

EE-105 Fundamentals of Electrical Engineering

Course Title	Fundamentals of Electrical Engineering	Course Code	EE-105
Semester/Year	I Year	Course Group	Core
Teaching Scheme in Periods (L:T:P)	4:1:0	Credits	3
Methodology	Lecture + Tutorials	Total Contact Periods	150
CIE	60 Marks	SEE	40 Marks

COURSE DESCRIPTION

The Fundamentals of Electrical Engineering (EE-105) course introduces the basic principles of electrical engineering, including electrical materials, DC and AC circuits, electromagnetic induction, inductors, capacitors, and electrical energy utilization. The course builds a strong foundation for understanding electrical systems, domestic installations, and safety practices required for further studies in electrical and electronics engineering.

***Faculty are encouraged to reference EE-108 lab experiments during theory lectures.**

PREREQUISITES

Knowledge of Basic Physics.

COURSE OBJECTIVES

1. To understand the properties and applications of basic electrical engineering materials.
2. To analyse DC and AC electrical circuits using fundamental laws and principles.
3. To explain the concepts of electromagnetic induction, inductors, and capacitors.
4. To evaluate energy storage in magnetic and electric fields.
5. To calculate electrical energy consumption and understand domestic electrical installations.
6. To develop awareness of electrical safety practices and energy conservation.

COURSE OUTCOMES (COs)

Upon successful completion of the course, the student will be able to:

CO Code	Course Outcome Description
CO1	Explain various electrical engineering materials.
CO2	Evaluate the equivalent resistance of a series-parallel resistive network.
CO3	Analyze different terms related to electromagnetic induction.
CO4	Evaluate the energy stored in Inductors.
CO5	Evaluate the energy stored in Capacitors.
CO6	Calculate the total energy consumed for a domestic system and explain the electrical safety at home.

CO-PO MAPPING MATRIX

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Mapping POs
CO1	3	1	--	2	--	--	1	1, 2, 5, 7
CO2	3	3	2	--	1	--	2	1, 2, 3, 5, 7
CO3	3	1	1	--	--	--	2	1, 2, 3, 7
CO4	3	2	2	--	1	--	2	1, 2, 3, 5, 7
CO5	3	2	2	--	1	--	2	1, 2, 3, 5, 7
CO6	3	3	1	--	2	--	2	1, 2, 3, 5, 7

Correlation Scale: 1-Low, 2-Medium, 3-High

COURSE CONTENTS

UNIT - 1: Electrical Engineering Materials

DURATION:20 HOURS

Types of materials - Conductor, Insulator, Semiconductor. Properties of conductors and insulators. Difference between insulators and dielectric materials. Classification of Insulating materials. Properties & Applications of Impregnated Paper, Wood, Asbestos, Mica, Ceramic, Glass, Thermo Plastics, Thermo Setting resins, PVC. Properties and Applications of Insulating Gases and Insulating liquids. Classification of magnetic materials - Soft & Hard magnetic materials. Curie point. Magnetostriction.

UNIT - 2: Electrical Sources and DC Circuits

DURATION:20 HOURS

Electric charge. Concept and units of Electromotive force, Voltage, Electric potential and Potential difference, Current, Power, Energy. Define DC and AC sources. Example of DC source. Applications of DC and AC sources. Ideal and practical sources. Regulated and Unregulated power sources. Comparison of DC and AC sources. Concept of resistance. Unit of resistance. Ohm's law. Factors affecting resistance. Temperature Coefficient of Resistance. Types of resistors. Material used for manufacturing resistors. Series connection of resistors. Parallel connection. Series-parallel connection of resistors. Equivalent resistance. Current supplied by source in series-parallel circuits. Applications of resistors.

UNIT - 3: Electromagnetic Induction and AC Fundamentals

DURATION:20 HOURS

Magnetic field. Lines of force. Permeability. Right hand Thumb rule. Field pattern due to long straight current carrying conductor. Magnetic field pattern due to current in a solenoid. Magnetic circuit. Magnetic flux, Magnetic flux density, Magnetizing force. Faraday's law of Electro Magnetic Induction. Lenz law. Application of Faraday's law of EMI. Fleming's right-hand rule. Dynamically and statically induced E.M.F. Alternating current. Concept of generation of AC voltage. Examples of AC waveforms. Expression for typical sinusoidal AC voltage. Peak

value, angular velocity, time-period, frequency. Instantaneous value, Average value, RMS value, phase, phase difference, power factor. Active power formula.

UNIT - 4: Inductors

DURATION:20 HOURS

Reluctance. Magnetomotive force. Self-inductance. Expression for inductance in series aiding and opposition. Energy stored in an inductor. Solve problems. Mutual inductance. Materials used to manufacture an Inductor. Comparison of Magnetic circuit with Electric circuit. Magnetic leakage flux and leakage Coefficient. Applications of inductors. Lorentz force law. Application of Lorentz force law. Force experienced by a conductor placed in a magnetic field. Fleming's Left Hand Rule. Force between two parallel current-carrying conductors. Solve problems.

UNIT - 5: Electrostatics and Capacitors

DURATION:20 HOURS

Coulomb's laws. Electrostatic flux. Permittivity. Electric potential. Potential difference. Strength of electric field. Electric Flux density. Comparison of Electrostatic and Magnetic lines of force. Dielectric strength. Dielectric constant. Capacitance. Materials used to manufacture a capacitor. Expression for capacitance. Types of capacitors. Equivalence of capacitance in series and parallel connection. Energy stored in a capacitor. Solve simple problems. Applications of capacitors.

UNIT - 6: Electrical Energy Consumption and Safety

DURATION:20 HOURS

Electric wiring. Energy consumption calculation. Ratings of different Domestic Appliances. Electricity tariff. Energy efficiency. Define energy conservation. Star rating of domestic appliances. Conversion of Units. Efficiency. Electricity bill of a Domestic Consumer - problems. Electrical Hazards. Effects of Electric Current on Human Body. Safety Devices in Electrical Installations. Earthing. Safe Practices in Electrical Work. First Aid for Electric Shock. Fire Safety in Electrical Systems.

BLUE PRINT FOR SEE

Unit No	Unit Name	Periods	Questions to be set for SEE		
			R (Remembering)	U (Understanding)	A (Application)
1	Electrical Engineering Materials	20	R: Q4	U: Q1	A: Q9(a), Q13(a)
2	Electrical Sources and DC Circuits	20			
3	Electromagnetic Induction and AC Fundamentals	30		U: Q2	A: Q10(a), Q14(a)
4	Inductors	30			
5	Electrostatics and Capacitors	30		U: Q3	A: Q5, Q6, Q9(b), Q11(a), Q11(b), Q13(b), Q15(a), Q15(b)
6	Electrical Energy Consumption and Safety Measures	20			A: Q7, Q8, Q10(b), Q12(a), Q12(b), Q14(b), Q16(a), Q16(b)
Total		150	8	8	8

REFERENCE BOOKS

1. Electrical Technology Vol. I -- B. L. Theraja, S. Chand & Co.
2. Electrical and Electronic Technology -- Hughes, John Hiley, Pearson Education
3. A Course in Electrical Technology -- J. B. Gupta, Katson Books
4. Elements of Electrical Engineering -- G. B. Bharadhwajan & A. Subba Rao
5. Basic Electrical Engineering -- D. C. Kulshreshtha, Tata McGraw-Hill Education
6. EE-108 Lab Manual – Electrical and Electronics Lab

SUGGESTED E-LEARNING REFERENCES

1. NPTEL -- <https://nptel.ac.in/courses/>
2. Electrical4U -- <http://electrical4u.com/>
3. Students are advised to simulate circuits in LTspice/TinkerCAD **before performing corresponding EE-108 experiments.**

SUGGESTED STUDENT ACTIVITIES

1. Visit the Institute's Library / internet center and list the books/journals/e-books and any other resources available on the topics suggested by the teacher.
2. Visit the lab (EE-108) and demonstrate one wiring circuit or measurement setup related to the current theory topic.
3. Prepare charts of various electrical materials and their applications.
4. Prepare a short report comparing theoretical values (from EE-105) with practical measurements (from EE-108) for any one experiment.

SUGGESTED LEARNING OUTCOMES

Upon completion of the course, the student shall be able to demonstrate the following competencies aligned with each Course Outcome:

CO1: Explain various electrical engineering materials.

1. List different types of Electrical Engineering materials.
2. Define Conducting Materials.
3. Define Semiconducting Materials.
4. Define Insulating materials.
5. Draw the energy band diagram for conductors, semiconductors, and insulators.
6. State the properties of conducting materials.
7. Mention the Properties & Applications of Copper and Aluminium.
8. Mention the properties & applications of ACSR Conductors and AAAC.
9. List examples of a) Low Resistivity Materials b) High Resistivity materials.
10. Distinguish between Conductors, Insulators and Semiconductors.
11. Compare dielectric materials and insulation materials.
12. Classify Insulating materials on the basis of temperature (Y, A, E, B, F, H and Class).
13. Classify insulating materials.
14. State the properties and applications of (a) Impregnated paper (b) Wood (c) Asbestos (d) Mica (e) Ceramics (f) Glass.
15. Explain the properties and applications of PVC.
16. Explain Thermoplastic & Thermosetting resins with examples.
17. State the Properties and applications of the following gases (a) Hydrogen (b) Sulphur-Hexafluoride (SF_6).
18. State examples of liquid insulators along with their applications.
19. Classify the Magnetic Materials: (a) Ferro (b) Para (c) Dia-Magnetic materials with examples.
20. Explain (a) Soft Magnetic materials (b) Hard Magnetic materials.
21. State Curie point.
22. Define Magnetostriction.

CO2: Evaluate the equivalent resistance of a series-parallel resistive network.

1. Define electric charge.
2. Define Electromotive force and state its unit.

3. Define Voltage and state its unit.
4. Define Electric potential and state its unit.
5. Define Potential difference and state its unit.
6. Define Current and state its unit.
7. Define Power and state its unit.
8. Define Electrical Energy and state its unit.
9. Define Direct Current source.
10. State examples of DC source.
11. State applications of DC source.
12. Define Alternating Current source.
13. State applications of AC source.
14. Compare AC source and DC source.
15. Define Ideal DC source and Practical DC source.
16. Compare Regulated and Unregulated power sources.
17. Define Resistance and state its unit.
18. State Ohm's law and list the limitations of Ohm's law.
19. Define the terms i) Specific resistance ii) Conductance iii) Conductivity.
20. Derive the relation $R = (\rho L)/A$ and solve problems.
21. List the factors affecting resistance.
22. Explain the effects of temperature on resistance.
23. Define temperature Coefficient of resistance and give its unit.
24. List the types of resistors.
25. Develop expressions for equivalent Resistance with simple SERIES and PARALLEL connections.
26. Solve problems on equivalent resistance in case of Series-Parallel networks.
27. List applications of resistors.

CO3: Analyze different terms related to electromagnetic induction.

1. Define Magnetic field.
2. Define Magnetic lines of force.
3. Define magnetic flux and state its unit.
4. Define Permeability and state its unit.

5. State Right-hand Thumb rule.
6. Draw the field pattern due to a long straight current-carrying conductor.
7. Draw the field pattern due to current in a solenoid.
8. Define Magnetic circuit.
9. Define Magnetic Pole strength.
10. Define Magnetic flux density and state its unit.
11. Define Magnetizing force and state its unit.
12. Explain Faraday's law of Electro Magnetic Induction.
13. State Lenz law.
14. List applications of Faraday's law of Electro Magnetic Induction.
15. State Fleming's right-hand rule.
16. Explain Dynamically and Statically induced E.M.F.
17. State the concept of generation of AC voltage.
18. Draw different AC waveforms.
19. Write the expression for a typical sinusoidal AC waveform.
20. Define: a. Peak value, b. Angular velocity, c. Time period, d. Frequency.
21. Define: 1. Instantaneous value, 2. Average value, 3. RMS value.
22. Define phase, phase difference.
23. Define Power factor.
24. Write the formula for active power in AC circuits.

CO4: Evaluate the energy stored in Inductors.

1. Define Reluctance and state its unit.
2. Define Magnetomotive force.
3. Explain Self-Inductance and state its unit.
4. Explain Mutual Inductance.
5. Explain total inductance in series connections (Series Aiding and Series Opposition).
6. Develop an expression for the energy stored in a magnetic field and solve problems.
7. Develop an expression for the energy stored per unit volume in a magnetic field.
8. List materials used to manufacture an Inductor.
9. Compare Magnetic circuit with Electric circuit.

10. Define Magnetic leakage flux.
11. Define Magnetic leakage Coefficient.
12. State applications of inductors.
13. State Lorentz force law.
14. State application of the Lorentz force law.
15. Derive expression for force experienced by a conductor placed in a magnetic field.
Solve problems.
16. State Fleming's Left Hand Rule.
17. Derive the force between two parallel current-carrying conductors.

CO5: Evaluate the energy stored in Capacitors.

1. State Coulomb's law and solve problems.
2. Define Electrostatic flux.
3. Draw electric field around (a) Positive charge, and (b) Negative charge.
4. Define terms and state units: (i) Absolute permittivity (ii) Relative permittivity (iii) Flux Density (iv) Field intensity.
5. Compare Electrostatic and Magnetic circuits.
6. Define electric potential and potential difference.
7. Define Dielectric strength and Dielectric constant with unit.
8. Define Capacitance.
9. List materials used to manufacture a capacitor.
10. State different types of capacitors with uses.
11. Derive expression for capacitance of a parallel plate capacitor and state factors affecting capacitance. Simple problems.
12. Derive expression for equivalent capacitance: a) Series connection; b) Parallel connection. Simple problems.
13. Derive expression for Energy stored in a capacitor and solve problems.

CO6: Calculate total energy consumed for a domestic system and explain electrical safety at home.

1. Define Electric wiring.
2. List different types of Wiring systems.
3. Define Energy consumption.

4. Write ratings and power factor of domestic appliances (Tube Light, Fan, Refrigerator, Mixer, Exhaust fans, Geyser, Air Conditioner, TV, etc.).
5. Solve problems on Work, Power and Energy in Electrical, Mechanical and Thermal units.
6. Define Electric Tariff.
7. Calculate total energy consumption of a house/office and electricity bill.
8. Define Energy conservation.
9. State need for Energy conservation.
10. Explain star rating of domestic appliances.
11. Define Electrical Hazard.
12. Explain possible reasons for Electric shocks and hazards.
13. Explain effect of Electric Current on Human Body.
14. List Safety Devices in Electrical Installations for domestic purposes.
15. Define Earthing.
16. Explain how earthing reduces Electrical shocks.
17. List safe practices in Electrical wiring.
18. Mention First Aid steps for Electric Shock.
19. Explain causes, control, and prevention of electric Fire accidents in Electrical Systems.

INTERNAL EVALUATION

Test	Units	Marks
Mid Sem 1	1 and 2	20
Mid Sem 2	3 and 4	20
Slip Test 1	1 and 2	5
Slip Test 2	3 and 4	5
Assignments	—	5
Seminars	—	5
Total		60

QUESTION PAPER PATTERN FOR MID SEMESTER EXAMS

Sl.No	Description	Level	No of Questions	Marks per Question	Choice	Total Marks
1	Part-A	Remembering (R)	4	1	Nil	4 Marks
2	Part-B	Understanding (U)	4	3	2	6 Marks
3	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),5(b)	7(a),7(b)	
2	Unit-II	3,4	6(a),6(b)	8(a),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),5(b)	7(a),7(b)	
2	Unit-IV	3,4	6(a),6(b)	8(a),8(b)	
Total Questions		4	4	4	

The length of answer for each question framed in respect of Part-A, B & C shall not exceed $\frac{1}{4}$ of a page, 1 page and 2 pages respectively.

QUESTION PAPER PATTERN FOR SEMESTER END EXAM

Sl.No	Description	Level	No of Questions	Marks per Question	Choice	Total Marks
1	Part-A	Remembering (R)	8	1	Nil	8 Marks
2	Part-B	Understanding (U)	8	3	4	12 Marks
3	Part-C	Application (A)	8	5	4	20 Marks
Total Marks						40 Marks

MODEL QUESTION PAPERS
MID SEMESTER - I EXAM MODEL PAPER
STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
Diploma in Electrical & Electronics Engineering

I Year

Course Code: EE-105
Time: 60 min.

Course Name: Fundamentals of Electrical Engineering
Max. Marks: 20

PART - A ($4 \times 1 = 4$ Marks)

(Answer all questions)

1. State Ohm's law.
2. Compare series and parallel circuits in any three aspects.
3. Draw the energy band diagram for Insulators.
4. Give any two examples of Conductors.

PART - B ($2 \times 3 = 6$ Marks)

(Answer any TWO questions)

5. (a) Mention the properties & applications of ACSR Conductors and AAAC.
OR
(b) State the properties and applications of (a) Impregnated paper (b) Wood.
6. (a) Define specific resistance and state its SI units.
OR
(b) Derive an expression for division of current between resistances when two resistances are connected in parallel.

PART - C ($2 \times 5 = 10$ Marks)

(Answer any TWO questions)

7. (a) Explain (a) Soft Magnetic materials (b) Hard Magnetic materials.
OR
(b) Distinguish between Conductors, Insulators and Semiconductors.
8. (a) Derive the relation $R = (\rho L)/A$ and explain each term.
OR
(b) Explain the effects of temperature on resistance with examples.

MID SEMESTER - II EXAM MODEL PAPER
STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
Diploma in Electrical & Electronics Engineering
I Year

Course Code: EE-105
Time: 60 min

Course Name: Fundamentals of Electrical Engineering
Max. Marks: 20

PART - A ($4 \times 1 = 4$ Marks)
(Answer all questions)

1. Define magnetic flux and state its unit.
2. Define Power factor.
3. Define Magnetic leakage flux.
4. State Fleming's Left Hand Rule.

PART - B ($2 \times 3 = 6$ Marks)
(Answer any TWO questions)

5. (a) List the applications of Faraday's law of Electro Magnetic Induction.
OR
(b) Write the expression for a typical sinusoidal AC waveform, mentioning each term.
6. (a) State the applications of inductors.
OR
(b) Compare Magnetic circuit with Electric circuit.

PART - C ($2 \times 5 = 10$ Marks)
(Answer any TWO questions)

7. (a) Explain Faraday's law of Electro Magnetic Induction.
OR
(b) Explain Dynamically and Statically induced E.M.F.
8. (a) Explain the total inductance in series connections (Series Aiding and Series Opposition).
OR
(b) Derive the expression for the force experienced by a conductor placed in a magnetic field.

SEMESTER END EXAM MODEL PAPER
STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TELANGANA
Diploma in Electrical & Electronics Engineering
I Year

Course Code: EE-105
Engineering
Time: 2 hours

Course Name: Fundamentals of Electrical
Max. Marks: 40

PART - A ($8 \times 1 = 8$ Marks)
(Answer all questions)

1. Define resistance and mention its units.
2. Define Voltage and state its unit.
3. State Coulomb's law.
4. Define Capacitance.
5. Draw the electric field around a positive charge.
6. Define Energy conservation.
7. Define Electric Tariff.
8. Define Electric wiring.

PART - B ($4 \times 3 = 12$ Marks)
(Answer any FOUR questions)

9. (a) Classify the Magnetic Materials.
OR
(b) State different types of capacitors with its uses.
10. (a) Draw different AC waveforms, mentioning their names.
OR
(b) State the need for Energy conservation.
11. (a) Compare Electrostatic and Magnetic circuits in different aspects.
OR
(b) Three capacitors are having capacitances of $2 \mu\text{F}$, $4 \mu\text{F}$ and $12 \mu\text{F}$. Calculate equivalent capacitance when they are connected in (i) series and (ii) parallel.
12. (a) List safe practices to work with in Electrical wiring.
OR
(b) List the Safety Devices in Electrical Installations for domestic purposes.

PART - C ($4 \times 5 = 20$ Marks)
(Answer any FOUR questions)

13. (a) Explain Thermoplastic & Thermosetting resins with examples.
OR

(b) Derive an expression for equivalent capacitance when two Capacitors are connected in series.

14. (a) Develop an expression for the energy stored per unit volume in a magnetic field.

OR

(b) Two bulbs rated 60 W at 220 V and 100 W at 220 V are connected in series across a 220 V DC supply. Calculate the power absorbed by each lamp. If the above two bulbs are connected in parallel across the 220V DC Supply, what is the Power absorbed by each lamp?

15. (a) Derive an expression for the Energy stored in a capacitor.

OR

(b) Derive the expression for capacitance of a parallel plate capacitor and state factors affecting the capacitance of a capacitor.

16. (a) Explain the causes, control, and prevention of electric Fire accidents in Electrical Systems.

OR

(b) Explain how earthing reduces the Electrical shocks.

LAB ALIGNMENT TABLE

EE-105 Unit	EE-108 Experiment
Unit 2: DC Circuits	Measurement of resistance, Ohm's Law verification
Unit 3: AC Fundamentals	CRO measurements of AC waveforms
Unit 4: Inductors	Testing inductor characteristics
Unit 5: Capacitors	Testing capacitor characteristics, energy storage
Unit 6: Safety & Wiring	Wiring circuits, earthing, safety practices

Note for Faculty:

To strengthen the connection between theory (EE-105) and lab (EE-108), faculty are encouraged to:

- Refer to relevant EE-108 experiments during theory lectures.
- Design tutorial problems that reflect practical measurements from EE-108.
- Discuss lab safety and procedures during Unit 6 (Safety) sessions.