ANALOG CIRCUITS-II
Ex/ET/PC/B/T/221
3Pds/Wk Credit-3 (3+0+0)

Syllabus

1. Multistage amplifiers, cascaded BJT and FET amplifiers, frequency response of R-C coupled multistage amplifier. (6L)

2. Power amplifiers Analysis and design of class A, class B, class AB, class C, class D amplifiers. Design of heat sink, IC power amplifiers.**(7L)**

3. Tuned amplifiers, bandwidth consideration of tuned amplifiers, analysis of single and double tuned amplifiers, stagger tuning, Butter worth and Chebyshev response. **(6L)**

4. Feedback concepts, connection types, practical circuits, phase and frequency considerations. **(3L)**

5. Waveform generator, oscillation criteria and oscillator circuits. Blocking oscillator, relaxation oscillator, multivibrators, their classification and implementation using BJT, OPAMP and 555 timers, 555 timer as variable duty cycle square wave generator, variable frequency LC and RC sine wave oscillators, Phase shift oscillator ,Wien-bridge oscillator, colpitts oscillator, Hartley oscillator and clapp oscillator and crystal oscillators. Linear time base circuits. [10L]

6. PLL-architecture and applications, VCO architecture and applications, synchronization and frequency division circuits. [3L]

Course Outcome

CO1. Classify and describe various amplifiers, oscillators and waveform generators and identify their applications. [K2, A1, A2]
CO2. Formulate and analyze various analog electronic circuits. [K4, K5, A3,S4]
CO3. Determine various parameters of various amplifiers, oscillators and waveform generators and compare.[K3, K4, K5]
CO4. Design analog electronic circuit to meet specific output and justify. [K5, K6, A4, A5]

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

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O3
	CO1	3	2	1									1	1		
	CO2	2	3	2		1							1	1		
	CO3	2	3	`1	1	1							1	1		
	CO4	2	2	3	2	2							2	1		

Content delivery methods

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

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. Thomas L. Floyd, David M. Buchla, “Fundamentals of Analog Circuits”, Pearson, 2nd 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

S. No.	Topics to be Covered	No. of Classes	Teaching Learning Methods	COs Covered
1	Multistage Amplifiers and Frequency Response	6	Lecture, Design Examples, Simulation	CO1, CO2
2	Power Amplifiers	7	Lecture, Design Exercises, Simulation	CO1, CO2
3	Tuned Amplifiers	6	Lecture, Simulation	CO2, CO3
4	Feedback Concepts	3	Lecture, Examples	CO2
5	Waveform Generators and Oscillator Circuits	10	Lecture, Design Exercises	CO1, CO3
6	PLL and VCO	3	Lecture, Case Studies	CO4

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Lecture Plan

1. Multistage amplifiers

Class 1-2:

- Introduction to multistage amplifiers.
- Explanation of cascaded BJT and FET amplifier configurations.
- Analysis of voltage gain, current gain, and input/output impedance in multistage amplifiers.
- Example problems to demonstrate amplifier configurations.

Class 3-4:

- Frequency response of R-C coupled multistage amplifiers.
- Calculation of lower and upper cutoff frequencies.
- Bandwidth considerations and frequency response plots.
- Design considerations for maximizing bandwidth.

Class 5-6:

- Applications of multistage amplifiers in practical circuits.
- Case studies on the use of multistage amplifiers in audio amplifiers, RF amplifiers, etc.
- Troubleshooting and practical tips for designing and implementing multistage amplifier circuits.
- Hands-on lab session or simulation exercises to reinforce concepts.

2. Power Amplifiers (7 Classes)

Class 1-2:

- Overview of power amplifiers and their classification (Class A, B, AB, C, D).
- Analysis of Class A amplifier operation, efficiency, and distortion.
- Design considerations for Class A amplifiers.

Class 3-4:

- Analysis and design of Class B and Class AB amplifiers.
- Cross-over distortion reduction techniques.
- Design of push-pull configurations.

Class 5-6:

- Introduction to Class C and Class D amplifiers.
- Switching amplifier principles and operation.

- Design considerations for achieving high efficiency and low distortion in Class C and Class D amplifiers.

Class 7:

- Design of heat sinks for power amplifiers.
- Introduction to integrated circuit (IC) power amplifiers.
- Comparison of discrete and integrated power amplifier designs.

3. Tuned Amplifiers (6 Classes)

Class 1-2:

- Introduction to tuned amplifiers and their significance.
- Analysis of resonant circuits and their frequency response.
- Design of single-tuned amplifiers.

Class 3-4:

- Bandwidth considerations in tuned amplifiers.
- Analysis and design of double-tuned amplifiers.
- Stagger-tuned amplifier configurations and their advantages.

Class 5-6:

- Introduction to filter responses (Butterworth, Chebyshev) in tuned amplifiers.
- Design considerations for achieving desired filter responses.
- Simulation exercises or lab sessions to explore the performance of tuned amplifiers.

4. Feedback Concepts (3 Classes)

Class 1:

- Introduction to feedback in amplifiers and oscillators.
- Types of feedback (voltage, current, series, shunt) and their effects.

Class 2:

- Analysis of practical feedback circuits (voltage divider, emitter degeneration, etc.).
- Stability criteria and oscillation prevention techniques.

Class 3:

- Phase and frequency considerations in feedback circuits.
- Design of feedback networks for specific applications.

- Examples and case studies illustrating the use of feedback in amplifiers and oscillators.

5. Waveform Generators and Oscillator Circuits (10 Classes)

Class 1-2:

- Introduction to waveform generation and oscillation criteria.
- Analysis and design of blocking oscillators.

Class 3-4:

- Relaxation oscillator circuits and their applications.
- Design of astable, monostable, and bistablemultivibrators.

Class 5-6:

- Implementation of waveform generators using BJT, OPAMP, and 555 timers.
- Design of variable duty cycle square wave generators.

Class 7-8:

- Design of variable frequency LC and RC sine wave oscillators.
- Analysis and design of Phase Shift Oscillators.

Class 9-10:

- Introduction to Wien-bridge, Colpitts, Hartley, and Clapp oscillators.
- Design considerations for crystal oscillators.
- Linear time base circuits and their applications.

6. PLL and VCO (3 Classes)

Class 1:

- Introduction to Phase-Locked Loop (PLL) architecture and operation.
- Applications of PLL in frequency synthesis, demodulation, and clock recovery.

Class 2:

- Voltage-Controlled Oscillator (VCO) architecture and applications.
- Design considerations for VCOs in PLL circuits.

Class 3:

- Synchronization and frequency division circuits using PLLs.
- Real-world applications and case studies of PLL and VCO circuits.
- Design exercises and simulations to reinforce concepts.