B.E. MECHANICAL ENGINEERING FIRST YEAR FIRST SEMESTER SUPPLEMENTARY EXAM - 2024

SUBJECT: BASIC ELECTRICAL ENGINEERING

Time: Three Hours | Full Marks: 100 (50 Marks for each part)

Use a separate Answer-Script for each part

Two marks reserved for neat and well-organized answers

Question No.	Part-I	Marks

Answer any three questions

1. (a) Calculate Form factor and Peak factor for the periodic waveform as shown in Fig. 1. 10

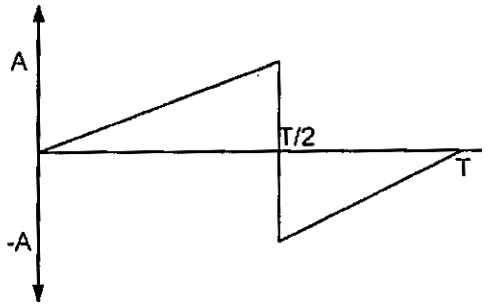

Fig. 1.

(b) A voltage $v(t) = 141.4 \sin(314\,t + 10°)$ is applied to a circuit and a steady current of $i(t) = 14.14 \sin(314\,t - 20°)$ is obtained. Determine (i) the power factor of the circuit and (ii) the power delivered to the circuit. Draw the phasor diagram. 6

2. (a) Discuss about the current characteristics of a series combination of R-C components under pure sinusoidal voltage. What do you mean by instantaneous power? Calculate instantaneous power for the series combination of R-C components under pure sinusoidal voltage. 3+2+3

(b) Three branches, possessing resistance of 50Ω, an inductance of 0.15H and a capacitance of 100μF respectively, are connected in parallel across a 100V, 50Hz supply. Calculate: (i) the current in each branch, (ii) the supply current and (iii) the phase angle between the supply current and the supply voltage (iv) the impedance (v) active and reactive power of the circuit. 8

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3. (a) Calculate the impedance of the circuit in Fig.2. Also deduce the expression of frequency at resonance condition. 4+5

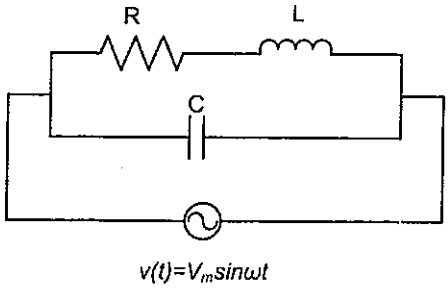

Fig. 2

(b) Describe the transfer of electrical power from generating station to the service mains using single line diagram. 7

4. (a) What do you mean by active and passive transducer? With proper example, discuss about the operation of primary and secondary transducer 2+4

(b) Discuss about the selection criteria of a transducer. Also discuss about the advantages and disadvantages of transducer. 5+5

5. Write short notes on the following topics 4×4
(i) Phasor diagram
(ii) Power triangle
(iii) Thermocouple
(iv) Electrical transducer

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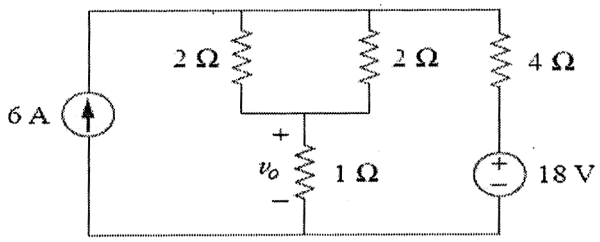
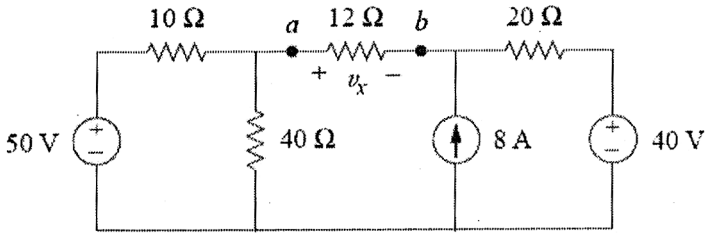
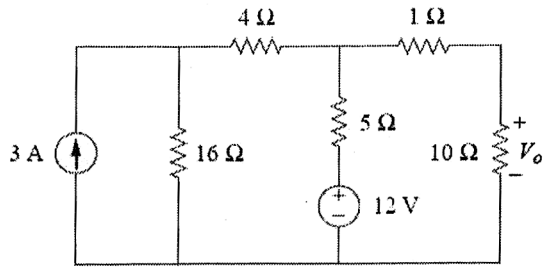
No. of question	**Part II (50 Marks)** **Answer any three questions (*2 marks reserved for neat and well-organized answer*)**	Marks
1. a)	Correct or Justify: An ideal current source and an ideal voltage source have internal resistances of infinite and zero value, respectively.	4
b)	State and explain superposition theorem.	4
c)	Find v_0 in the circuit of Fig. 1 using superposition theorem.  Fig. 1	8
2. a)	Apply source transformation to find v_x in the circuit of Fig. 2.  Fig. 2	6
b)	State and explain Thevenin's theorem. Apply Thevenin's theorem to find v_0 in the circuit of Fig. 3.  Fig. 3	4+6

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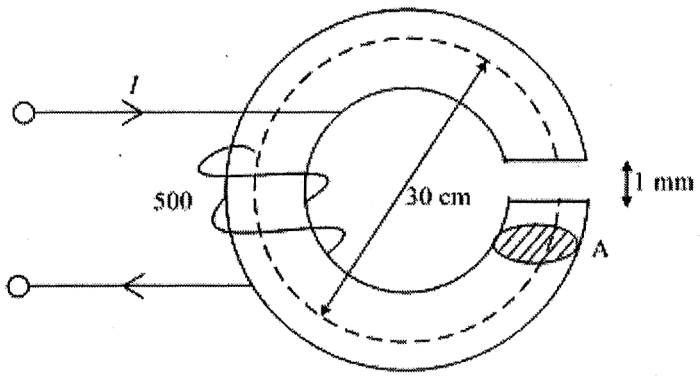
3. a)	What is eddy current loss in a magnetic circuit? Give electrical analogies of m.m.f, reluctance and magnetic field strength of a magnetic circuit.	3+3
b)	A ring of 30-cm mean diameter is made using a cylindrical iron rod of diameter 2.5 cm. A saw-cut 1-mm wide is made through the ring to create an air-gap as shown in the Fig.4. A coil with 500 turns of wire is wound on the ring. Calculate the current required in the exciting coil to produce a flux of 4 mWb in the ring. Assume the relative permeability of iron at this flux density as 800. Neglect any leakage or fringing of the magnetic field.  Fig. 4	10
4. a)	Draw the hysteresis loop for a ferromagnetic material subjected to sinusoidal excitation. What do you understand by the term retentivity and coercivity of a magnetic material?	8
b)	Describe the various operating forces needed for proper operation of an analog indicating instrument.	8
5. a)	Describe the construction and working principle of the PMMC instrument. Derive the expression for deflection if the instrument is spring controlled.	10
b)	A permanent magnet moving coil instrument has a coil of dimensions 15 mm x 12 mm. The flux density in the air gap is 1.8×10^{-3} Wb/m^2 and the spring constant is 0.14×10^{-6} Nm/rad. Determine the number of turns required to produce an angular deflection of 90 degrees when a current of 5 mA is flowing through the coil.	6