ARSD College, University of Delhi

Lesson Plan

Course Name : B.Sc. (Physics)						
Semester	**Course Code**	**Course Title**	**Lecture (L)**	**Tutorial (T)**	**Practical (P)**	**Credit (C)**
IV		PHYSICS-C X: ANALOG SYSTEMS AND APPLICATIONS	4	0	0	4
Teacher/Instructor(s)		Dr. Manisha				
Session		2021-22				

Course Objective:

- To learn Fundamentals of electronic devices.
- To design and Applications of electronic circuits.
- To learn through practice mode the fundamental electronic devices

Course Learning Outcomes:

Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
1.	Semiconductor Diodes	1	Distinction between metals, semiconductors and insulators, Concentration of charge carriers,
		2	Formation of energy bands in solids, Direct & Indirect band gap
		3	Density of states, conduction band, valence band, Fermi level,
		4	Intrinsic and extrinsic semiconductors, P and N type semiconductors and their energy level diagrams
		5	Conductivity and Mobility, Concept of Drift velocity.
		6	PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction diode.
		7-8	Derivation for Barrier Potential, Barrier Width and Current for abrupt Junction.
		9	Current Flow Mechanism in Forward and Reverse Biased Diode.

2.	Two-terminal Devices and their Applications:	10	Rectifier Diode: Half-wave Rectifiers. Centre-tapped full wave rectifier
		11	Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency
		12	C-filter
		13-14	Zener Diode and Voltage Regulation.
		15	Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell,
		16	Qualitative idea of Schottky diode and Tunnel diode
3.	Bipolar Junction transistors	17-18	Dopind concentration and width of emitter, base and collector junction, n-p-n and p-n-p Transistors
		19	I-V characteristics of CB and CE Configurations.
		20	Active, Cutoff and Saturation Regions.
		21	Current gains α and β. Relations between α and β. Load Line analysis of Transistors, DC Load line and Q point.
		22	Physical Mechanism of Current Flow.
4.	Amplifiers	23	Need for biasing and stabilization methods/ circuits
		24	Fixed bias
		25	Voltage divider bias
		26-27	Transistor as two port network, h parameter
		28	H parameter equivalent circuit
		29-30	Analysis of a single-stage CE amplifier using Hybrid Model
		31	Input and Output Impedance. Current, Voltage and Power Gains.
		32	Classification of Class A, B & C Amplifiers.
5.	Coupled Amplifier	33-34	Two stage RC-coupled amplifier and its frequency response- Low frequency and mid frequency response
		35-36	High frequency response
6	Feedback in Amplifiers	37-38	Positive and Negative Feedback.
		39-40	Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.
7	Sinusoidal Oscillators	41-42	Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator (determination of Frequency)
		43-44	Hartley & Colpitts oscillators (determination of Frequency)
8	Operational Amplifiers	45-46	Characteristics of an Ideal and Practical Op-Amp. (IC 741)
		47-48	Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground

		49	(1) Inverting and non-inverting amplifiers,
		50-51	(2) Adder, (3) Subtractor, (4) Differentiator,
		52-53	Integrator, (6) Log amplifier
		54-55	Comparator and Zero crossing detector
		57	Wein bridge oscillator.
		58	D/A Resistive networks (Weighted ladder)
		59	R-2R Ladder
		60	Accuracy and Resolution.

Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment		25
	• Quiz		
	• Class Test		
	• Attendance		
	• Assignment		
2.	End Semester Examination	3 hr	75

Details of the Course		
Unit	**Contents**	**Contact Hours**
1	Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram.Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Barrier Width and Current for abrupt Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.	9
2	Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter, (2) Zener Diode and Voltage Regulation. Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell, Qualitative idea of Schottky diode and Tunnel diode.	7
3	Bipolar Junction transistors: n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cut off and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Qpoint. Physical Mechanism of Current Flow.	6
4	Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network.h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.	10
5		4

	Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response.	
6	Feedback in Amplifiers: Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.	**4**
7	Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.	**4**
8	Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.	**4**
9	Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Comparator and Zero crossing detector (8) Wein bridge oscillator.	**9**
10	Conversion: D/A Resistive networks (Weighted and R-2R Ladder). Accuracy and Resolution.	**3**
	Total	**60**

Suggested Books:

Sl. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1	Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.	1991
2	Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.	2004
3	Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning.	2009
4	Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill.	2012
5	OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.	2000
6	Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.	2014
7	Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India.	2002
8	Microelectronic Devices & Circuits, David A.Bell, 5th Edn.,2015, Oxford University Press.	2015

Mode of Evaluation:	Internal Assessment / End Semester Exam

Progress Report:

Unit No.	Learning Objective	Date	Topics to be covered
1.	Semiconductor Diodes		Distinction between metals, semiconductors and insulators, Concentration of charge carriers,
			Formation of energy bands in solids, Direct & Indirect band gap
			Density of states, conduction band, valence band, Fermi level,
			Intrinsic and extrinsic semiconductors, P and N type semiconductors and their energy level diagrams
			Conductivity and Mobility, Concept of Drift velocity.
			PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction diode.
			Derivation for Barrier Potential, Barrier Width and Current for abrupt Junction.
			Current Flow Mechanism in Forward and Reverse Biased Diode.
2.	Two-terminal Devices and their Applications:		Rectifier Diode: Half-wave Rectifiers. Centre-tapped full wave rectifier
			Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency
			C-filter
			Zener Diode and Voltage Regulation.
			Principle, structure and characteristics of (1) LED, (2) Photodiode and (3) Solar Cell,
			Qualitative idea of Schottky diode and Tunnel diode
3.	Bipolar Junction transistors		Dopind concentration and width of emitter, base and collector junction, n-p-n and p-n-p Transistors
			I-V characteristics of CB and CE Configurations.
			Active, Cutoff and Saturation Regions.
			Current gains α and β. Relations between α and β. Load Line analysis of Transistors, DC Load line and Q point.
			Physical Mechanism of Current Flow.
4.	Amplifiers		Need for biasing and stabilization methods/ circuits
			Fixed bias
			Voltage divider bias
			Transistor as two port network, h parameter
			H parameter equivalent circuit
			Analysis of a single-stage CE amplifier using Hybrid Model
			Input and Output Impedance. Current, Voltage and Power Gains.
			Classification of Class A, B & C Amplifiers.
5.			

	Coupled Amplifier		Two stage RC-coupled amplifier and its frequency response- Low frequency and mid frequency response
			High frequency response
6	Feedback in Amplifiers		Positive and Negative Feedback.
			Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.
7	Sinusoidal Oscillators		Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator (determination of Frequency)
			Hartley & Colpitts oscillators (determination of Frequency)
8	Operational Amplifiers		Characteristics of an Ideal and Practical Op-Amp. (IC 741)
			Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground
			(1) Inverting and non-inverting amplifiers,
			(2) Adder, (3) Subtractor, (4) Differentiator,
			Integrator, (6) Log amplifier
			Comparator and Zero crossing detector
			Wein bridge oscillator.
			D/A Resistive networks (Weighted ladder)
			R-2R Ladder
			Accuracy and Resolution.