| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ii. | Define the following terms related to magnetic circuits:<br>(a) Magnetic flux density<br>(b) Magneto Motive Force<br>(c) Magnetic field intensity<br>(d) Flux<br>(e) Reluctance<br>(f) Absolute permeability<br>(g) Relative permeability | **7** | 01 | 01<br>01 | 01 |
| OR | iii. | Discuss B-H curve of a Ferro-magnetic material and explain the following:<br>(a) Magnetic saturation (b) Hysteresis<br>(c) Residual magnetism (d) Coercive force | **7** | 02 | 01<br>06<br>12 | 03 |
| Q.5 | i. | Draw the circuit diagram and explain the principle of operation of a single-phase transformer. | **4** | 02 | 01<br>06<br>12 | 03 |
| | ii. | With neat sketch, discuss the constructional details of D.C motor. | **6** | 02 | 01<br>06<br>12 | 03 |
| OR | iii. | With neat sketch, discuss the constructional details of three phase induction motor. | **6** | 02 | 01<br>06<br>12 | 03 |
| Q.6 | | Attempt any two: | | | | |
| | i. | Draw and explain the single line diagram of a power system from generation to distribution. | **5** | 02 | 01<br>06<br>12 | 03 |
| | ii. | Draw the block diagram of a thermal power plant and write down the function of each component. | **5** | 03 | 01<br>02 | 04 |
| | iii. | Calculate the electricity bill amount for a month of 31 days, if the following devices are used as specified:<br>(a) 3 bulbs of 30 watts for 5 hours<br>(b) 4 tube lights of 50 watts for 8 hours<br>(c) 1 fridge of 300 watts for 24 hours<br>Given the rate of electricity is 2 Rs. Per unit. | **5** | 03 | 01<br>02 | 04 |

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*Total No. of Questions: 6* *Total No. of Printed Pages:4*

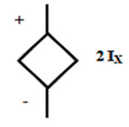
**Enrollment No.....**

# Faculty of Engineering / Science
## End Sem Examination Dec 2024
## EN3ES17 / BC3ES01 Basic Electrical Engineering

Programme: B.Tech./ B.Sc. Branch/Specialisation: All

**Duration: 3 Hrs.** **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

| | | | **Marks** | **BL** | **PO** | **CO** | **PSO** |
|---|---|---|---|---|---|---|---|
| Q.1 | i. | According to Thevenin's theorem, any bilateral network can be replaced by a network with _____.<br>(a) An independent current source in parallel to the equivalent resistance<br>(b) An independent voltage source in series with the equivalent resistance<br>(c) An independent voltage source in parallel to the resistance<br>(d) None of these | **1** | 01 | 01 | 01 | |
| | ii. | If $I_X$ represents any branch current of the network then following diagram is the symbol of-<br>  <br><br>(a) Voltage depend ource<br>(b) Current dependent current source<br>(c) Voltage dependent current source<br>(d) Current dependent voltage source | **1** | 01 | 01 | 01 | |
| | iii. | If the AC voltage applied to a circuit is expressed by $v(t) = 220\sqrt{2}\sin 314t$ then the r.m.s value of voltage and frequency of the source would be-<br>(a) 311.12V, 50Hz (b) 220V, 60Hz<br>(c) 311.12V, 60Hz (d) 220V, 50Hz | **1** | 03 | 01<br>02 | 04 | |
| | iv. | The ratio of active power to apparent power is known as-<br>(a) Form factor (b) Peak factor | **1** | 01 | 01 | 01 | |

(c) Power factor (d) None of these

v. The co-efficient of coupling between two isolated coils is- **1** 01 01 01
(a) 1 (b) 0.5 (c) 0.75 (d) 0

vi. Permeability in a magnetic circuit corresponds to _____ in an electric circuit. **1** 01 01 01
(a) Resistance (b) Resistivity
(c) Conductivity (d) Conductance

vii. The primary winding of a transformer has a 120V AC supply. What is the value of secondary voltage if the transformation ratio is 1.5? **1** 03 01 02 04
(a) 120V (b) 80V
(c) 180V (d) 220V

viii. Which of the following part is used in construction of DC machine but not in AC machine? **1** 01 01 01
(a) Armature winding (b) Field winding
(c) Commutator (d) Shaft

ix. Which of the following is not a component of thermal power plant? **1** 01 01 01
(a) Condenser (b) Cooling tower
(c) Turbine (d) Fuel tank

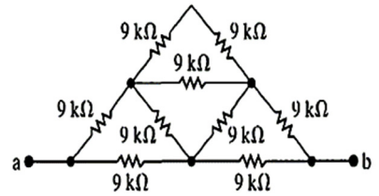
x. Calculate the number of units of electricity used if a bulb of 1000W is kept on for 5 hours. **1** 03 01 02 04
(a) 1 unit (b) 0.1 unit
(c) 5 unit (d) 0.5 unit

Q.2 i. Write down the statement of Ohm's law and using ohm's law solve the following: **2** 03 01 02 04
If the current flowing through a 4Ω resistor is 2A, what will be the voltage across the given resistor?

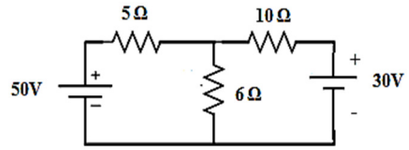
ii. Differentiate between the followings: **3** 02 01 02 01
(a) Ideal and practical sources
(b) Active and passive elements

iii. Find out the equivalent resistance between terminals a & b of the following network using star-delta transformation: **5** 03 01 02 04






OR iv. Find the current through 6Ω resistor of the network shown below using nodal analysis method. **5** 03 01 02 04




Q.3 i. Define the following terms related to AC: **2** 01 01 01
(a) R.M.S Value (b) Average value
(c) Form Factor (d) Peak Factor

ii. For an A.C single phase R- L- C circuit: **8** 03 01 02 04
(a) Draw the Voltage triangle, Impedance triangle & Power triangle.
(b) Find the power factor of the circuit, if resistance (R) is 5Ω, Inductive reactance ($X_L$) is 15Ω and Capacitive reactance ($X_C$) is 10Ω.

OR iii. For a 3-phase star connected supply system: **8** 02 01 02
(a) Draw the circuit diagram and phasor diagram.
(b) With the help of phasor diagram, deduce the relation between line quantities and phase quantities.

Q.4 i. Two coils, A of 12,500 turns and B of 16,000 turns, lie in parallel plane so that 60% of flux produced in A links coil B. It is found that a current of 5A in A produces a flux of 0.6mWb while the same current in B produces 0.8mWb. Determine (a) Mutual inductance **3** 03 01 02 04
(b) Co-efficient of coupling

# Scheme of Marking

Basic Electrical Engineering (T) - EN3ES17 (T)

| | | | |
|---|---|---|---|
| Q.1 | i) | (b) An independent voltage source in series with the equivalent resistance | **1** |
| | ii) | (d) Current dependent voltage source | **1** |
| | iii) | (c) Power Factor | **1** |
| | iv) | (d) 220V, 50Hz | **1** |
| | v) | (d) 0 | **1** |
| | vi) | (c) Conductivity | **1** |
| | vii) | (c) 180V | **1** |
| | viii) | (c) Commutator | **1** |
| | ix) | (d) Fuel tank | **1** |
| | x) | (c) 5 unit | **1** |
| Q.2 | i. | Statement (1 Mark), Voltage = 8V (1 Mark) | **2** |
| | ii. | (a) First difference (1mark ) + second difference (0.5 mark)<br>(b) First difference (1mark ) + second difference (0.5 mark) | **3** |
| | iii. | Transformation formula (1 mark), solution- (3.5 marks), Equivalent resistance answer- (0.5mark) | **5** |
| OR | iv. | KCL equation- 2 marks, determination of node potential-2 marks, Calculation of branch current-1 mark | **5** |
| Q.3 | i. | Each definition- 0.5 mark | **2** |
| | ii. | Voltage triangle- 2marks, Impedance triangle- 2marks, Power triangle- 2 marks, Power factor calculation- 2marks | **8** |
| OR | iii. | Circuit diagram-2 mark, Phasor diagram-3marks, Deduce the relationship -3marks | **8** |
| Q.4 | i. | Mutual inductance calculation- 1 mark,<br>Co-efficient of Coupling calculation – 1 mark<br>Self-Inductance Value – 1 mark | **3** |
| | ii. | Each definition – 1 mark | **7** |
| OR | iii. | B-H curve explanation- 2 marks,<br>Hysteresis loop explanation- 3.5 marks,<br>residual magnetism, magnetic saturation, coercive force<br>each 0.5 mark 0.5 mark * 3 – 1.5 marks | **7** |
| Q.5 | i. | Circuit diagram- 1mark, principle-1 mark, explanation- 2marks | **4** |
| | ii. | Sketch- 2marks, explanation- 4 marks | **6** |
| OR | iii. | Sketch- 2marks, explanation- 4 marks | **6** |
| Q.6 | | | |
| | i. | Single line diagram- 3marks, explanation- 2marks | **5** |
| | ii. | Block diagram-3marks, Function of components- 2marks | **5** |
| | iii. | KWH for three loads -3marks, total units for 31days-01 mark, electric bill-01 mark | **5** |

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P.T.O.

# Solution

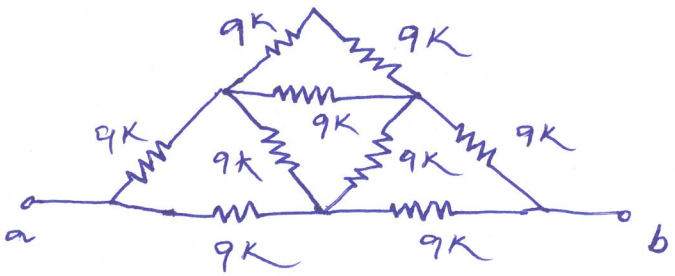
# BEE

# ENGES17

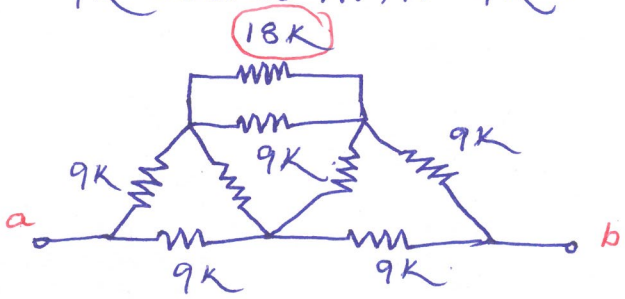
Q.2 (i) $R = 4\Omega$, $I = 2A$.

$V = IR = 2 \times 4 = \boxed{8V}$

(ii)

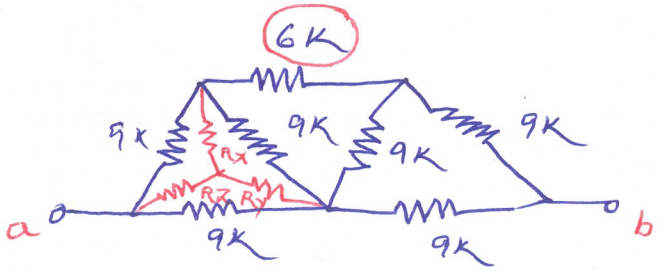



⇒ 9K series with 9K.




⇒ 18K & 9K are in parallel

$$Req = \frac{18 \times 9}{18 + 9} = 6K\Omega$$



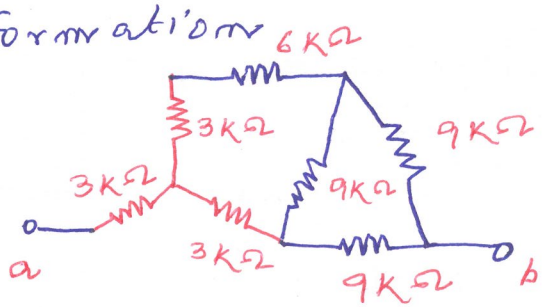

⇒ Applying Y-Δ-Y transformation

$$Rx = \frac{9 \times 9}{27} = 3K\Omega$$

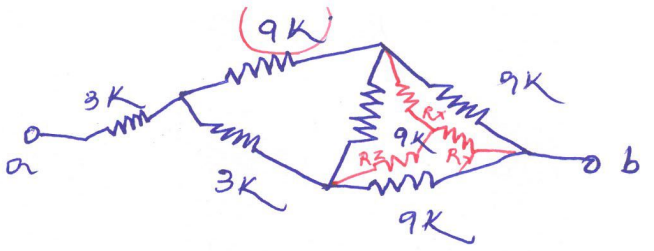
$$Ry = \frac{9 \times 9}{27} = 3K\Omega$$

$$Rz = \frac{9 \times 9}{27} = 3K\Omega$$

⇒

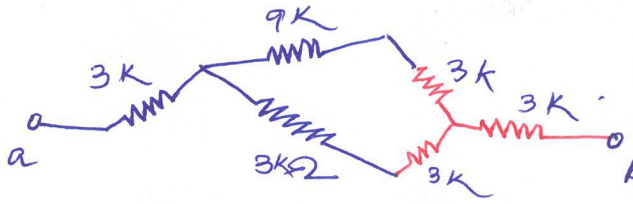



⇒ 6K & 3K are in series.

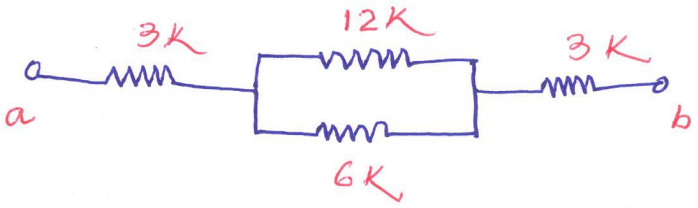



⇒ Again applying Δ-y transformation

$R_X = \frac{9 \times 9}{27} = 3K\Omega$, $R_Y = 3\Omega$, $R_Z = 3\Omega$




⇒ 9K, 3K are in series & 3K, 3K are in series.




⇒ 12K & 6K are in parallel

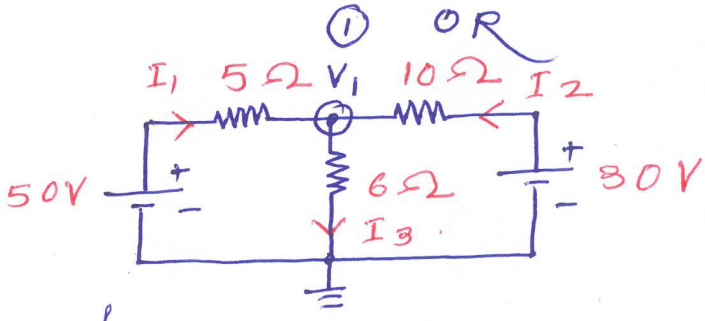
$$Req = \frac{12 \times 6}{12+6} = 4K\Omega$$


⇒ 3K, 4K & 3K are in series


* equivalent resistance $R_{ab} = 10K\Omega$

— o —

(iv)




At node-1, applying KCL

$$\boxed{I_1 + I_2 = I_3} \quad \ldots\ldots (1)$$

$$\Rightarrow \frac{50-V_1}{5} + \frac{30-V_1}{10} = \frac{V_1}{6}$$

$$\Rightarrow \frac{100-2V_1+30-V_1}{10} = \frac{V_1}{6} \Rightarrow \frac{130-3V_1}{10} = \frac{V_1}{6}$$

$$\Rightarrow 780 - 18V_1 = 10V_1 \Rightarrow 28V_1 = 780 \Rightarrow V_1 = \frac{780}{28} = \boxed{27.857}$$

Now current through 6Ω resistor

$$I_3 = \frac{V_1}{6} = \frac{27.857}{6} = \boxed{4.642\,A}$$

Q.3 (ii) (b) $R = 5\Omega$, $X_L = 15\Omega$, $X_C = 10\Omega$

$$\therefore Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{5^2 + (15-10)2}$$

$$= \sqrt{25+25} = \sqrt{50} = 7.071\,\Omega$$

$$\therefore \text{power factor } \cos\phi = \frac{R}{Z} = \frac{5}{7.071} = \boxed{0.707 \text{ (lag)}}$$

Q.4 (c)

A: $N_1 = 12,500$

B: $N_2 = 16,000$

$$L_1 = \frac{N_1\Phi_1}{I_1} = \frac{12,500 \times 0.6\times10^{-3}}{5}\,H$$

$$= \frac{7.5\,H}{5} = \boxed{1.5H}$$

$$L_2 = \frac{N_2\phi_2}{I_1} = \frac{16000 \times 0.8\times10^{-3}}{5} = \boxed{2.56H}$$

$$M = \frac{N_2 \times 60\% \text{ of } \phi_1}{I_1} = \frac{16000 \times \frac{60}{100} \times 0.6\times10^{-3}}{5}$$

$$= \boxed{1.152H}$$

Co-efficient of coupling

$$K = \frac{M}{\sqrt{L_1L_2}} = \frac{1.152}{\sqrt{1.5\times2.56}} = \boxed{0.5878}$$

Q.6 (iii) (a) 3 bulbs, 30W, 5hours

Total energy consumed per day

$= 3 \times \frac{30}{1000} \times 5$ KWH = 0.45KWH

(b) 4 tube lights, 50W, 8hr

Total energy consumed/day

$= 4 \times \frac{50}{1000} \times 8$ = 1.6KWH

(c) 1 Fridge, 300W, 24hr

Total energy consumed/day

$= 1 \times \frac{300}{1000} \times 24$ = 7.2KWH

Total energy consumed for all loads per day = (0.45+1.6+7.2) = 9.25KWH

For 31 days total energy consumed

= 31 x 9.25 = 286.75KWH = 286.75 units

Electric bill = 2 x 286.75 = Rs 573.5