

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title: ELEMENTS OF ELECTRICAL ENGG	Course Code : 15EE11T
Semester : I	Course Group : Core
Teaching Scheme (L:T:P) : 4:0:0(in Hours)	Credits : 4 Credits
Type of course : Lecture + Assignments	Total Contact Hours : 52
CIE : 25 Marks	SEE : 100 Marks

Pre-requisites : Mathematics and Science Secondary Education.

Course Objectives :To introduce the concept of Electrical energy, with the knowledge of electrical current, voltage, power, energy and electrical circuits, DC circuits, electrostatics, Faraday’s laws of electrolysis and electrical engineering materials.

Course Topics:

Unit No	Unit Name	Hours
1	Introduction and Electrical current and voltage	5
2	DC circuits and Resistance and temperature effects	12
3	Work, Power and Energy	7
4	Electrostatics	10
5	Faraday’s laws of Electrolysis	9
6	Electrical Engineering Materials	9
	Total	52

Course Outcomes:

On successful completion of the course, the students will be able to attain CO:

1. Understand the sources of energy, applications, different electrical parameters and symbols.
2. Understand Ohm's law, Resistance combinations, temperature effects. Solve problems.
3. Distinguish Electrical Work, Power and Energy and understand Joule's law. Solve problems.
4. Understand Electrostatics laws and capacitor combinations. Solve problems.
5. Differentiate cells and batteries. Understand charging and discharging of Lead Acid battery. Analyse grouping of cells.
6. Understand electrical engineering materials, properties and their applications.

Composition of Educational Components

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's Taxonomy) such as:

Sl. No.	Educational Component	Weightage (%)	Total Marks (Out of 145)
1	Remembering	20	30
2	Understanding	40	60
3	Application	40	55
Total		100	145

Course Outcome linkage to Cognitive Level

Cognitive Level Legend: R- Remember, U- Understand, A- Application

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the sources of energy, applications, different electrical parameters and symbols.	<i>R/U</i>	2,6,10	5
CO2	Understand Ohm's law, Resistance combinations, temperature effects. Solve problems.	<i>U/A</i>	2,10	12
CO3	Distinguish Electrical Work, Power and Energy and understand Joule's law. Solve problems.	<i>R/U/A</i>	1,2,5,10	7
CO4	Understand Electrostatics laws and capacitor combinations. Solve problems.	<i>R/U/A</i>	1,2,10	10
CO5	Differentiate cells and batteries. Understand charging and discharging of Lead Acid battery. Analyse grouping of cells.	<i>U/A</i>	1,2,10	9
CO6	Understand electrical engineering materials, properties and their applications.	<i>R/U</i>	1,2,10	9
		Total sessions		52

Course Content and Blue Print of Marks for SEE:

Unit No	Unit Name	Hour	Max. Marks per Unit	Questions to be set for (5marks) PART - A			Questions to be set for (10marks) PART - B			Marks weightage (%)
				R	U	A	R	U	A	
1	Introduction and Electrical current and voltage	5	15	1				1		10
2	DC circuits and Resistance and temperature effects	12	35	1	1	1			2	24
3	Work, Power and Energy	7	20	1	1				1	15
4	Electrostatics	10	25		1			1	1	17
5	Faraday's laws of Electrolysis	9	25	1				1	1	17
6	Electrical Engineering Materials	9	25		1		1	1		17
	Total	52	145	9 (45 Marks)			10 (100 Marks)			100

Course-PO Attainment Matrix

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
ELEMENTS OF ELECTRICAL ENGG.	3	3	-	-	1	1	-	-	-	3

LEVEL 3- HIGHLY ADDRESSED, LEVEL 2-MODERATELY ADDRESSED, LEVEL 1-LOW ADDRESSED.

METHOD IS TO RELATE THE LEVEL OF PO WITH THE NUMBER OF HOURS DEVOTED TO THE COS WHICH ADDRESS THE GIVEN PO.
 IF $\geq 40\%$ OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 3
 IF 25 TO 40% OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 2
 IF 5 TO 25% OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 1
 If $< 5\%$ of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course Contents:

Unit I

Introduction to sources of electrical energy, advantages of electrical energy and the effects of electric current and its applications.

Electrical Current, Voltage and Circuits: Electrical current, e.m.f., voltage, potential difference, open circuit, closed circuit and short circuit. Symbolic representation of sources, loads and basic protective devices.

Unit II

DC circuits: Ohm's law, Ohm's law applications and its limitations. Simple problems on ohm's law.

Resistance and Temperature effects: Electrical Resistance and its unit. Series, Parallel and Series-Parallel circuits. Simple problems.

Laws of Resistance, Specific Resistance and its unit. Effect of temperature on resistance and temperature co-efficient. Simple problems.

Unit III

Work, Power and Energy: Work, Power, Energy, Problems on Power and energy, conversion from Mechanical units into Electrical units and vice-versa. Joule's law of heat. Simple problems.

Unit IV

Electrostatics: Electric charge, Electric flux, Flux density, Electric field, Electric field intensity, Laws of electrostatics, dielectric constant and permittivity, Capacitance. Types of Capacitors, Capacitors in series and parallel, Energy stored in a capacitor. Simple problems on Electrostatic laws, capacitor combinations and energy stored.

Unit V

Faraday's laws of Electrolysis: Laws, Difference between Cell and a Battery. Difference between Primary and Secondary Cells. Lead - Acid Battery- Construction, Chemical action during charging and discharging. Grouping of cells. Problems on grouping of cells.

Unit VI

Electrical Engineering Materials: Different Conductor materials, properties and applications. Different Resistor materials, properties and applications. Different Insulating materials, properties and applications. Different magnetic materials, properties and applications.

Reference Books:

1. Basic Electrical and Electronics Engineering By V.Jegathesan, K.Vinoth Kumar &R.Saravakumar Wiley India Pvt.Ltd.
2. Basic Electrical and Electronics Engineering By B.L.Theraja S. Chand Publications.
3. Basic Electrical Engineering By V.K. Mehta &Rohit Mehta S. Chand Publications

e-Resources:

1. <http://www.facstaff.bucknell.edu>
2. <http://electrical4u.com/>
3. <http://www.electronics-tutorials>

Course Delivery:

The Course will be delivered through Lectures, Classroom Interaction, Animations, Group Discussion, Exercises and Assignments.

Course Assessment and Evaluation Scheme:

	What		To Whom	Frequency	Max Marks	Evidence Collected	Course Outcomes
Direct Assessment	CIE (Continuous Internal Evaluation)	I A Tests	Students	Three tests (average of three tests will be computed)	20	Blue Books	1 to 6
				Student activity	05	Log of activity	1 to 6
				TOTAL	25		
	SEE (Semester End Examination)	End Exam	Students	End Of the Course	100	Answer Scripts at BTE	1 to 6
Indirect Assessment	Student Feedback on course		Students	Middle Of The Course	Questionnaire		Effectiveness of Delivery of instructions and Assessment Methods
	End Of Course Survey			End Of The Course			

*CIE – Continuous Internal Evaluation

*SEE – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Suggested Student Activities:

Each Student has to prepare and submit at least 3 pages of self hand written report, considering any one of the following topics (**Mini project or Charts or Applications**)

1. **DC circuits, Electrical Current, Voltage, Power and Energy and Meters to measure, etc.**
2. **Resistance -materials used and Temperature effects**
3. **Cells and Batteries**
4. **Electrostatics**
5. **Electrical Engineering Materials**

MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY (Course Coordinator)

Dimension	Scale					Students score (Group of five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	3				
2	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2				
3	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	5				
4	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	4				
Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks One activity on any one CO (course outcome) may be given to a group of FIVE students Grand Average/Total						14/4				
						=3.5				
						≈4				

**Example only: MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY-
Task given- Industrial visit and report writing**

Dimension	Scale					Students score (Five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1. Organisation	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed	3				
2. Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles	2				
3. Conclusion	Poor	Less Effective	Partially effective	Summarises but not exact.	Most Effective	5				
4. Conventions	Frequent Error	More Error	Some Error	Occasional Error	No Error	4				
Total marks						14/4=3.5 ≈4				

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
Ex: I test/6 th week of sem 10-11 Am	I/II SEM		20			
	Year:					
Name of Course coordinator : CO's: _____			Units: __			
Question no	Question		MARKS	CL	CO	PO
1						
2						
3						
4						

Note: Internal choice may be given in each CO at the same cognitive level (CL).

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks		
1 st Test/ 6 th week, 9 Aug 15, 10-11 AM	I SEM, E & E Engg	Elements Of Electrical Engg	20		
	Year: 2015-16	Course code:			
Name of Course coordinator :					
Units Covered :1 and 2					
Course Outcomes : 1 and 2					
Instruction : (1). Answer all questions (2). Each question carries five marks					
Question No.	Question	CL	CO	PO	
1	State the advantages of electrical energy.	R	1	2,6,10	
2	Show symbolical representations of electrical sources.	U	1	2,6,10	
	OR Draw an electric circuit showing (i) Switch (ii) Protective Device (iii) Voltage Source and (iv)Load.	U			
3	State Ohms' Law and explain.	U	2	2,10	
4	Differentiate between positive temperature co-efficient and negative temperature co-efficient?	U	2	2,10	
	OR Find the resistance of a bulb which takes 2A when connected to 230V supply.	A			

CL: Cognitive Level, R-Remember, U-Understand, A-Application, PO: Program Outcome

Model Question Paper:

Code: 15 EE 11T

I Semester Diploma Examination. ELEMENTS OF ELECTRICAL ENGINEERING

Time: 3 Hours]

[Max. Marks: 100

- Note:** (i) Answer any **SIX** questions from Part – A. (Each question carries 5 marks)
(ii) Answer any **SEVEN** questions from Part – B. (Each question carries 10 marks)

PART - A

1. State the sources of Electrical energy. 5
2. State and explain Ohms' Law. 5
3. What is positive temperature co-efficient and negative temperature co-efficient? 5
4. Explain Joule's law of heat. 5
5. Explain the Laws of electrostatic. 5
6. Define Electric field intensity and Flux density. 5
7. Differentiate between Primary and Secondary Cells. 5
8. Explain the need of grouping of cells. 5
9. What are the applications of copper conductor? 5

PART - B

10. (a) Derive the total resistance when three resistances are connected in series. 5
(b) Show the symbolical representations of Electrical Sources. 5
11. (a) Find the total current when three 100 ohm, 150 ohm and 200 ohm are Connected in parallel. 5
(b) Find total charge when three capacitors 10microFarad, 20microFarad and 30microFarad are connected in parallel. 5
12. (a) Explain Laws of Resistance. 4
(b) A wire 50cm long and having a diameter of 0.05 cm is in a room at 20°C. The specific resistance of the material of wire is 2 micro-ohm per cm cube while its temperature coefficient is 0.004 at 20°C. Calculate the resistance of wire at 20°C. If the temperature of the room rises to 25°C, find the new resistance of wire.

6

13. (a) What is the effect of temperature on resistance?
5(b) A house is fitted with 5 lamps of 100 watts each, one electric press of

220V drawing 2A of current, 4 fans of 110 watts each and a heater of 1120 watts. If all the appliances work for 2 hours a day, find the electricity bill for the month of September. Electrical energy is supplied at Rs.2 per KWh.

5

14. (a) List the properties of Insulating materials. 5
(b) Explain the chemical action during discharging in a lead-acid battery. 5
15. (a) List the applications of Resistor materials. 5
(b) Twelve cells, each of emf 2 V and internal resistance 0.5Ω , are connected in series across an external resistance of 4.5Ω . Determine (i) the current supplied by the battery (ii) terminal voltage of the battery. 5
16. a) List the properties of Resistor materials. 5
b) Four cells, of emf 1.5 V and internal resistance 0.5Ω , are connected in parallel across an external resistance of 2.5Ω . Determine (i) the current supplied by the battery (ii) current supplied by each cell and (iii) the terminal voltage of the battery. 5
17. a) Explain with a neat sketch the construction of a Lead - Acid Battery. 6
b) State the applications of magnetic materials. 4
18. a) Derive the total capacitance when three capacitors are connected in series. 6
b) Explain Energy stored in a capacitor. 4
19. a) Find the resistance of a bulb which takes 2A when connected to 230V supply. 5
b) Find energy stored in a capacitor when three capacitors $100\mu\text{F}$, $120\mu\text{F}$ and $130\mu\text{F}$ are connected across 230 V supply. 5

---XXX---

**I Semester Diploma Examination.
ELEMENTS OF ELECTRICAL ENGINEERING****Cognitive Level: REMEMBER**

1. State the sources of electrical energy.
2. Define current and voltage and mention their units.
3. Draw open circuit, closed circuit and short circuit.
4. State Joule's law of heat.
5. Define (i) Capacitance (ii) Dielectric strength of a medium.
6. Explain laws of electrostatics.
7. Define electric charge, electric field, electric flux, electric field intensity and flux density.
8. State the different sources of electrical energy.
9. State any five effects of electrical current with an example.
10. Define the following and mention their units (i) electric current (ii) voltage.
11. What are the factors on which the resistance of a material depend?
12. Define (i) resistance (ii) Specific resistance and mention their SI units.
13. Define temperature co-efficient of resistance and mention its unit.
14. Define (i) Electrical Power (ii) Electrical Energy and mention their units.
15. State and explain Joules law of heating.
16. Mention the SI units of (i) Work (ii) Electrical Power (iii) Electrical energy (iv) Mechanical Power (v) Mechanical energy and (vi) Heat energy.
17. State the different types of conductor materials.
18. State the different types of conductor materials.
19. State the different types of resistor materials.

Cognitive Level: UNDERSTAND

20. State the advantages of electrical energy.
21. State any five effects of electrical current.
22. State any five applications of electrical energy.
23. Show symbolical representations of electrical sources.
24. Draw an electric circuit showing (i) Switch (ii) Protective Device (iii) Voltage Source and (iv) Load.
25. State Ohms' Law and explain.
26. What are the limitations of Ohm's Law?
27. State Laws of Resistance.
28. State the effect of temperature on resistance.
29. Draw the symbols of loads and basic protective devices.
30. Convert mechanical units into electrical units.

31. State the characteristics of good conducting materials.
32. What are resistor materials? Mention their uses. Give examples.
33. State the properties of a good insulation material.
34. Mention the properties and composition of silicon steel.
35. Mention the advantages of electrical energy over other sources of energy.
36. State the applications of electrical energy.
37. Differentiate between e.m.f and potential difference.
38. What is an electric circuit? What are the requirements of good electric circuit?
39. Give SI symbol of (i) a.c. supply (ii) switch (iii) fuse (iv) load (v) battery.
40. With reference to an electric circuit differentiate between (i) open circuit (ii) closed circuit (iii) short circuit.
41. Draw an electric circuit showing the following and mark the direction of current (i) d.c. supply (ii) switch (iii) fuse and (iv) load.
42. Explain the construction of lead-acid battery.
43. Explain the chemical reaction with equation in a lead acid battery during discharging.
44. Explain the need of grouping cells in Series and Parallel combination.
45. Twelve cells, each of emf 2 V and internal resistance 0.5Ω , are connected in series across an external resistance of 4.5Ω . Determine (i) the current supplied by the battery (ii) terminal voltage of the battery.
46. Explain the chemical reaction with equation in a lead acid battery during charging.
47. A battery consists of 4 cells, each of emf 1.46V. The cells are connected in parallel to an external resistance of 0.525Ω . If the current supplied by the battery is 0.8A, find the internal resistance of each cell.
48. State the different types of insulating materials.
49. State on the different types of Magnetic materials.
50. State the properties of conductor material.
51. State the applications of conductor material.
52. State the properties of Resistor materials.
53. State the applications of Resistor materials.
54. State the properties of Insulating materials.
55. State the applications of Insulating materials.
56. State the properties of magnetic materials.
57. State the applications of magnetic materials.

Cognitive Level: APPLICATION

58. Differentiate between positive temperature co-efficient and negative temperature co-efficient?
59. Find the resistance of a bulb which takes 2A when connected to 230V supply.
60. What are the applications of Ohm's law?
61. Explain the terms (i) absolute permittivity (ii) relative permittivity.
62. Derive an equation for energy stored in a capacitor.
63. Distinguish between primary cell and secondary cell with examples.

64. Differentiate between a cell and a battery.
65. Explain (i) positive temperature co-efficient and (ii) negative temperature co-efficient of resistance and give one example each.
66. A tungsten lamp has a resistance of 150Ω at 2850°C . What is its resistance at 20°C ? Given temperature co-efficient of resistance of tungsten is 0.0049°C at 0°C .
67. State and explain Ohm's law.
68. State the limitations of Ohm's law.
69. Derive the equation for total resistance when three resistances are connected in series.
70. Three resistors 4Ω , 12Ω and 6Ω are connected in parallel. If the total current taken is 12A , find the current through each resistor.
71. Derive the equation for total resistance when three resistances are connected in parallel.
72. Three resistances of 30Ω , 40Ω and 50Ω are connected in series across a voltage supply of 100V , find (i) total current (ii) voltage drop across each resistor.
73. Derive the total resistance when three resistances are connected in series.
74. Three resistances of 10 , 20 and 30 are connected in parallel across a voltage supply of 50V , find (i) total current (ii) current through each resistor.
75. Compare the properties of Copper and Aluminium conductors.
76. State the properties of nichrome material and mention the applications.
77. Explain the terms (i) Ferro-magnetic material (ii) Para-magnetic material and (iii) Dia-magnetic material.
78. Differentiate between soft and hard magnetic materials.
79. A copper wire has a resistance of 25Ω , at 0°C what would be its resistance at 100°C . Assume the temperature co-efficient at 0.004°C at 0°C .
80. State the factors on which the resistance of a material depends.
81. Calculate the resistance of a copper conductor having length of 2 kms and a cross section of 22mm^2 . Assume resistivity as $18 \times 10^{-9} \Omega\text{m}$.
82. A house is fitted with four lamps each of 40W capacity and a T.V. of 60W and used on average for 4 hours per day. Find the KWh consumed in a month of 30 days and also electricity bill at the rate of Rs.2 per unit.
83. An electric kettle rated 500W 230V , was found to take 15 minutes to bring 1kg of water at 25°C to boiling point of 100°C . Determine the heat efficiency of the kettle.
84. A motor of 1 H.P. works 4 hours per day. Find the monthly energy consumption for a month having 30 days. Also find the monthly electricity bill if the cost per unit is Rs.2.00
85. Derive the total capacitance when three capacitances are connected in series.
86. Three capacitors have capacitances of $2\mu\text{F}$, $3\mu\text{F}$ and $4\mu\text{F}$ respectively. Calculate the total capacitance when they are connected (i) in series (ii) in parallel.
87. Derive the total capacitance when three capacitances are connected in parallel.
88. Three capacitors of capacitance $2\mu\text{F}$, $4\mu\text{F}$ and $6\mu\text{F}$ respectively are connected in series to a 220V d.c. supply. Find (i) the total capacitance (ii) charge on each capacitor and (iii) potential difference across each capacitor.
89. Derive an equation for effective capacitance of 3 capacitance connected in parallel.

90. Three capacitances of $8\mu\text{F}$, $10\mu\text{F}$ and $12\mu\text{F}$ are connected in series. Calculate the equivalent capacitance.
91. Derive an equation for effective capacitance of 3 capacitance connected in series.
92. Three capacitances of $8\mu\text{F}$, $10\mu\text{F}$ and $12\mu\text{F}$ are connected in parallel. Calculate the equivalent capacitance.
93. Derive an equation for energy stored in a capacitor.
94. A capacitance has a charge of 1000 micro-Coulomb and is connected across a 100 V a.c. 50 Hz supply. Calculate the capacitance and energy stored in the capacitor.