2PM

25/4/17

Indian Institute of Engineering Science and Technology, Shibpur

B. Tech - M. Tech Dual Degree 2nd Semester (CE, ME, AE, Met.E, Min.E)

Final Examination, April-2017

Basic Electrical Engineering (EE-1201)

Full Marks: 70 **Time: 3 hours**

(i) Use separate answer-script for each half
(ii) Answer ***SIX*** questions taking any ***THREE*** questions from each half
(iii) All parts of a question ***MUST*** be answered in the same place
(iv) Two marks are reserved in each half for neat and organized answer-script

First Half

1. (a) State and explain Maximum Power Transfer Theorem.

   (b) Use Thevenin's Theorem to find the power delivered to the 3 Ω resistance in the circuit shown in Fig.Q1

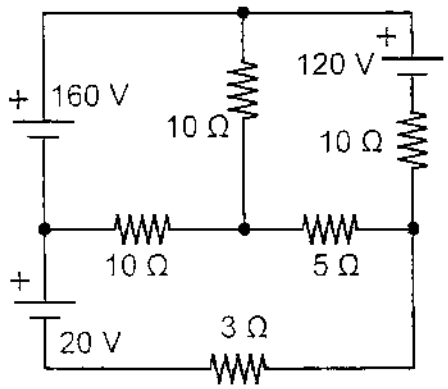

Fig. Q1

[3 + 8]

2. A 20 hp, 230 V, 1150 RPM shunt motor has four poles, four parallel armature paths, and 882 armature conductors. The armature-circuit resistance is 0.188 Ω. At rated speed and rated output, the armature current is 73 A and the field current is 1.6 A. Calculate:

   (a) The electromagnetic torque

   (b) The flux per pole

   (c) The copper loss in the armature circuit

   (d) The developed mechanical power

[3 + 3 + 3 + 2]

3 (a) Explain different components of iron loss. Define the following terms in connection with magnetic hysteresis:

(i)Residual flux density (ii) Coercive force

(b) A rectangular iron core is shown in **Fig. Q3**. An air gap of 0.2 cm is cut through the core. Mean length of the iron path is 60 cm. The cross-sectional area of the core is 15 cm^2. It is excited by two coils each having 400 turns. When the current in the coils is 1.0A, the resulting flux density gives a relative permeability of 1200. Calculate (i) the reluctance of the iron part, (ii) the reluctance of the air gap, (iii) total reluctance, (iv) total flux and (v) flux density in the air gap. Neglect leakage and fringing.

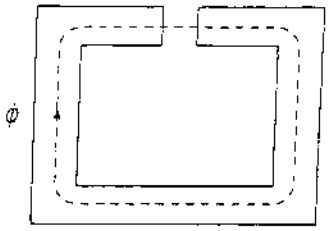

Fig. Q3

[(3+3) +5]

4. (a) Draw a complete phasor diagram of a transformer under no load condition and explain the presence and position of each phasor.

(b) A 40 KVA, single phase transformer has 500 turns on the primary winding and 100 turns on the secondary winding. The primary winding is connected to a 3000V, 50 Hz. Single phase supply.

Determine the following.

(i) Secondary voltage on open circuit

(ii) Primary and secondary full load currents

(iii) Maximum value of flux [5+(1 + 3 +2)]

5. Answer any two of the following. [2 x 5.5]

(a) Describe how open-circuit and short-circuit tests are performed on a single phase transformer. Discuss the significance of these tests.

(b) Describe the working of a permanent magnet moving coil ammeter.

(c) Describe the major constructional parts of a dc machine and their functions

Second Half

6. (a) Calculate the RMS value, average value, peak factor and form factor of the voltage waveform as shown in **Fig.- Q6.**

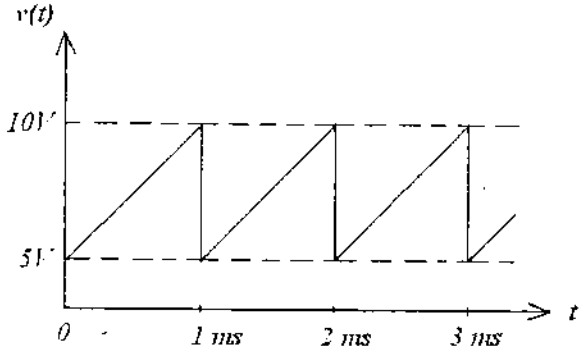

Fig.-Q6

(b) A sinusoidal voltage of $v(t)$ =325 sin (314t – π/6) when applied across an L-R series circuit causes a current of $i(t)$ =14.14 sin(314t- π/3) flowing through the circuit. Calculate the value of L and R of the circuit. Also, calculate the active and reactive power consumed by the load.

[(2+2+1)+(3+2)]

7. (a) Define power factor in a single phase AC circuit. (2)

(b) Prove that $j = \sqrt{(-1)}$. (2)

(c) Determine the total current drawn from the supply as shown in **Fig-Q7**. Draw the phasor diagram showing all important voltages and currents. Also calculate the power factor of the circuit.

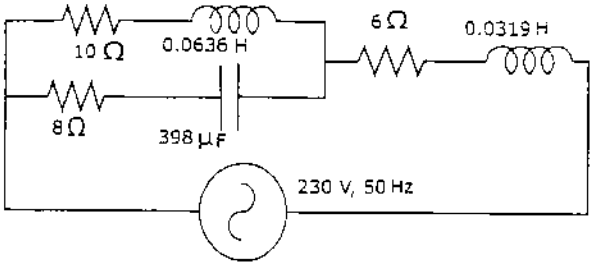

Fig-Q7

[2+2+ (2+3+2)]

8. (a) Define and explain 'half power frequency' and 'bandwidth' for a series RLC circuit.

(b) A circuit of R= 4 Ω, L=0.5H and a variable capacitance C in series is connected across a 100V, 50Hz supply. Calculate (a) the value of capacitance for which resonance will occur, (b) the voltage across the capacitor at resonance and the Q-factor of the circuit.

[(2+2)+(3+2+2)]

9. (a) Explain the term "phase sequence" with reference to a three phase voltage source.

(b) A balanced three phase delta connected load is fed from a 400V, 3-phase, 50 Hz supply. The current per phase is 25A (leading) and the total active power absorbed by the load is 14 kW. Determine (i) the resistance and capacitance of the load per phase (ii) the total reactive power and (iii) the total apparent power.

[(3) +(2+2+2+2)]

10.(a) A 3-phase, 4-pole, 100Hz induction motor has a slip of 2% at no load and 4% at full load. Find (i) The synchronous speed (ii) the no-load speed (iii) the full load speed, (iv) the frequency of rotor currents at standstill and (v) the frequency of rotor-currents at full load.

(b) Explain how and why a rotating magnetic field is created in a three phase induction motor. Hence, explain the principle of working of a 3-phase induction motor.

[(1+1+1+1+1) +(3+3)]

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