

MEE-105 BASIC ELECTRONICS AND AMPLIFIERS

Course Title	Basic Electronics and Amplifiers	Course Code	MEE-105
Year	I Year	Course Group	Core
Teaching Scheme (L:T:P)	4:1:0	Credits	3
Methodology	Lecture+Tutorials	Total Contact Periods	150
CIE	60 Marks	SEE	40

Pre requisites

The student should have basic knowledge of mathematics and basic electrical laws

Course Outcomes

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

CO1	Apply network laws and A.C/D.C source principles to analyze basic electrical circuits involving passive components, transformers, and relays.
CO2	Explain diode operation and characteristics and analyze rectifier and voltage regulator circuits using equivalent models.
CO3	Analyze the characteristics, operating modes, biasing methods, and amplifier performance of bipolar junction transistor circuits
CO4	Explain the operation and biasing of FETs and MOSFETs and analyze their amplifier performance using equivalent circuits.
CO5	Analyze multistage amplifier circuits with respect to gain, coupling methods, bandwidth, and frequency response
CO6	Explain feedback principles and the operation of oscillator circuits.

Course Content and Blue Print of Marks for SEE

Unit No	Unit Name	Periods	Questions to be set for SEE			
			R		U	A
1	Basic Electrical Components, Sources, and Electromechanical Devices	20	Q4	Q1	Q9(a)	Q13(a)

2	Semiconductor Devices – Diodes	30					
3	Bipolar Junction Transistors (BJT)	20		Q2		Q10(a)	Q14(a)
4	Field Effect Transistors and MOSFET	25					
5	Multistage Amplifiers and Frequency Response	20		Q3	Q5, Q6	Q9(b), Q11(a), Q11(b)	Q13(b), Q15(a), Q15(b)
6	Feedback Amplifiers and Oscillators	30			Q8	Q10(b), Q12(a), Q12(b)	Q14(b), Q16(a), Q16(b)
Total		150		8		8	8

Course Contents

UNIT–I: Basic Electrical Components, Sources, and Electromechanical Devices

Duration: 20 Periods (L: 16 – T:4)

A.C and D.C sources - Ideal and practical voltage and current sources with characteristics- Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL) and their application to simple electrical networks.- Resistor fundamentals - Series and parallel equivalent resistance - Simple resistive circuits and applications. Colour coding of resistors - Inductor working principle - Series and parallel equivalent inductance - Combination of series and parallel inductors - Mutual inductance - Transformer working principle and applications - Relay working principle and applications - Capacitor working principle - Series and parallel equivalent capacitance - Combination of series and parallel capacitors.

UNIT–II: Semiconductor Devices – Diodes

Duration: 30 Periods (L: 24 – T:6)

Semiconductor fundamentals - Intrinsic and extrinsic semiconductors - PN junction formation - PN junction diode operation and V–I characteristics - Equivalent electrical circuit of PN junction diode - PN diode as rectifier circuits including half-wave rectifier and full-wave rectifier - Zener diode operation and characteristics - Equivalent electrical circuit of Zener diode - Zener diode as voltage regulator and its applications - LED operation, characteristics, applications, and equivalent electrical circuit - Photodiode operation, characteristics, applications, and equivalent electrical circuit - Varactor diode operation, applications, and equivalent electrical circuit - Schottky diode operation, characteristics, applications, and equivalent electrical circuit.

UNIT–III: Bipolar Junction Transistors (BJT)

Duration: 20 Periods (L: 15 – T:5)

Construction and operation of bipolar junction transistors - BJT characteristics - Modes of operation including cut-off mode, active mode, and saturation mode - Transistor regions of operation - Equivalent electrical circuit of BJT - Need for transistor biasing - Stability factor and its significance - Basic biasing methods including fixed bias, collector-to-base bias, and voltage divider bias - BJT configurations with emphasis on common emitter configuration - BJT as an amplifier in common emitter mode - Determination of voltage gain and current gain.

UNIT–IV: Field Effect Transistors and MOSFET

Duration: 25 Periods (L: 20 – T:5)

Principle of operation of field effect transistors - Construction, working principle, and characteristics of JFET - Equivalent electrical circuit of JFET - Construction, working principle, and characteristics of MOSFET - Equivalent electrical circuit of MOSFET - Comparison between BJT and FET - Biasing methods of FET including fixed bias, self-bias, and voltage divider bias - Biasing methods of MOSFET including fixed bias, voltage divider bias, and drain feedback bias - Operation of FET and MOSFET amplifiers.

UNIT–V: Multistage Amplifiers and Frequency Response

Duration: 20 Periods (L: 16 – T:4)

Concept of single-stage and multistage amplifiers - Need for multistage amplifiers - Cascading of amplifier stages - Overall voltage gain, current gain, and power gain of multistage amplifiers - Coupling methods including RC coupling, transformer coupling, and direct coupling - RC-coupled amplifier operation and characteristics - Transformer-coupled amplifier operation and characteristics - Direct-coupled amplifier operation and characteristics - Comparison of different coupling methods - Frequency response of multistage amplifiers - Definition of bandwidth and half-power frequencies - Low-frequency, mid-frequency, and high-frequency regions of operation - Causes of low-frequency and high-frequency roll-off - Gain–bandwidth relationship - Gain–bandwidth product - Applications and limitations of multistage amplifiers.

Unit VI. Feedback Amplifiers and Oscillators

Duration: 30 Periods (L: 25 – T:5)

Concept of feedback- four types of negative feedback amplifiers- Effect of negative feedback on gain , band width, input impedance ,output impedance - Merits and De-merits of Negative Feedback. Barkhausen criteria in oscillators- Types of Oscillator circuits- RC Phase shift oscillator, Wien Bridge Oscillator, Hartley oscillator- Colpitts oscillator- Crystal Oscillator- Expressions for frequency of oscillation - Advantages of crystal oscillators- Merits and demerits of RC and LC oscillators.

Reference Books

1. “Basic Electronics” by S. Y. Kulkarni & B. Somanathan Nair
2. “Electronics Principles” by Albert Malvino
3. “The Art of Electronics” by Paul Horowitz & Winfield Hill
4. “Getting Started in Electronics” by Forrest M. Mims III

Suggested E-learning references

1. <https://testbook.com/electrical-engineering/analog-electronics>
2. https://edurev.in/courses/9205_Electronic-Devices-Notes--Videos--MCQs--PPTs
3. www.youtube.com

Suggested Learning Outcomes

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

UNIT–I: Basic Electrical Components, Sources, and Electromechanical Devices

After completing this unit, the student will be able to:

- 1.1. Explain the concept of electrical sources and differentiate between A.C and D.C sources.
- 1.2. Distinguish between ideal and practical voltage and current sources using their characteristics.
- 1.3. State Kirchhoff’s Current Law (KCL).
- 1.4. State Kirchhoff’s Voltage Law (KVL).
- 1.5. Apply KCL and KVL to analyze simple electrical networks.
- 1.6. Explain the basic concepts and electrical behavior of resistors, inductors, and capacitors.
- 1.7. Describe the working principle of resistors and identify their applications.
- 1.8. Determine equivalent resistance for series and parallel resistor networks.
- 1.9. Interpret resistor colour codes to determine resistance value and tolerance.
- 1.10. Explain the working principle of inductors and calculate equivalent inductance for series and parallel combinations.
- 1.11. Explain the concept of mutual inductance and its significance.
- 1.12. Explain the working principle and applications of transformers.
- 1.13. Explain the construction, working principle, and applications of relays.
- 1.14. Explain the working principle of capacitors and calculate equivalent capacitance for series and parallel combinations.

UNIT–II: Semiconductor Devices – Diodes

- 2.1. Explain the basic concepts of semiconductor materials.
- 2.2. Differentiate between intrinsic and extrinsic semiconductors.
- 2.3. Explain the formation of a PN junction.
- 2.4. Describe the operation and V–I characteristics of a PN junction diode.

- 2.5. Explain the equivalent electrical circuit of a PN junction diode.
- 2.6. Analyze half-wave and full-wave rectifier circuits.
- 2.7. Explain the operation and characteristics of a Zener diode.
- 2.8. Explain the equivalent electrical circuit of a Zener diode.
- 2.9. Analyze Zener diode voltage regulator circuits.
- 2.10. Explain the operation, characteristics, and applications of LED, photodiode, varactor diode, and Schottky diode.
- 2.11. Explain the equivalent electrical circuits of LED, photodiode, varactor diode, and Schottky diode.
- 2.12. Analyze the performance of basic diode circuits under different operating conditions.

UNIT–III: Bipolar Junction Transistors (BJT)

- 3.1. Explain the construction and basic operation of bipolar junction transistors.
- 3.2. Describe the input and output characteristics of a BJT.
- 3.3. Explain the different modes of operation of a BJT.
- 3.4. Identify the regions of operation of a BJT.
- 3.5. Explain the equivalent electrical circuit of a BJT.
- 3.6. Explain the need for transistor biasing.
- 3.7. Explain the concept of stability factor and its significance.
- 3.8. Describe basic biasing methods of BJT.
- 3.9. fixed bias, collector-to-base bias, and voltage divider bias
- 3.10. Explain the operation of BJT as an amplifier in CE mode.
- 3.11. Determine the voltage gain of a CE amplifier.
- 3.12. Determine the current gain of a CE amplifier.
- 3.13. Analyze the performance of BJT amplifier circuits.

UNIT–IV: Field Effect Transistors and MOSFET

- 4.1. Explain the basic principle of operation of field effect transistors.
- 4.2. Describe the construction and working principle of JFET.
- 4.3. Explain the characteristics of JFET.
- 4.4. Explain the equivalent electrical circuit of JFET.
- 4.5. Describe the construction and working principle of MOSFET.
- 4.6. Explain the characteristics of MOSFET.
- 4.7. Explain the equivalent electrical circuit of MOSFET.
- 4.8. Differentiate between BJT and FET.
- 4.9. Explain the need for biasing in FET and MOSFET circuits.
- 4.10. Describe biasing methods of FET.
- 4.11. Describe biasing methods of MOSFET.
- 4.12. Explain the operation of FET and MOSFET amplifiers.

4.13. Analyze the performance of FET and MOSFET amplifier circuits.

UNIT–V: Multistage Amplifiers and Frequency Response

- 5.1. Explain the concept of single-stage and multistage amplifiers.
- 5.2. State the need for multistage amplifiers.
- 5.3. Explain cascading of amplifier stages.
- 5.4. Calculate overall voltage gain of multistage amplifiers.
- 5.5. Calculate overall current gain and power gain of multistage amplifiers.
- 5.6. Explain different coupling methods used in amplifiers.
- 5.7. Describe the operation of RC-coupled amplifiers.
- 5.8. Describe the operation of transformer-coupled amplifiers.
- 5.9. Describe the operation of direct-coupled amplifiers.
- 5.10. Explain the frequency response of multistage amplifiers.
- 5.11. Define bandwidth and half-power frequencies and explain gain–bandwidth relationship.
- 5.12. Analyze multistage amplifiers with respect to gain, bandwidth, and frequency response.

Unit VI: Feedback Amplifiers and Oscillators

- 6.1 Define feedback in amplifiers.
- 6.2 Distinguish between positive and negative feedback.
- 6.3 Classify negative feedback amplifiers.
- 6.4 Explain the effect of negative feedback on gain.
- 6.5 Explain the effect of negative feedback on bandwidth.
- 6.6 Explain the effect of negative feedback on input impedance.
- 6.7 Explain the effect of negative feedback on output impedance.
- 6.8 State advantages of negative feedback.
- 6.9 State disadvantages of negative feedback.
- 6.10 Define oscillation and oscillator.
- 6.11 State Barkhausen criterion for oscillation.
- 6.12 Explain the working of RC phase shift oscillator.
- 6.13 Explain the working of the Wien bridge oscillator.
- 6.14 Explain the working of the Hartley oscillator.
- 6.15 Explain the working of Colpitts oscillator.
- 6.16 Explain the working of crystal oscillators.
- 6.17 State advantages of crystal oscillators.
- 6.18 Compare RC and LC oscillators.

CO – PO MAPPING MATRIX

	E	P	De sig	C on du	En gi ne	T h	Et h	I nd ivi	C o	Pr oi	Li fe-
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	1	2	-	-	-	-	-	1
CO2	3	3	1	1	2	-	-	-	-	-	1
CO3	3	3	2	2	2	-	-	-	-	-	1
CO4	3	3	2	2	2	-	-	-	-	-	1
CO5	3	3	2	2	2	-	-	-	-	-	1
CO6	3	3	2	2	2	-	-	-	-	-	1

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)	4	1	Nil	4 Marks
02	Part-B	Understanding(U)	4	3	2	6 Marks
03	Part-C	Application(A)	4	5	2	10 Marks
Total Marks						20 Marks

MID SEM-I EXAM

S.No	Unit No	R	U	A	Remarks
1	Unit-I	1,2	5(a)	7(a)	
			5(b)	7(b)	
2	Unit-II	3,4	6(a)	8(a)	
			6(b)	8(b)	
Total Questions		4	4	4	

MID SEM-II EXAM

S.No	Unit No	R	U	A	Remarks
1	Unit-III	1,2	5(a)	7(a)	
			5(b)	7(b)	
2	Unit-IV	3,4	6(a)	8(a)	
			6(b)	8(b)	

Total Questions		4	4	4	
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TELANGANA
DIPLOMA EXAMINATION (C-26)
MID-I EXAMINATION
MEE-105, BASIC ELECTRONICS AND AMPLIFIERS
Model Question Paper

Duration: 1 hour

Max. Marks: 20

PART – A

Answer All Questions

4 × 1 = 4 Marks

1. State Kirchhoff's Current Law (KCL).
2. Define practical voltage source.
3. What is intrinsic semiconductor?
4. Define Zener diode.

PART – B

2 × 3 = 6 Marks

5. a) Explain resistor colour coding with an example.
(or)
b) Explain the working principle of the transformer.
6. a) Explain the operation of the PN junction diode.

(or)

b) Explain half-wave rectifier with circuit diagram.

PART – C

2 × 5 = 10 Marks

7. a) Apply KVL to analyze a simple resistive circuit.

(or)

b) Explain relay working principle and applications.

8. a) Explain full-wave rectifier with neat circuit diagram and waveform.

(or)

b) Explain Zener diode as voltage regulator with circuit diagram.

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DIPLOMA EXAMINATION (C-26)

MID–II EXAMINATION

MEE-105, BASIC ELECTRONICS AND AMPLIFIERS

Model Question Paper

Duration: 1 hour

Max. Marks: 20

PART – A

Answer All Questions

4 × 1 = 4 Marks

1. Define transistor biasing.
2. What is the stability factor?
3. Define JFET.
4. What is MOSFET?

PART – B

2 × 3 = 6 Marks

5. a) Explain the modes of operation of BJT.

(or)

b) Explain voltage divider bias method.

6. a) Differentiate between BJT and FET.

(or)

b) Explain the self-bias method of FET.

PART – C

2 × 5 = 10 Marks

7. a) Explain BJT as CE amplifier with neat circuit diagram.
(or)
b) Determine voltage gain and current gain of CE amplifier.
8. a) Explain construction and characteristics of JFET.
(or)
b) Explain construction and operation of MOSFET.

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DIPLOMA EXAMINATION (C-26)
END EXAMINATION
MEE-105, BASIC ELECTRONICS AND AMPLIFIERS
Model Question Paper**

Duration: 2 hour

Max. Marks: 40

PART – A

Answer All Questions

8 × 1 = 8 Marks

1. State Kirchhoff's Voltage Law (KVL).
2. Define transistor biasing.
3. Define multistage amplifier.
4. What is mutual inductance?
5. Define rectifiers.
6. What is bandwidth?
7. Define feedback in amplifiers.
8. What is an oscillator?

PART – B

Answer Any Four Questions

4 × 3 = 12 Marks

9. a) Explain the working principle of capacitor.
(or)
b) Explain RC coupled amplifiers.

10. a) Explain transistor biasing methods.
(or)
b) Explain the effect of negative feedback on bandwidth.
11. a) Explain transformer coupled amplifier.
(or)
b) Explain direct coupled amplifiers.
12. a) Explain Barkhausen criterion.
(or)
b) Explain Wien bridge oscillator.

PART – C

Answer Any Four Questions 4 × 5 = 20 Marks

13. a) Analyze simple electrical circuits using KCL and KVL.
(or)
b) Explain frequency response of multistage amplifiers.
14. a) Explain CE amplifier and determine voltage gain.
(or)
b) Explain Hartley oscillator with circuit diagram.
15. a) Compare RC, transformer and direct coupling methods.
(or)
b) Explain Colpitts oscillator with circuit diagram.
16. a) Explain the effect of negative feedback on gain, bandwidth, input and output impedance.
(or)
b) Compare RC and LC oscillators with merits and demerits.