MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

ES-101

BASIC ELECTRICAL AND ELECTRONIC ENGINEERING - I

Time Allotted: 3 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.
All symbols are of usual significance

PART – I (Electrical)

GROUP A

(Multiple Choice Type Questions)

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

(i) Inductive reactance of a coil of inductance 0.2H at 50Hz is

(A) 62.8 Ω (B) 628 Ω (C) 6.28 Ω (D) 4 Ω

(ii) If a voltage source is to be neglected then the terminals across the source will be

(A) open circuited (B) short circuited
(C) both (A) and (B) (D) none of these

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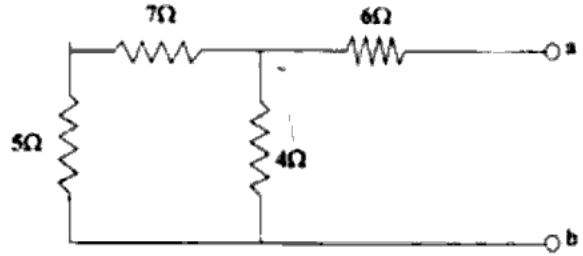
(iii) The form factor of a waveform is 1, its shape is

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

(iv) The equivalent resistance across the terminal a-b will be

(A) 9 Ω (B) 3 Ω
(C) 6 Ω (D) 2 Ω



(v) An inductive coil with impedance $Z = (5 + j10)$, it's conductance will be

(A) 0.2 ℧ (B) 2 ℧
(C) 4 ℧ (D) 0.4 ℧

(vi) The bandwidth of a series resonant a. c. circuit is equal to

(A) $\frac{1}{2\pi R}$ (B) $\frac{L}{2\pi R}$
(C) $\frac{R}{2\pi L}$ (D) $\frac{1}{RLC}$

(vii) Kirchhoff's current law is used for

(A) loop analysis (B) node analysis
(C) finding out equivalent resistance (D) none of these

GROUP B

(Short Answer Type Questions)

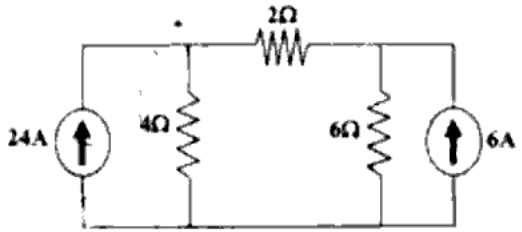
Answer any *two* questions. 2×5 = 10

2. Derive an expression for the resonant frequency of a parallel circuit, one branch consisting of a coil of inductance L in series with resistance R and the other branch of capacitance C.

3. Two coils having self inductances L_1 and L_2 and mutual inductance between them is M. Derive a mathematical expression for co-efficient of coupling k for these coils.

4. State and prove Maximum Power Transfer Theorem.

5. Applying Superposition theorem compute the current through 2 Ω resistor.



GROUP C

(Long Answer Type Questions)

Answer any *two* questions. 2×10 = 20

6. (a) A capacitor of 100 μF is connected across a 200 V, 50 Hz single phase supply. Calculate (i) the reactance of the capacitor, (ii) r.m.s. value of current, (iii) the maximum current. 3

   (b) What is meant by bandwidth? With a neat sketch of waveform find out the expression for the bandwidth of a resonant circuit. 7

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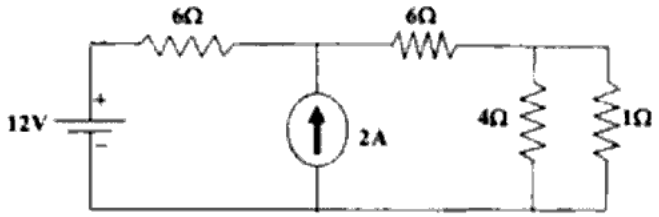
7. (a) Give an example of passive element. 1

   (b) State and explain Thevenin's Theorem. 3

   (c) Find the current through 1 Ω resistor using Thevenin's Theorem. 6



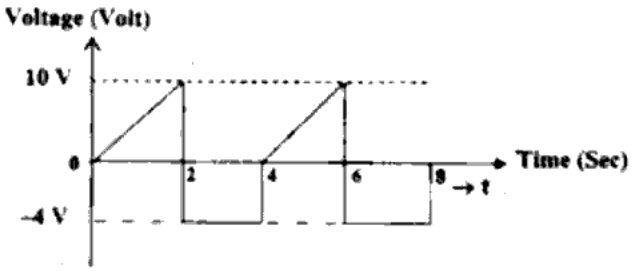
8. (a) State and explain Bio-Savart's law. 3

   (b) What is meant by hysteresis in a magnetic circuit? Draw the B-H curve. 3

   (c) The coil of a moving coil instrument is wound with 50 turns of wire. The flux density in the gap is 0.06 wb/m^2 and the effective length of the coil side in the gap is 4 cm. Find the force acting on each side of the coil when the current is 40 mA. 4

9. (a) Prove that the current in purely capacitive circuit leads the applied voltage by an angle 90° and draw their waveforms. Also calculate the average power of capacitive circuit. 5

   (b) Find the Form Factor of the given waveform. 5



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PART – II (Electronic)

GROUP A
(Multiple Choice Type Questions)

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

(i) The temperature coefficient of resistance of a pure semiconductor is-

(A) negative (B) positive
(C) constant (D) none of these

(ii) Unit of diffusion constant for silicon in SI unit is

(A) m^2 / V.s (B) m^2 / s
(C) m / s (D) V / s

(iii) If line frequency is 60 Hz, the output frequency of a bridge rectifier is

(A) 30 Hz (B) 60 Hz
(C) 120 Hz (D) 240 Hz

(iv) Without a DC source, a clipper acts like a

(A) rectifier (B) clamper
(C) chopper (D) demodulator

(v) Zener diodes are used as

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

(vi) A transistor acts like a diode and a

(A) voltage source (B) current source
(C) power supply (D) resistance

(vii) A BJT is a

(A) voltage controlled device (B) current controlled device
(C) power controlled device (D) none of these

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(viii) For an npn transistor, I_{CBO} approximately doubles for temperature rise of every

(A) 5°C (B) 7°C
(C) 10°C (D) none of these

GROUP B
(Short Answer Type Questions)

Answer any *two* questions. 2×5 = 10

2. Define the mobility of charge carriers in a semiconductor. Obtain expressions for the electrical conductivity of (i) an intrinsic, (ii) an n-type.

3. Draw the energy band diagram of a (a) forward biased pn junction diode, (b) reverse biased pn junction diode, (c) unbiased pn junction diode.

4. A full wave bridge rectifier is fed from a 15 V r.m.s. source and is connected across a 100 ohm load. Calculate PIV, RMS current draw from the supply and average D.C. current across the load.

5. What is meant by d.c. operating point or Q point in the context of transistor characteristics? What is load line? Why is transistor biasing necessary?

GROUP C
(Long Answer Type Questions)

Answer any *two* questions. 2×10 = 20

6. (a) Write the difference between metal, insulator and semiconductor. 4
(b) Why does extrinsic semiconductor behave as good conductor? 3
(c) What do you mean by depletion region of p-n junction diode? 3

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7. (a) What is ripple factor? Evaluate the ripple factor and efficiency of full-wave rectifier. 5

(b) A silicon diode having internal resistance $R_f = 30\ \Omega$ is used for half-wave rectification. The input ac voltage is $V_i = 6 \sin\omega t$ and load resistance is $500\ \Omega$. Find 5
(i) dc output voltage,
(ii) ac input power,
(iii) the efficiency of the rectifier.

8. (a) Explain why the collector region is larger than that of the emitter and base in a transistor? 3

(b) Why n-p-n and p-n-p transistors are called bipolar transistors? 2

(c) Show that the collector current is given by : $I_C = \beta I_B + (1 + \beta) I_{CO}$ 5

9. Draw the common-base input characteristics of a transistor. What is early effect? Refer to the following circuit $V_{BE,sat} = 0.85$ V and $V_{CE,sat} = 0.22$ V. If $h_{FE} = 110$, is the transistor operating in the saturation region? 3+2+5