

B.E. MECHANICAL ENGINEERING FIRST YEAR FIRST SEMESTER - 2022**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 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. 8

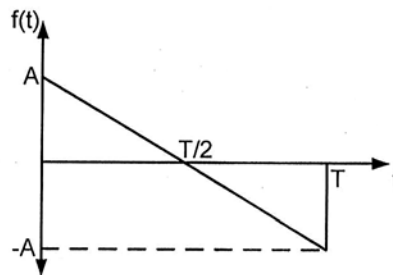
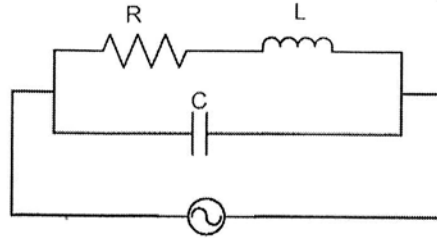


Fig. 1.

- (b) Three branches, possessing resistance of 50Ω , an inductance of 0.15H and a capacitance of $100\mu\text{F}$, 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. 8
2. (a) Discuss about the current characteristics of a parallel combination of R-C components under pure sinusoidal voltage. What do you mean by instantaneous power? Calculate instantaneous power for the parallel combination of R-C components under pure sinusoidal voltage. 3+2+3
- (b) In a circuit, the equation for instantaneous voltage and current is given by $v=141.4\sin(\omega t-2\pi/3)\text{V}$ and $i=7.07\sin(\omega t-\pi/2)\text{A}$, where $\omega=314\text{rad/s}$. 8
- (i) Sketch a neat phasor diagram for the circuit.
- (ii) Calculate the impedance with phase angle.
- (iii) Calculate the average power and power factor
- (iv) Calculate the instantaneous power at the instant $t=0$.

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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



$v(t) = V_m \sin \omega t$
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
- Active and reactive power
 - Average and RMS value of ac signal
 - Thermocouple
 - Electrical transducer

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| No. of question | <p align="center">Part II (50 Marks)</p> <p align="center"><u>Answer any three questions(2 marks reserved for neat and well-organized answer)</u></p> | Marks |
|-----------------|---|-------|
| 1. a) | <p>Three resistors of 20Ω resistances are connected in star. Find the equivalent delta resistances. If a dc voltage source of 230 V is connected across any two terminals of the equivalent delta connected resistances, find the current drawn from the source.</p> | 8 |
| b) | <p>Correct or Justify: An ideal current source and an ideal voltage source have internal resistances of infinite and zero value, respectively.</p> | 4 |
| c) | <p>State and explain Norton's theorem.</p> | 4 |
| 2. a) | <p>Using superposition theorem, find the voltage drop across 15Ω resistor in the figure below.</p> | 8 |
| | | |
| b) | <p>Find out the Thevenin and Norton's equivalents at AB.</p> | 8 |
| | | |
| 3.a) | <p>In the magnetic circuit shown below, calculate the required current (I) to be passed in the coils in order to establish a flux of 0.5 mWb in the air gap. Relative permeability of the ferromagnetic core is 1200. Neglect magnetic leakage and fringing.</p> | 12 |

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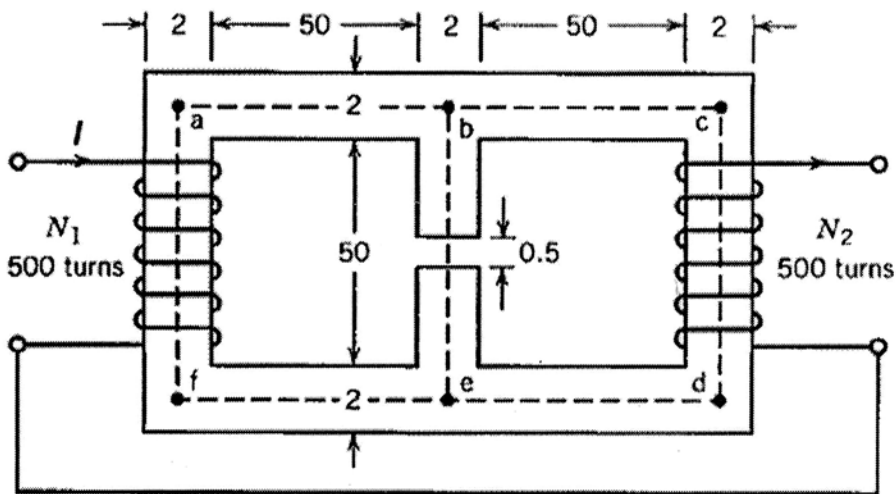
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All dimensions are in centimetres, and the magnetic material has a square cross sectional area.



b) Explain eddy current loss. How it can be minimized? 4

4. a) Explain the working principle of (i) attraction type and (ii) repulsion type of moving iron instruments with the help of neat diagram. 10

b) Draw the hysteresis loop for a ferromagnetic material subjected to sinusoidal excitation. What is the significance of the area enclosed by this loop. 6

5. a) Describe the construction and working principle of PMMC instrument. Derive the expression for deflection if the instrument is spring controlled. 10

b) A moving coil instrument has the following data: numbers of turn=75, width of coil=20mm, depth of coil=30mm, flux density in the gap=0.1 Wb/m². Calculate the deflecting torque when carrying a current of 10mA. Also calculate the deflection if the control spring constant is 2x10⁻⁶ Nm/degree. 6