

ES-108: SEMICONDUCTOR DEVICES AND CIRCUITS LAB

Course Title :	Semiconductor Devices and Circuits Lab	Course Code	ES-108
YEAR	1ST YEAR	Course Group	Practical
Teaching Scheme in Periods(L:T:P)	0:0:3	Credits	2
Methodology	Lecture + Practical	Total Contact Periods :	90 Periods
CIE	60 Marks	SEE	40 Marks

Pre requisites

This course requires the basic skills of Handling Basic Electronics tools and Components, knowledge of connecting cables and meters

Course Outcomes:

Upon completion of the course, the student should be able to

CO1	Identify electronic components and laboratory instruments, perform basic testing, and carry out proper soldering and desoldering practices for electronic circuit construction.
CO2	Plot and analyze V–I characteristics of PN junction and Zener diodes, and construct rectifier, filter, and regulated power supply circuits to evaluate their performance parameters.
CO3	Plot input and output characteristics of BJTs, implement biasing circuits, and verify transistor operation as an amplifier and as a switch.
CO4	Plot drain and transfer characteristics of JFETs and demonstrate proper handling, testing, and protection techniques for MOSFET devices.
CO5	Construct and analyze small-signal and power amplifier circuits to determine voltage gain, frequency response, bandwidth, efficiency, and distortion.
CO6	Design and test oscillator circuits and special semiconductor devices such as SCRs, LEDs, and opto-couplers for signal generation, control, and isolation applications.

Course Content and Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE		
			R	U	A
I	Electronic Workshop and PCB Practice	10	1,2		3,4,5
II	Diodes and Power Supply Circuits	15		6,7	8,9,10
III	Bipolar Junction Transistors (BJT)	15		11,12	13,14
IV	Field Effect Transistors (FET)	15		15,16	17
V	Amplifiers (Small Signal and Power Amplifiers)	20			18,19,20,21,22
VI	Oscillators and Special Semiconductor Devices	15		28	23,24,25,26,27,29
Total		90			

E-Learning Resources

1. <http://electrical4u.com/>
2. www.electronics-tutorials.ws
3. www.nptel.ac.in
4. www.youtube.com

LIST OF EXPERIMENTS

UNIT-1: Electronic Workshop and PCB Practice

1. Study of Laboratory Equipment

Study and demonstration of Regulated Power Supply (RPS), Function Generator, Cathode Ray Oscilloscope (CRO) / Digital Storage Oscilloscope (DSO), and Digital Multimeter (DMM).

2. Identification and Testing of Components

Identification of resistors (fixed and variable), capacitors (ceramic and electrolytic), inductors, and transformers. Measurement of component values using DMM and verification using colour codes or markings. Testing of switches, fuses, and relays.

3. PCB Soldering Practice

Soldering of simple components such as resistors, LEDs, and capacitors on a general-purpose PCB (dot board). Identification of good solder joints and dry solder joints.

4. Desoldering Practice

Removal of components from a PCB using desoldering pump and desoldering wick without damaging PCB tracks.

5. Switch and Relay Wiring

Construction of a simple relay control circuit using a toggle switch to control a lamp or load.

UNIT-2: Diodes and Power Supply Circuits

6. PN Junction Diode Characteristics

Plotting of forward and reverse bias V-I characteristics of a PN junction diode.

Determination of cut-in voltage and static and dynamic resistances.

7. Zener Diode Characteristics

Plotting of V-I characteristics of a Zener diode and determination of Zener breakdown voltage.

8. Rectifier Circuits

Construction of half-wave and full-wave (centre-tapped) rectifier circuits. Observation of input and output waveforms using CRO and calculation of ripple factor.

9. Bridge Rectifier with Filter

Construction of bridge rectifier with capacitor filter. Study of the effect of filter capacitor on ripple voltage.

10. Regulated Power Supply

Construction of +5V regulated power supply using IC 7805 and +12V regulated power supply using IC 7812. Measurement of load regulation.

UNIT-3: Bipolar Junction Transistors (BJT)

11. Input Characteristics of BJT (CE Configuration)

Plotting of input characteristics (I_B vs V_{BE}) for constant V_{CE} and determination of input impedance.

12. Output Characteristics of BJT (CE Configuration)

Plotting of output characteristics (I_C vs V_{CE}) for constant I_B and determination of current gain (β) and output admittance.

13. Transistor Biasing

Construction of potential divider bias circuit and measurement of operating point (Q-point).

14. Transistor as a Switch

Construction of a transistor switching circuit to drive an LED or relay and verification of cut-off and saturation regions.

UNIT-4: Field Effect Transistors (FET)

15. JFET Drain Characteristics

Plotting of drain characteristics (I_D vs V_{DS}) for various values of V_{GS} and identification of operating regions.

16. JFET Transfer Characteristics

Plotting of transfer characteristics (I_D vs V_{GS}) for constant V_{DS} and determination of pinch-off voltage and I_{DSS} .

17. MOSFET Handling and Testing

Demonstration of proper MOSFET handling techniques using anti-static precautions and testing of MOSFET using a digital multimeter.

UNIT-5: Amplifiers (Small Signal and Power Amplifiers)**18. Single-Stage CE Amplifier**

Construction of a single-stage RC-coupled common emitter amplifier and measurement of voltage gain.

19. Frequency Response of CE Amplifier

Determination of frequency response of CE amplifier by varying input frequency and calculation of bandwidth.

20. Two-Stage RC-Coupled Amplifier

Construction of a two-stage RC-coupled amplifier and observation of gain and phase relationship.

21. Class A Power Amplifier

Construction of a Class A power amplifier and calculation of efficiency.

22. Class B Push-Pull Amplifier

Construction of a complementary symmetry Class B push-pull amplifier and observation of crossover distortion using CRO.

UNIT-6: Oscillators and Special Semiconductor Devices**23. RC Phase Shift Oscillator**

Construction of RC phase shift oscillator and verification of Barkhausen criterion.

24. Hartley Oscillator

Construction of Hartley oscillator and measurement of frequency of oscillation.

25. Colpitts Oscillator

Construction of Colpitts oscillator and measurement of frequency of oscillation.

26. Crystal Oscillator

Construction of crystal oscillator and observation of frequency stability.

27. SCR Characteristics

Plotting of $V-I$ characteristics of SCR and determination of breakover voltage and holding current.

28. LED Characteristics

Plotting of $V-I$ characteristics of LED.

29. Opto-Coupler Application

Construction of opto-coupler (MCT2E) based circuit for electrical isolation.

Suggested Student Activities

- (i) Collection of catalogues and specification sheets, preparation of a chart displaying symbols of passive components and connectors/cables.
- (ii) Collection of the contributors (scientists) and contribution details to the field of Electrical and Electronics engineering
- (iii) Any other such activities that can contribute to the student's knowledge in respect of this course.
- (iv) Record the best practices used in the disposal of E-waste and precautions in the operation of electrical appliances.

CO-PO Mapping Matrix

	Basic and Discipline Specific Knowledge	Problem Analysis	Design/Development of Solutions	Engineering Tools, Experimentation and Testing	Engineering Practices for Society, Sustainability and Environment	Project Management	Lifelong Learning	Linked PO
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	
CO1	3	1	2	3	2		2	1,2,3,4,5,7
CO2	3	2	3	3			1	1,2,3,4,7
CO3	3	3	2	3			1	1,2,3,4,7
CO4	2	2	1	3	2		1	1,2,3,4,5,7
CO5	3	3	3	3			1	1,2,3,4,7
CO6	2	2	3	3	1		2	1,2,3,4,5,7

QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R) and Understanding(U)	2	4	Nil	8 Marks
02	Part-B	Application(A)	2	12	1	12 Marks
Total Marks						20 Marks

QUESTION PAPER PATTERN FOR SEMESTER END EXAM

Sl.No	Description	Level	No of Questions	Marks for each question	Choice	Total Marks
01	Part-A	Remembering(R) and Understanding(U)	4	4	Nil	16 Marks
02	Part-B	Application(A)	2	24	1	24 Marks
Total Marks						40 Marks