ES-101

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Time Allotted: 1 Hours | Full Marks: 70

The questions are of equal value
The figures in the margin indicate full marks
Candidates are required to give their answers in their own words as far as practicable

PART - I (Electrical)

(Use blue colour answer book for this part)

GROUP A

(Multiple Choice Type Questions)

1 Answer any *five* questions $5 \times 1 = 5$

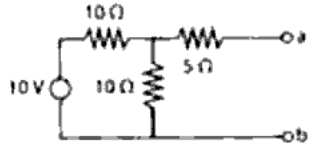
(i) Force experienced by a small conductor of length L, carrying current I, placed in a magnetic field B, is at an angle θ with respect to B is given by

(A) BIL (B) BIL sin θ (C) BIL cos θ (D) zero

(ii) Three resistance of 4 ohm, 6 ohm and 8 ohm are connected in parallel. The maximum power dissipation will occur in

(A) 4 ohm (B) 6 ohm
(C) 8 ohm (D) equal in all resistor

(iii) For the circuit shown the Thevenin's voltage and resistance as shown at ab are



(A) 5 V, 10 ohm (B) 10 V, 10 ohm (C) 5V, 5 ohm (D) 5 V, 15 ohm

(iv) Inductive resistance of a coil of inductance will be proportional to

(A) 62.8 ohm (B) 628 ohm (C) 0.2 ohm (D) 20 ohm

(v) The power factor of a purely inductive will be proportional to

(A) zero (B) one (C) infinity (D) 0.5

(vi) The form factor current is 1, its shape is

(A) sinusoidal (B) triangle (C) square (D) sawtooth

(vii) The unit of m.m.f is

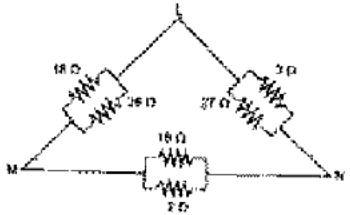
(A) AT/m (B) N/Wb (C) both (A) and (B) (D) Wb/m^2

GROUP B

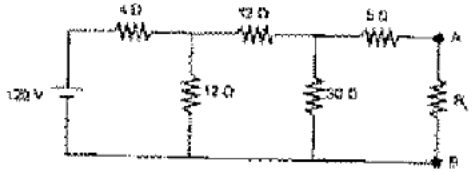
(Short Answer Type Questions)

Answer any *two* questions. 2×5

2. A network of resistance is formed as given in the figure. Compute the resistance measured between L and M.



3. Obtain the maximum power transferred to R_L in the circuit and also the value of R_L.



4. Two impedances $Z_1 = (40.93 + j26.3)$ Ω and $Z_2 = (10 - j5)$ Ω are connected in parallel across a 200 volt, 50 Hz supply. Find the current through each impedance and total current. What is the phase difference angle of each branch current with respect to the applied voltage?

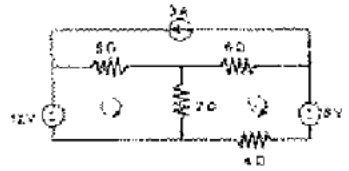
5. Derive an expression for the lifting power of an electromagnet

GROUP C

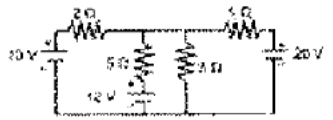
(Long Answer Type Questions)

Answer any *two* questions. 2×10 = 20

6. (a) Using Mesh analysis, determine the currents I_1 and I_2 in the network shown below 5



(b) Determine the voltage across 3 Ω resistor by applying Thevenin's Theorem in the following network. 5



7. (a) A coil of resistance 10 Ω and inductance 0.02 H is connected in series with another coil of resistance 6 Ω and inductance 15 mH across a 230 V, 50 Hz supply. 6

Calculate (i) impedance of the circuit

(ii) the voltage drop across each coil and

(iii) the total power consumed by the circuit

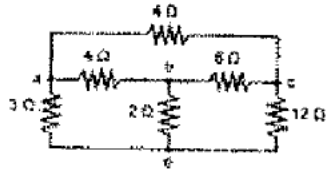
(b) Define Power factor. Show that the active power of a purely capacitive circuit over a complete cycle is zero. 1+3

8. (a) State Faraday's Laws of Electromagnetic Induction. Show that $M = K\sqrt{L_1 L_2}$ where M is the mutual inductance between the coils L_1 and L_2, and K is the co-efficient of coupling.

(b) A coil of 250 turns carrying a current of 2A produces a flux of 0.3 mWb. When the current is reduced to zero in 2 ms, the voltage induced in a nearby coil is 60 V. Calculate the self-inductance of each coil and the mutual inductance between the two coils. Assume co-efficient of coupling to be 0.7.

9. (a) Explain Delta (Δ) – Star (Y) conversion and Star (Y) – Delta (Δ) conversion, for a purely resistive circuit. 2

(b) Reduce the network given below to obtain the equivalent resistance as seen between nodes a, d.



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PART - II (Electronics)

(Use green colour answer book for this part)

GROUP A

(Multiple Choice Type Questions)

1. Answer any *five* questions 5 × 1 = 5

(i) Fermi level of a p-type semiconductors lies

(A) Near the conduction band edge (B) near the valence band edge
(C) at the middle of the band gap (D) none of these

(ii) With the rise in temperature reverse saturation current

(A) increases linearly (B) increases exponentially
(C) decreases linearly (D) decreases exponentially

(iii) Zener diodes are used as

(A) reference voltage elements (B) reference current elements
(C) reference resistance (D) both (A) and (B)

(iv) With both junctions reverse biased the transistor operates in

(A) active region (B) cut-off region
(C) saturation region (D) inversed region

(v) The ripple factor for a half wave rectifier is

(A) 0.482 (B) 0.41
(C) 1.21 (D) 1.11

(vi) If $\alpha = 0.98$ then $\beta =$

(A) 0.49 (B) 49
(C) 50 (D) 0.5

GROUP B

(Short Answer Type Questions)

Answer any *two* questions.

2. (i) Explain the drift and diffusion current for a semiconductor.
   (ii) What is meant by *intrinsic* semiconductor?

3. At 300 K, the intrinsic carrier concentration of Si is 1.5×10^{16} m^{-3}. If the electron and hole mobility are 0.13 and 0.05 m^{2}V^{-1}s^{-1}, calculate the intrinsic resistivity of Si at 300 K.

4. Distinguish between zener break down and avalanche break down.

GROUP C

(Long Answer Type Questions)

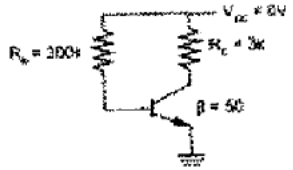
Answer any *two* questions.

5. (i) Define Fermi level.
   (ii) What is the position of Fermi level in an intrinsic semiconductor? How does its position change when (a) donors and (b) acceptors are added to the semiconductor?
   (iii) Draw the energy band diagram of a (a) forward biased pn junction diode (b) reverse biased pn junction diode (c) unbiased pn junction diode.
   (iv) Determine the resistivity of germanium (a) in intrinsic condition at 300K (b) with donor impurity of 1 in 10^7 (c) with acceptor impurity of 1 in 10^8. Given that for germanium at 300K, $n_i = 2.5 \times 10^{13}$ cm^{-3}, $\mu_n = 3800$ cm^2/V–s, $\mu_p = 1800$ cm^2/V–s and number of germanium atoms / cm^3 = 4.4×10^{22}.

6. (i) Explain the operation of a half-wave rectifier with the help of circuit diagram. Obtain a mathematical expression for the efficiency of the half-wave rectifier and show that its ripple factor is 1.21

(ii) A diode having internal resistance 20 Ω is used for half-wave rectification. The ac input voltage is 6 sin ω and load resistance is 900 Ω. Obtain (a) dc output voltage (b) ac input power (c) ripple factor and (d) the efficiency of the rectifier. 4

7. (i) Draw the circuit diagram and output characteristics of a common emitter transistor showing different regions. 3+2
   (ii) Explain the concept of thermal run-away and Q-point. 2+2
   (iii) Calculate V_{CE} and I_C in the circuit below. Assume $V_{BE} = 0.7$ V 3



8. Write short notes on any *two* of the following: 2×5 = 10
   (a) Zener diode as a voltage regulator
   (b) Junction capacitances
   (c) Stability factors
   (d) Varactor diode