SEM 1 – 4 (RC 07-08)

F.E. Semester I (Revised in 2007-08) Examination, November/December 2010
BASIC ELECTRICAL ENGINEERING

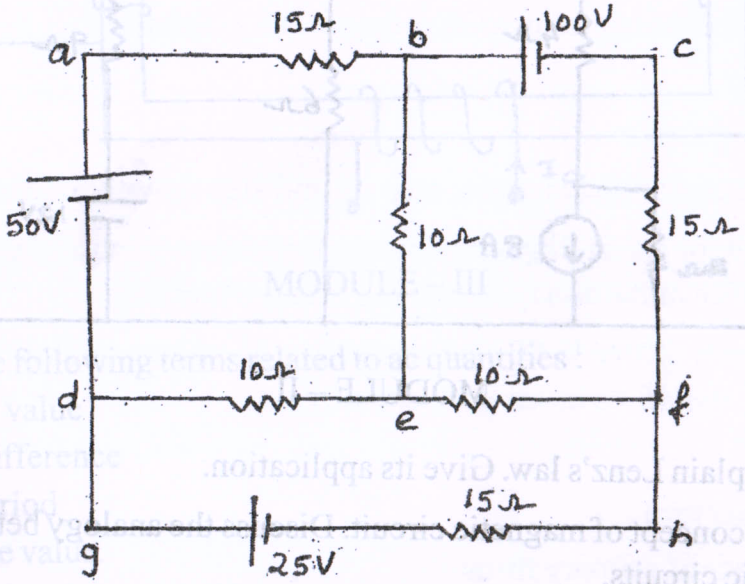
Duration: 3 Hours | Total Marks: 100

Instructions: *1) Answer 5 questions in **full** with at least **one** question from **each** Module.*
*2) Missing data, **if any**, may be suitably **assumed**.*

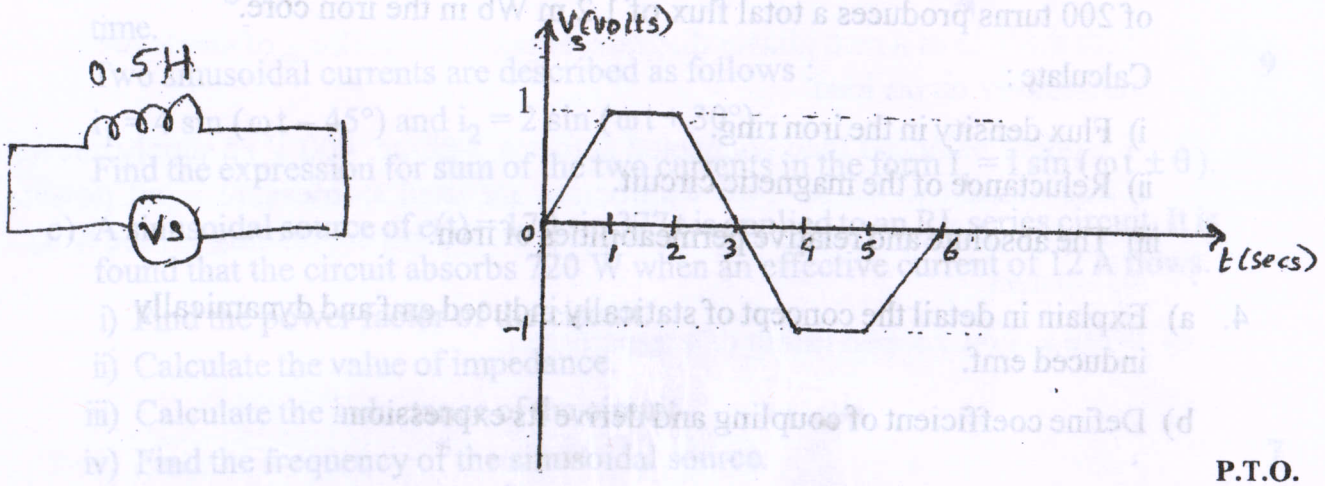
MODULE – I

1. a) Derive expressions for converting a star network to a delta equivalent network. **4**

   b) Using Kirchoff laws, find currents in all the branches of the network. **8**



   c) The voltage waveform shown is applied across an inductor of 0.5 H. Sketch the resultant current waveform in time synchronisation with voltage waveform. **8**

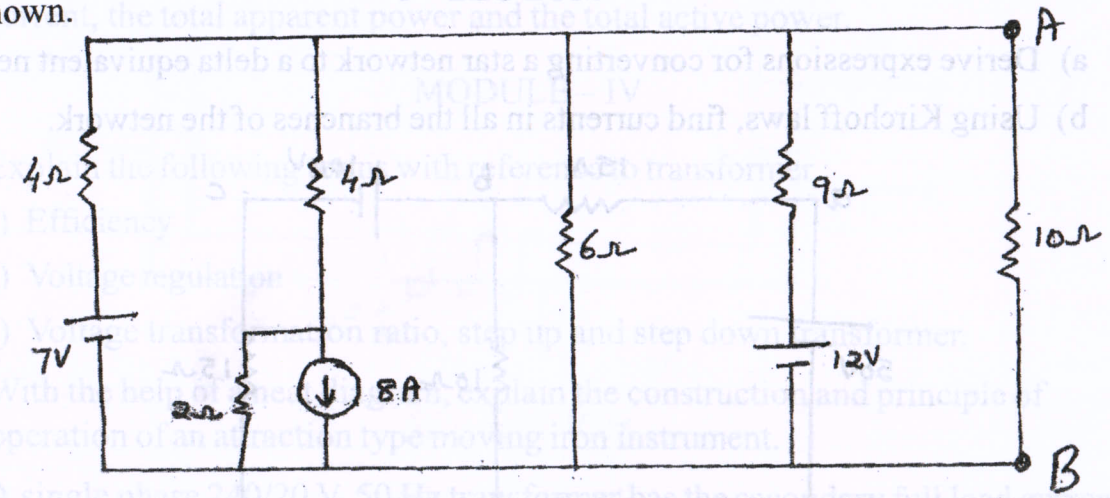


P.T.O.

2. a) State Thevenins theorem and Norton's theorem. 4

b) Explain the energy viewpoint of resistance. A piece of silver wire has a resistance of 1 Ω. What will be the resistance of manganin wire of one-third of the length and one-third the diameter of that of silver wire ? The resistivity of manganin is 30 times that of silver. 8

c) Using Norton's theorem, find the current in the 10 Ω resistor in the network shown. 8



MODULE – II

3. a) State and explain Lenz's law. Give its application. 6

b) Explain the concept of magnetic circuit. Discuss the analogy between electric and magnetic circuits. 8

c) A magnetic circuit consists of an iron ring of mean circumference 80 cms with cross-sectional area 12 cm^2 throughout. A current of 2A in the magnetising coil of 200 turns produces a total flux of 1.2 m Wb in the iron core. 6

Calculate :

i) Flux density in the iron ring.

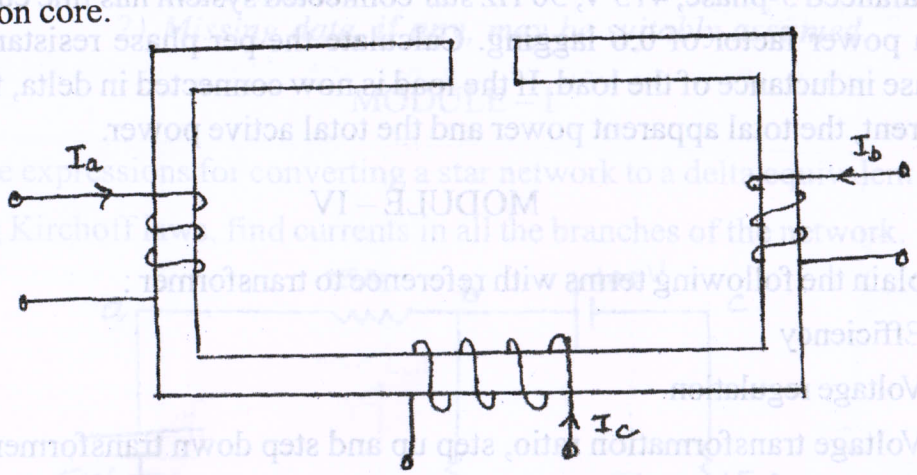
ii) Reluctance of the magnetic circuit.

iii) The absolute and relative permeabilities of iron.

4. a) Explain in detail the concept of statically induced emf and dynamically induced emf. 6

b) Define coefficient of coupling and derive its expression. 7

c) A rectangular iron core as shown, has a mean length of magnetic path of 100 cms, cross section of 2 cm × 2 cm, relative permeability of 1400 and an air gap of 5 mm cut in the core. The three coils carried by the core have number of turns, $N_a = 335$, $N_b = 600$, $N_c = 600$ and the respective currents are $I_a = 1.6$ A, $I_b = 4$ A and $I_c = 3$ A. The direction of the currents are as shown. Find the flux in the iron core. 7



MODULE – III

5. a) Explain the following terms related to ac quantities :
   i) Average value
   ii) Phase difference
   iii) Time period
   iv) Effective value. 4

   b) With a neat sketch explain how an alternating voltage is produced when a coil is rotated in a magnetic field. Derive an expression for the instantaneous value of alternating sinusoidal emf in terms of its maximum value, angular frequency and time.
   Two sinusoidal currents are described as follows : 9
   $i_1 = 4 \sin(\omega t - 45°)$ and $i_2 = 2 \sin(\omega t + 30°)$
   Find the expression for sum of the two currents in the form $I_s = I \sin(\omega t \pm \theta)$.

   c) A sinusoidal source of $e(t) = 170 \sin 377\,t$ is applied to an RL series circuit. It is found that the circuit absorbs 720 W when an effective current of 12 A flows.
   i) Find the power factor of the circuit.
   ii) Calculate the value of impedance.
   iii) Calculate the inductance of the circuit.
   iv) Find the frequency of the sinusoidal source. 7

6. a) Draw the waveform representation of a 3-phase system and show that the resultant instantaneous values of the three emf's is zero. 4

   b) Derive the relationship between phase and line quantities in a delta connected three-phase system. 8

   c) A balanced 3-phase, 415 V, 50 Hz star connected system has line current of 4 A at a power factor of 0.6 lagging. Calculate the per phase resistance and per phase inductance of the load. If the load is now connected in delta, find the line current, the total apparent power and the total active power. 8

MODULE – IV

7. a) Explain the following terms with reference to transformer : 6

   i) Efficiency

   ii) Voltage regulation

   iii) Voltage transformation ratio, step up and step down transformer.

   b) With the help of a neat diagram, explain the construction and principle of operation of an attraction type moving iron instrument. 9

   c) A single phase 240/20 V, 50 Hz transformer has the secondary full load current of 180 A. It has 45 turns on its secondary.

   Calculate :

   i) voltage per turn

   ii) the number of primary turns

   iii) the full load primary current and

   iv) the kVA output of the transformer. 5

8. a) With the help of a neat phasor diagram, explain the working of single phase transformer on no-load. 7

   b) A 3-phase balanced load connected across a 3-phase, 400 V ac supply, draws a line current of 10 A. Two wattmeters are used to measure input power. The ratio of the two wattmeter readings is 2 : 1. Find the readings of the two wattmeters. 8

   c) Write a short note on rating of a transformer. 5