Total No. of Questions : 5]

SEAT No. : ____

PC5150

[Total No. of Pages : 3

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F.E.

ESC-102-ELE: BASIC ELECTRICAL ENGINEERING

(2024 Pattern) (Credit System) (Semester - I)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Attempt any one from each sub question.***
3) ***Figures to the right indicate full marks.***
4) ***Neat diagrams must be drawn wherever necessary.***
5) ***Assume suitable additional data, if necessary.***
6) ***Use of non-programmable calculator is allowed.***

Q1) a) Attempt any One. **[6]**

i) Draw and explain single line diagram for elementary power system and list down any four components associated with electrical power system.

ii) Derive the expressions for conversion of a delta connected resistive network into an equivalent star connected resistive network.

b) Attempt any One. **[8]**

i) State meaning of unilateral and bilateral network and find current through 5 ohm resistance by loop analysis method in Figure 1 (All resistances are in ohm)

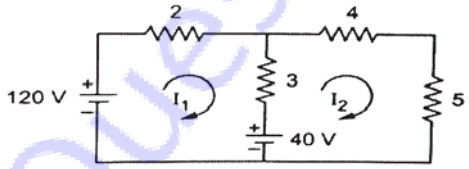

Figure 1

ii) State superposition theorem and find current through 5 ohm resistance by using this theorem in Figure 1.

Q2) a) Attempt any One. **[6]**

i) Draw series magnetic circuit with small airgap provided on an iron ring. Also draw an equivalent electrical circuit of this magnetic circuit. Show various electrical and magnetic circuit parameters in both diagrams. Write expression to calculate flux in this magnetic circuit.

ii) Define self-inductance and derive expression of energy stored in inductor coil in terms of self-inductance.

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b) Attempt any One. **[8]**

i) Define MMF and reluctance. An iron ring of mean length 100 cm and cross- sectional area of 120cm^2 with an air gap of 2 mm has a winding of 500 turns. The relative permeability of iron is 600. When a current of 3 A flows in the winding, determine reluctance of iron, reluctance of air gap & magnetic flux. (Neglect magnetic leakage & fringing).

ii) State relationship between self-inductance and mutual inductance between two magnetically coupled coils. Calculate mutual inductance and self-inductance of each coil if two coils of 250 and 750 turns respectively. They are wound on iron ring of mean diameter 175mm and cross section area of 750 sq mm with relative permeability of 1500. Assume perfect coupling between two coils.

Q3) a) Attempt any One. **[6]**

i) Derive the expression for RMS value in terms of its maximum value for sinusoidally varying alternating current.

ii) Obtain the expression for instantaneous power in case of purely capacitive circuit and by using this expression, prove that this circuit never consumes power.

b) Attempt any One. **[8]**

i) Define form factor and peak factor. Root means square value of a pure sine wave shaped alternating current is 10A. Waveform completes half cycle in 10ms when starting at t=0 sec. Write the equation of current and estimate instantaneous values at t=l5ms and t=4ms in first complete cycle.

ii) Draw phasor diagram for purely inductive and capacitive circuit. There are two impedances $Z_1 = 3 + j\,4$ and $Z_2 = 6 - j\,8$. Carry out following mathematical operations to find Z (equivalent) in rectangular form.

1) $Z_1 \times Z_2$

2) $Z_2 - 3\,Z_1$

3) $Z_2 - 2\,Z_1$

Q4) a) Attempt any One. **[6]**

i) Derive expression for resonance frequency in RLC series circuit and show how reactance's, impedance and current vary with frequency.

ii) Derive the relation between line voltage and phase voltage for three phase star connected balanced R-L load.

b) Attempt any One. **[8]**

i) Explain power triangle in R-L circuit and estimate three types of powers in a typical motor winding circuit having resistance of 30 ohm and inductive reactance of 40 ohm when connected across 230V AC supply.

ii) With the help of diagram show how to get a single-phase supply from a three-phase supply system. Three phase load consist of 100 ohm resistance in each branch and is connected to 3 Ph, 415V, 50Hz supply. Calculate phase voltage, line current, and active power, when load is connected in star and then in delta.

Q5) a) Attempt any One. **[6]**

i) With the help of suitable diagrams, explain working principle of three phase induction motor and state any four applications of same.

ii) Draw sectional view of DC motor and state functions of any three parts.

b) Attempt any One. **[8]**

i) Explain working principle of transformer. Calculate primary turns, full load secondary current and maximum flux in core of a single-phase transformer having rating of 10kVA 3300V/220V, 50Hz. EMF per turn is 10V.

ii) Write formula of copper loss and iron loss in single phase transformer. Full load copper loss and iron loss of a 80KVA, l000V/ 250V, 50Hz, transformer are 1200W and 800W respectively. Calculate efficiency at half load, unity power factor and full load, 0.8 power factor (lagging).

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