

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

Course Title: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	Course Code : 15EE01E
Semester : I / II	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
Programme: Mechanical (GL), Mechanical (Instr.), MTT, HPT, WSM, Mechatronics, Printing Technology, Textile Technology, Ceramics, Mining Engg., Metallurgical Engg.	

Pre-requisites	: Mathematics and Science in Secondary Education.
Course Objectives	: To introduce the concept of electrical current, voltage, power, energy, electrical circuits, magnetic fields, electromagnetic induction and alternating current. Introduction of Transformers, DC Generators, AC Generators and Motors, protective devices and Earthing. Introduction to Battery, UPS, electronic components and their applications.

Course Unit-wise Weightage of Marks:

Unit Nos.	Topics	Teaching Hours	SEE Max. Marks
1	Electricity and DC Circuits	9	30
2	Electromagnetism and DC Generators	7	20
3	AC Fundamentals, Transformers and AC Generators	9	25
4	Electric Motor Drives	9	25
5	Protective Devices, UPS and Estimation	9	25
6	Electronic Components and Applications	9	20
Total		52	145

Course Content:

Unit 1

Electricity and DC Circuits: Introduction to sources of electrical energy, advantages, effects of electric current and its applications. Electrical current, voltage, emf, potential difference, electric work, power, energy & their units and measuring instruments. Conductors, insulators and semiconductors. Resistance, Ohm's law and limitations. Resistances connected in series, parallel, series and parallel combinations. Horse Power and BHP. Simple problems on Ohm's law, resistance combinations and energy calculations.

Unit 2

Electromagnetism: Magnetic field, Magnetic flux, Magneto motive force, flux density, Reluctance and their units. permeability. Faraday's laws, statically and dynamically induced EMF, self and mutual induced emf. Inductance, mutual inductance and their units.
DC Generator: Construction and working.

Unit 3

Fundamentals of AC Circuits: Sinusoidal voltage, current, amplitude, time-period, cycle, frequency, phase, phase difference, RMS value, Average value, form factor, and their units. Capacitance, capacitive reactance, inductive reactance, impedance and their units. Power, power factor and units. Difference between single phase and three phase power. Advantages of three phase power over single phase power.
Transformers: construction working, application, ratings.
AC Generators: construction working, applications, ratings.

Unit 4

Electric Motor Drives: DC motors, types, applications and selection criteria. AC motors, single and three phase motors, selection criteria, FHP motors applications and selection criteria, applications of single phase and three-phase motors. Name plate details of single phase and 3 phase motors. Necessity of starters for AC motors, types and applications. Advantages of 3 phase motors over single phase motors. List out the motors used for following purposes; Mining, Printing, Textiles, Cement, Mechanical, Aeronautical and Chemical industries by giving selection criteria. Importance of Motor enclosures, types, and their applications.

Unit 5

Protective Devices, UPS & Estimation: Necessity of protective devices, ratings, rewirable, cartridge, and HRC fuses. Types of switches, MCB and ELCB. Necessity of electrical earthing and types. General safety precautions to prevent electrical accident, first aid in electric shock. Cell, battery, types of batteries, conditions of fully charged and discharged battery of lead acid battery, sealed maintenance free (SMF) battery. Selection of batteries. UPS, types, applications and selection criteria of UPS.
i) Plan and estimate the cost of electrical wiring for one 3mX3m room having consisting of 2 tubelights, 1 ceiling fan, 2 three pin socket.
ii) Plan and estimate the cost of electrical wiring for one lathe for three phase wiring with MCBs, starters, Iron clad switches, and HRC fuses.

Unit 6

Electronic Components and Applications: Intrinsic and extrinsic semiconductors, P and N type materials. Diode, types and their applications. Forward and Reverse bias characteristics of a Diode. Half wave, full wave and bridge rectifiers without filter. Zener diode as a voltage regulator. Transistor, working, applications, and transistor as a switch. SCR working and industrial applications. Timers, applications. Relays, applications. Logic gates – OR, AND, NOT, EX-OR, NAND, and NOR, meaning and advantages of IC.

Reference Books

1. ABC of Electrical Engineering by B. L. Theraja and A. K. Theraja, S Chand Publishers, New Delhi, 2014 Edition.
2. Basic Electrical and Electronics Engineering by S. K. Bhattacharya, Pearson Education India, 2012 Edition.
3. Electronic Devices and Circuits by I. J. Nagrath, PHI Learning Pvt. Ltd., 2007 Edition.
4. Basic Electrical Engineering by V. Mittle and Arvind Mittle, McGraw Hill Companies, 2005 Edition.
5. Basic Electrical Engineering. By Sapna Publications.

e-Resources

6. http://jenko.eu/marjan/fpp_izredni/knjiga_df/df_1_digital_concepts.pdf
7. <http://www.facstaff.bucknell.edu/mastascu/elessonshtml/eeindex.html> - Welcome to Exploring Electrical Engineering.
8. Fundamentals Handbook of Electrical Science, Module 1, Basic Electrical Theory, Department of Energy, U. S. Department of Energy, June 1992.
9. <http://www.freeengineeringbooks.com/Electrical/Basic-Electrical-Engineering.php>
10. <http://www.electrical-engineering-portal.com>

Course Delivery:

The Course will be delivered through lectures, classroom interaction, animations, group discussion, exercises and assignments.

Course Contents with Lecture Schedule:

Lesson No./ Session No.	Contents	Duration
	Electricity and DC Circuits:	9 Hours
1.	Introduction to sources of electrical energy, advantages,	01 Hour
2.	Effects of electric current and its applications.	01 Hour

Lesson No./ Session No.	Contents	Duration
3.	Electrical current, voltage, emf, potential difference	01 Hour
4.	Electric work, power, energy & their units and measuring instruments.	01 Hour
5.	Conductors, insulators and semiconductors. Resistance.	01 Hour
6.	Ohm's law and limitations.	01 Hour
7.	Resistances connected in series, parallel, series and parallel combinations. Horse Power and BHP.	01 Hour
8.	Simple problems on Ohm's law, resistance combinations and energy calculations.	01 Hour
9.	Simple problems on Ohm's law, resistance combinations and energy calculations.	01 Hour
	Electromagnetism and DC Generator	7 Hours
10.	Magnetic field, Magnetic flux, Magneto motive force	01 Hour
11.	Flux density, Reluctance and their units. Permeability.	01 Hour
12.	Faraday's laws,	01 Hour
13.	Statically and dynamically induced EMF,	01 Hour
14.	Self and mutual induced emf.	01 hour
15.	Inductance, mutual inductance and their units.	01 Hour
16.	DC Generator- construction and working	01 Hour
	Fundamentals of AC Circuits, Transformers, and AC Generators	9 Hours
17.	Sinusoidal voltage, current, amplitude, time - period, cycle, frequency,	01 Hour
18.	Phase, phase difference, RMS value, Average value, form factor, and their units.	01 Hour
19.	Capacitance, capacitive reactance, inductive reactance, impedance and their units.	01 Hour
20.	Power, power factor and units. Difference between single phase and three phase power.	01 Hour

Lesson No./ Session No.	Contents	Duration
21.	Advantages of three phase power over single phase power	01 Hour
22.	Transformers- construction and working,	01 Hour
23.	Transformers- ratings and applications.	01 Hour
24.	AC Generators- construction working,	01 Hour
25.	AC Generators-ratings and applications.	01 Hour
	Electric Motor Drives	9 Hours
26.	DC Motors, types, applications	01 Hour
27.	Selection criteria of DC motors.	01 Hour
28.	AC motors, single and three phase	01 Hour
29.	Selection criteria for AC motor selection	01 Hour
30.	FHP motors applications and selection criteria,	01 Hour
31.	Applications of single phase and three-phase motors.	01 Hour
32.	Name plate details of single phase and 3 phase motors. Necessity of starters for AC motors, types and applications.	01 Hour
33.	Advantages of 3 phase motors over single phase motors.	01 Hour
34.	List out the motors used for following purposes; Mining, Printing, Textiles, Cement, Mechanical, Aeronautical and Chemical industries by giving selection criteria. Motor enclosures, importance and their applications.	01 Hour
	Protective Devices, Batteries ,UPS and Estimation	9 Hours
35.	Necessity of protective devices, ratings,	01 Hour
36.	Rewire-able fuse, fuse cartridge, and HRC fuse. Types of switches, MCB and ELCB.	01 Hour
37.	Necessity of electrical earthing and types.	01 Hour
38.	General safety precautions and electric shock treatment.	01 Hour
39.	Cell, battery, types of batteries, conditions of fully charged and discharged battery of lead acid battery	01 Hour

Lesson No./ Session No.	Contents	Duration
40.	Sealed maintenance free (SMF) battery. Selection of batteries.	01 Hour
41.	UPS, types, applications and selection criteria of UPS.	01 Hour
42.	Plan and estimate the cost of electrical wiring for one 3mx3m room consisting of 2 tube-lights, 1 ceiling fan, 2 three pin socket.	01 Hour
43.	Plan and estimate the cost of electrical wiring for One lathe for three phase wiring with MCBs, starters, Iron clad switches, and HRC fuses.	01 Hour
	Electronic Components and Applications	9 Hours
44.	Intrinsic and extrinsic semiconductors, P and N type materials.	01 Hour
45.	Diode, types and their applications. Forward and Reverse bias characteristics of a Diode.	01 Hour
46.	Half wave and full wave bridge rectifiers without filter.	01 Hour
47.	Zener diode as a voltage regulator. Transistor-working,	01 Hour
48.	Transistor types, applications, and transistor as a switch.	01 Hour
49.	SCR working and industrial applications.	01 Hour
50.	Timers, applications.	01 Hour
51.	Relays, applications.	01 Hour
52.	Logic gates –OR, AND, NOT, EX-OR, NAND, and NOR, advantages and applications of IC.	01 Hour

Course Outcomes

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

1. Understand Ohm's law and Faraday's laws of electromagnetic induction; solve problems on resistance combinations and energy.
2. Understand AC fundamentals.
3. Differentiate the applications of DC & AC motors and Generators, necessity of starters.
4. Explain protective devices like Fuses, MCB, and ELCB and earthing and safety measures, Batteries and UPS.
5. Understand electronic components and their applications, working of rectifiers and logic gates.

Mapping Course Outcomes with Program Outcomes:

Course Outcomes	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	S	M									M	
2	S										M	
3	M	S									M	
4	M	S									M	
5	S				M						M	

S – Strong Relationship

M- Moderate Relationship

Course Assessment and Evaluation

	What		To Whom	Frequency	Max Marks	Evidence Collected	Course Outcomes
Direct Assessment	CIE (Continuous Internal Evaluation)	I A Tests	Students	Three IA tests for Theory: (Average marks of Three Tests to be computed).	20	Blue Books	1 to 5
		Classroom Assignments		Classroom Assignments	05	Log of Activity	3 and 4
	TOTAL	25					
	SEE (Semester End Examination)	End Exam	Students	End Of the Course	100	Answer Scripts at BTE	ALL CO's
Indirect Assessment	Student Feedback on course		Students	Middle Of The Course	Feed Back Forms		All COs
	End Of Course Survey			End Of The Course	Questionnaires		All COs

Note: I.A. test shall be conducted for 20 marks. Any decimals shall be rounded off to the next higher digit.

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

Sl. No	Bloom's Category	% in Weightage
1	Remember	40
2	Understand	40
3	Apply	20

Model Question Paper:

Code: 15EE01E

I /II Semester Diploma Examination

BASIC OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Common for Mechanical (GL), Mechanical (Instr.), MTT, HPT, WSM, Mechatronics, Printing Technology, Textile Technology, Ceramics, Mining Engg., Metallurgical Engg..)

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.
2. Define and mention the SI units of i) Electric Current ii) Voltage
3. State Faraday's First and Second Laws of Electromagnetic Induction.
4. Define i) RMS value ii) Average value and write equations.
5. State the working principle of a Transformer.
6. State Five applications of DC motors.
7. Write the name plate details of a three phase Induction Motor.
8. Distinguish between MCB and ELCB.
9. State the advantages of Integrated Circuits over discrete components.

PART – B

10. a. State Ohm's Law and mentions the limitations. 4
b. Three resistances of $6\ \Omega$, $4\ \Omega$ and $10\ \Omega$ are connected in series, across supply of 100 V, Find
i) Effective resistance of the circuit.
ii) Total current in the circuit.
iii) Current through each resistance 6
11. a. Define i) Electric Power ii) Electric Energy and
mention the meters used to measure them. 4
b. A house consists of two bulbs of 100W each, three bulbs of 60W each and one fluorescent lamp of 40W. If they are used for 4 hours a day, find monthly consumption charges at Rs. 2.70 per unit. 6
12. a. Define with SI Units. i) Magnetic Flux ii) Magneto motive Force. 4
b. Distinguish between Statically Induced and Dynamically Induced emf. 6
13. a. Explain the construction of DC Generator. 4
b. Draw a sinusoidal waveform and mark the following
i) Maximum value
ii) Instantaneous value
iii) cycle 6
14. a. State Five advantages of 3-phase power supply over 1-phase power supply. 5
b. Explain the construction of an AC Generator. 5
15. a. State Five applications of FHP motors. 5
b. State the necessity of starters for 3-phase induction motors and list the types. 5
16. a. State the advantages of three phase motors over single phase motors. 5
b. Explain the need for different motor enclosures and state the applications. 5
17. a. State any five general electrical safety precautions. 5
b. Mention the conditions for fully charged and discharged lead acid battery. 5
18. a. Explain the selection criteria of an un-interrupted power supply (UPS). 4
b. Distinguish between Intrinsic and extrinsic semiconductors. 6
19. a. Explain the working of a full wave diode bridge rectifier with a neat sketch. 5
b. Draw the logic symbol and write the truth table for
NAND gate and ii) NOR gate. 5

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Model Question Paper Bank

Course Title: **BASIC ELECTRICAL AND
ELECTRONICS ENGINEERING**

Course Code : **15EE01E**

All the questions carry 5 marks each.

Unit 1 - Electricity and DC Circuits

1. State the Sources of Electrical Energy.
2. State Five effects of Electrical Current with an example each.
3. Mention any five applications of Electrical Energy.
4. State five advantages of electrical energy over other forms of energy.
5. Define and mention the SI units of i) Electric Current ii) Voltage.
6. Define and mention the SI units of i) Potential Difference ii) Resistance
7. Define i) Electric Current ii) Voltage and mention the meters used to measure them.
8. Distinguish between Conductors and Insulators.
9. Distinguish between Conductors and Semi-conductors.
10. State Ohm's Law and mentions its limitations.
11. State and explain Ohm's Law.
12. Determine the equivalent resistance of three resistances R_1 , R_2 and R_3 when connected in series across a supply voltage of V volts.
13. Determine the equivalent resistance of three resistances R_1 , R_2 and R_3 when connected in parallel across a supply voltage of V volts.
14. Three resistances of $6\ \Omega$, $4\ \Omega$ and $10\ \Omega$ are connected in series, across supply of $100\ V$, Find
 - i) Effective resistance of the circuit.
 - ii) Total current in the circuit.
 - iii) Current through each resistance
 - iv) Voltage drop across each resistance.
15. Define i) Electric Power ii) Electric Energy and mention the meters used to measure them.
16. Define Electric Power and write the three equations of electrical power with current, voltage and resistance.
17. A $100\ \text{watt}$ lamp is used for $6\ \text{hours}$ and a $60\ \text{watt}$ lamp is used for $4\ \text{hours}$ a day. Find
 - i) Energy consumed per month and
 - ii) Cost of energy if each unit costs $\text{Rs.}2.70$
18. A house consists of two bulbs of 100W each, three bulbs of 60W each and one fluorescent lamp of 40W . If they are used for $4\ \text{hours}$ a day, find monthly consumption charges at $\text{Rs. } 2.70$ per unit.
19. Define Horse power and Brake Horse power.

Unit 2 - Electromagnetism

20. Define with SI units. i) Flux density ii) Reluctance.
21. Define with SI units. i) Magnetic flux ii) Magneto Motive Force.
22. State Faraday's First and Second Laws of Electromagnetic Induction.
23. Define with SI units i) Permeability ii) Reluctance.
24. Distinguish between Statically Induced and Dynamically Induced e.m.f.
25. Distinguish between self-induced and mutual-induced e.m.f.
26. Define with SI units a) Inductance b) Mutual inductance
27. Explain with a sketch statically induced emf with an example.
28. Explain with a sketch dynamically induced emf with an example.
29. Explain the construction of DC Generator.
30. Explain the working of a DC Generator.

Unit 3 - Fundamentals of AC Circuits

31. Define i) RMS value ii) Average value and write equations.
32. Explain with illustration i) phase and ii) phase difference.
33. Draw a sinusoidal waveform and mark the following
 - i) Maximum value
 - ii) Instantaneous value
 - iii) cycle
 - iv) Time Period.
34. Define the following with reference to a sinusoidal waveform
 - i) Maximum value
 - ii) Instantaneous value
 - iii) Form factor.
35. Define with SI units. i) Frequency and ii) Time period.
36. The instantaneous value of current is given by $i = 50 \sin 520 t$, find
 - i) Instantaneous value at $t = 5\text{ms}$
 - ii) Maximum value
 - iii) Frequency
 - iv) Time period
37. Define with equations, i) Capacitive reactance ii) Inductive reactance.
38. Explain Impedance, mention the SI unit and also write the equation.
39. A resistance of 100Ω is connected in series with a capacitance of $150 \mu\text{F}$. If this is connected to a 200 V , 50 Hz supply, Find
 - i) Capacitive reactance.
 - ii) Impedance of the circuit
 - iii) Power factor
 - iv) Current

40. A resistance of 20 is connected in series with a inductance of 0.07 H . If this is connected to a 200V, 50 Hz supply, find
 - i) Inductive reactance
 - i) Impedance
 - ii) Power factor
 - iii) current
41. Define power factor and explain its effect on electrical power.
42. Compare between three phase power supply and single phase power supply.
43. State Five advantages of three phase power supply over single phase power supply.
44. Explain the working principle of an AC generator.
45. Explain the construction of an AC Generator.
46. State the working principle of a transformer.
47. Explain the construction of a transformer.
48. What is a transformer? State its applications.
49. Write the ratings of a typical transformer.
50. Write the ratings of a typical AC generator.
51. What is an AC generator? State its applications.

Unit 4 - Electric Motor Drives

52. What is a DC motor? List the types of DC motors.
53. State five applications of DC motors.
54. Explain briefly the selection of DC motors.
55. What is an AC motor? List the types of AC motors.
56. Compare single phase and three phase AC motors.
57. Explain briefly the selection of single phase and three phase AC motors.
58. State the applications of single phase AC motors.
59. State the applications of three phase AC motors.
60. What is FHP motor? List the applications of FHP motors.
61. Explain briefly the selection of FHP motors.
62. What is the importance of name plate details of an AC motor. Give one example for single phase and three phase AC motor.
63. State the necessity of starters for three phase AC motors and list the types and applications.
64. State the necessity of starters for three phase induction motors and list the types.
65. State the advantages of three phase motors over single phase motors.
66. List out the various industrial applications of DC motors.
67. List out the selection criteria of DC motors for various industrial applications.
68. List out the various industrial applications of AC motors.
69. List out the selection criteria of AC motors for various industrial applications.
70. Explain the need of mechanical enclosures for motors and state the applications.

71. List the different types of mechanical enclosures for motors with their applications.

Unit 5 - Protective Devices, UPS and Estimation

72. Explain the necessity of Protective devices. List the types.
73. State the meanings of over voltage, under voltage and normal voltage w.r.t AC.
74. State the meanings of over loading, over and short circuit currents.
75. What is fuse? List the types.
76. List the applications of re-wire able, cartridge, and HRC fuses.
77. List out the different types of switches with their symbols.
78. Distinguish between MCB and ELCB.
79. Explain the necessity of electrical Earthing. List types of earthing.
80. Explain the necessity of earthing an electrical equipment..
81. State any five general electrical safety precautions.
82. Explain briefly electric shock treatment.
83. State the sequence of steps for shock treatment.
84. State the definitions of Cell and Battery. List the types of Batteries.
85. Explain the ratings of Battery.
86. Differentiate Primary and Secondary Batteries.
87. Mention the conditions for fully charged and discharged Lead Acid Battery.
88. What are SMF batteries? List the advantages over conventional batteries.
89. Explain the selection of batteries.
90. What is an UPS and its rating? List the different types.
91. What are the functions of UPS.
92. Explain the selection criteria of an Un-interrupted Power Supply.
93. Plan and estimate the cost of electrical wiring for one 3mX3m room having consisting of 2 tubelights,1 ceiling fan, 2 three pin socket .
94. Plan and estimate the cost of electrical wiring for One lathe for three phase wiring with MCBs, starters, Iron clad switches ,and HRC fuses

Unit 6 - Electronic Components and Applications

95. What are semiconductors? List the properties.
96. What are semiconductors? List the types and applications.
97. Distinguish between Intrinsic and Extrinsic semiconductors.
98. Explain P and N type semiconductors.
99. What is a Diode. List the types and their applications.
100. Explain the operation of PN junction Diode.
101. Explain the operation of Diode in no bias, forward and reverse bias conditions.
102. Explain the VI characteristics of Diode.
103. With a neat diagram explain the working of half wave rectifier.
104. Explain with a neat sketch and waveforms the working of a full wave bridge rectifier.

105. Explain the operation of Zener diode as a Voltage Regulator.
106. What is a transistor? Mention the types with their symbols.
107. Explain the operation of NPN Transistor.
108. What is a BJT. List the applications of BJTs.
109. Explain with a neat circuit diagram the operation of Transistor as a Switch.
110. What is a SCR or Thyristor. Write the symbol. Also, list the industrial applications of SCRs.
111. Explain with a simple diagram the operation of SCR.
112. What is a Timer. List the types.
113. List the applications of Timers.
114. What is a Relay. List the types.
115. List the applications of Relays.
116. Draw the logic symbol, write the truth table and Boolean expression for the following logic gates;
 - a) NOT
 - b) OR
 - c) AND
 - d) NAND
 - e) NOR
 - f) EX-OR.
117. What is an IC? State the advantages of Integrated Circuits over discrete components.