensated attenuator.

**Tutorials:**

1. Practice problems on rectifier circuits, clipper, clamper, peak detector, and voltage multiplier circuits.
2. Hands-on exercises on RC filter response to non-sinusoidal signals.

**3. BJT Circuits (8Lectures + 3 Tutorials)**

**Lectures:**

1. Biasing techniques for BJT: fixed bias, collector to base feedback bias, emitter bias, voltage divider bias.
2. Stability analysis of biasing circuits: fixed bias, collector to base feedback bias.
3. Stability analysis of biasing circuits: , emitter bias, voltage divider bias.
4. AC analysis of BJT: modeling (re, hybrid equivalent, and hybrid  $\pi$  models).
5. AC analysis of BJT: expressions for input impedance, output impedance, voltage gain, and current gain.
6. Emitter follower with different biasing circuits.
7. Combination networks (Darlington pair, cascade, and cascode configurations, current mirror circuits).
8. Frequency response: Low frequency and high frequency response, Miller effect, Square wave testing

**Tutorials:**

1. Problem-solving sessions on biasing and stability analysis.
2. Practical exercises on BJT amplifier configurations.
3. Simulation and analysis of frequency response in BJT circuits.

**4. FET Circuits (7 Lectures + 2 Tutorials)**

**Lectures:**

1. Biasing techniques for FET: fixed bias, self-bias, voltage divider bias.
2. Common drain and common gate configurations.
3. AC analysis of FET: small-signal model
4. AC analysis of FET: expressions for input impedance, output impedance, and voltage gain.

5. Frequency response of FET circuits: low-frequency and high-frequency response, Miller effect.

**Tutorials:**

1. Hands-on practice on FET biasing techniques.
2. Simulation and analysis of FET amplifier circuits.

**5. Op-Amp Circuits (8 Lectures + 3 Tutorials)**

**Lectures:**

1. Basics of operational amplifiers (op-amps): ideal characteristics and practical limitations.
2. Differential amplifier circuit: structure, common-mode rejection ratio (CMRR).
3. Open-loop and closed-loop configurations: inverting and non-inverting amplifiers.
4. Applications of op-amps: summing amplifier, difference amplifier, integrator, differentiator, logarithmic and antilogarithmic amplifiers.
5. Rectifier, clipper, and clamper circuits using op-amps.
6. Peak detector circuit.

**Tutorials:**

1. Problem-solving sessions on op-amp characteristics and basic circuits.
2. Hands-on experiments on op-amp applications.
3. Design and simulation exercises on various op-amp circuits.

**6. Regulated Power Supply (5 Lectures + 2 Tutorial)**

**Lectures:**

1. Basics of voltage regulation: Zener diode and IC regulator circuits.
2. Voltage regulation factor and efficiency.
3. Filter circuits for voltage regulation: series and shunt regulators.
4. Introduction to switching regulators and switch-mode power supplies.

**Tutorials:**

1. Design of voltage regulators and regulated power supply circuits.
2. Simulation of voltage regulators.