

END SEMESTER EXAMINATION

MAY-2012

EE-105 ELECTRICAL SCIENCES

Time: 3:00 Hours

Max. Marks : 70

**Note :** Question No. **ONE** is compulsory & should be answered at one place.  
Answer any **FOUR** questions from the rest.  
Assume suitable missing data, if any.

- 1 Explain the following with reasoning:
- [a] Why is damping torque necessary in indicating instruments?
  - [b] Discuss, how an induction machine has the action of a generalized transformer?
  - [c] Define magnetic reluctance and show that it is analogous to electric resistance.
  - [d] Show that in a three phase balanced voltage sources connected to form a delta, the sum of voltages around the loop so formed is zero.
  - [e] Explain the meaning of reactive power and power factor in ac (steady state) circuits.
  - [g] Show that for a network with dependent sources, the Thevenin resistance of a network as seen from two terminals is given by:  
 $R_{TH} = V_{oc} / I_{sc}$ .
  - [h] Show that the frequency of instantaneous power is double the frequency of applied voltage in a pure capacitor.

2×7=14

- 2[a] A resistance of 12 ohm, an inductance of 0.15H and a capacitance of 100μF are connected in series across a 100V, 50 Hz supply. Calculate the impedance, current, the voltage across R, L, C the pf of the circuit active and reactive power consumed. 7

- [b] Derive the relation between quality factor, Bandwidth and resonance frequency for a parallel RLC circuit. 7

3[a] Discuss the working principle of digital electronic ammeter. Draw a block diagram scheme for it and bring out the functions of each block.

7

[b] A 60 mV /120mV dual range multimeter when used to measure the voltage across two points in a dc circuit gives reading of 27.5 mV to 30 mV when 60 mV and 120 mV ranges respectively, are employed. Assuming that meter has been correctly calibrated, estimate the true value of the voltage existing across the two points in the dc circuit. The millivoltmeter has sensitivity of  $7.5\text{K}\Omega/\text{V}$ .

7

4[a] Explain the working principle of 3- $\phi$ , induction motor. Why 1-phase induction motor is not self starting?

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[b] A 400V, 3- $\phi$ , 50 Hz, power supply is applied across the three terminals of a delta connected three phase load,. The resistance and reactance of each phase is  $6\Omega$  and  $8\Omega$  respectively. Calculate the line current, phase current, active power, reactive power and apparent power of the circuit.

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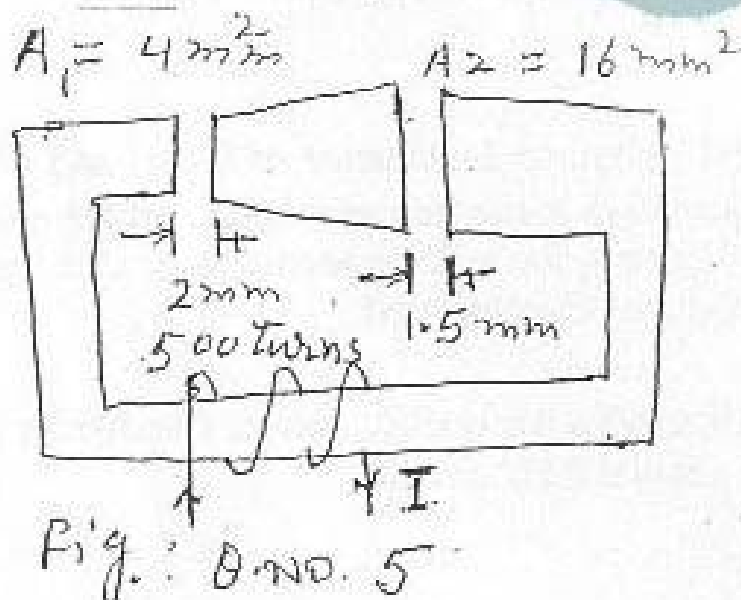
5[a] A magnetic circuit with a tapered slug of steel supported between two pole pieces is shown in Fig. below. The coil has 500 turns and  $\mu_0 = 4\pi \times 10^{-7}$ . The permeability of the core is infinity and fringing in the air gap is neglected.

(i) How much current is required in the coil to set up a flux density of  $1\text{wb}/\text{m}^2$ , in the left hand air-gap?

(ii) What is the inductance of coil?

(iii) If there is a dc current of I amperes in the coil, what is the net force on the steel slug between the poles.

7



[b] A 1000/200V, 25 kVA a transformer is connected as an auto-transformer to yield a transformation ratio of 1000/200V. Calculate its KVA rating as an auto transformer. Also calculate currents in the two windings and line currents when the transformer is fully loaded. 7

6[a] Find the phasor form of the following:

(i)  $i(t) = 10 \cos(10t + 60^\circ) + 15 \cos(10t - 30^\circ) A$

(ii)  $i(t) = 460 \cos(500\pi t - 25^\circ) - 220 \sin(500\pi t + 15^\circ) A$  4

[b] In the circuit shown below find the voltage, V using Norton's theorem 6

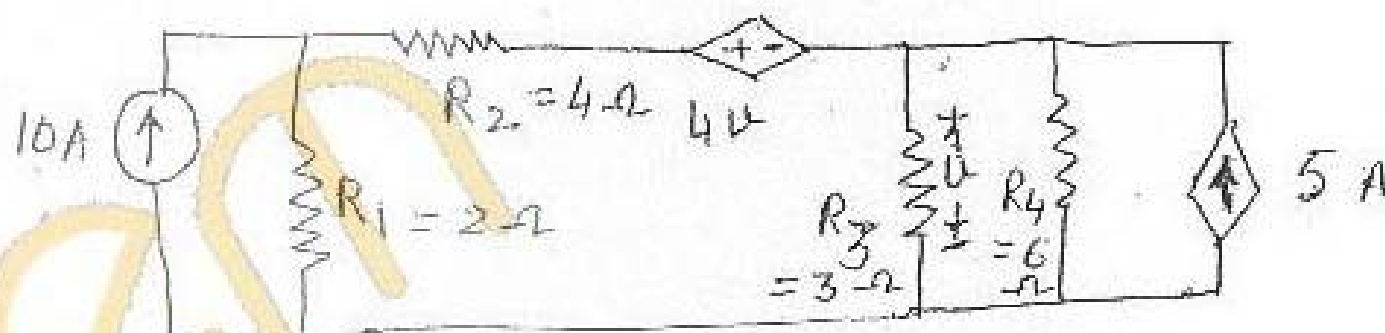


Fig. : 6-a

[c] A variable load  $R_L = (0 - 25 \text{ ohms})$ , is connected across the two batteries, which are connected in parallel. The open circuit voltages of the two batteries are 120V and 65V, respectively, and their internal resistances are  $40\Omega$  and  $60\Omega$  respectively. What is the maximum power that can be absorbed by the load if it is varied? Find the efficiency of the system. 4

7[a] Find the power consumed/generated by each element for the circuit Fig. 7(a) 3

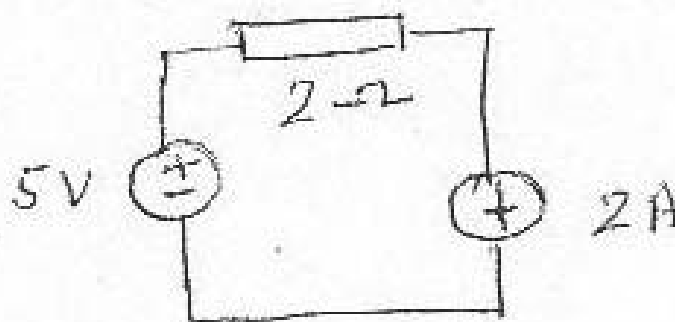


Fig. : (7-a)

- [b] The metro-station is supplied 7.5kw electric lightening and fan load by a small diesel generator set during power supply failure. The efficiency of diesel engine and electrical generator are 50% and 90% respectively. If the set runs average 70 hours/month. The cost of diesel is Rs.35 per litre and calorific value of diesel is 51, 500 kJ/hr, calculate the per KWh unit cost of electricity. 7
- [c] Two capacitors A and B having capacitances of  $20\mu\text{f}$  and  $30\mu\text{f}$ , respectively are connected in series to a 600 V dc supply. Now, a third capacitor C is connected in parallel with A and it is found that the p.d. across B is 400V. Calculate the capacitance of C and the energy stored in it. 4