F.E. (Sem. – I) (R.C. 2007-08) Examination, May/June 2013
BASIC ELECTRICAL ENGINEERING

Duration : 3 Hours Total Marks : 100

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

MODULE – I

1. a) Define the following circuit elements from geometrical viewpoint :
   i) Resistance
   ii) Inductance
   iii) Capacitance. 6

   b) Determine the current in 2 Ω resistor by the Thevenin's theorem. Also verify it using mesh analysis. 7

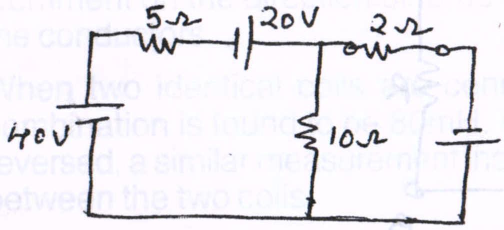

Fig. (1b)

   c) For the circuit shown, determine the equivalent series resistance of the circuit. Find the current in the 25 Ω resistance and the voltage drop across the 80 Ω resistance. 7

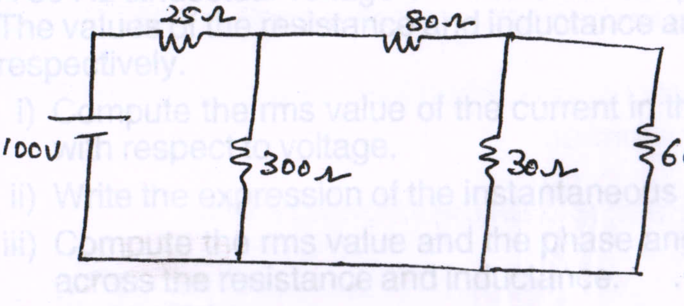

Fig. (1c)

2. a) State and explain : 6
   i) Kirchoff's current law
   ii) Kirchoff's voltage law.

   b) Find the capacitance of the circuit element for the following cases : 6
   i) A voltage of 100V yields an energy storage of 0.05 Joules in an electric field.
   ii) Voltage increases linearly from zero to 100V in 0.2 secs. causing a current flow of 5mA.
   iii) Two flat parallel plates are separated by a 0.1 mm layer of mica and have a total area of $0.113m^2$. Assume mica to have a relative permeability of 10.

   c) For the circuit shown in fig. (2c), determine the value of R for maximum power transfer. Calculate the maximum power transfer through R. 8

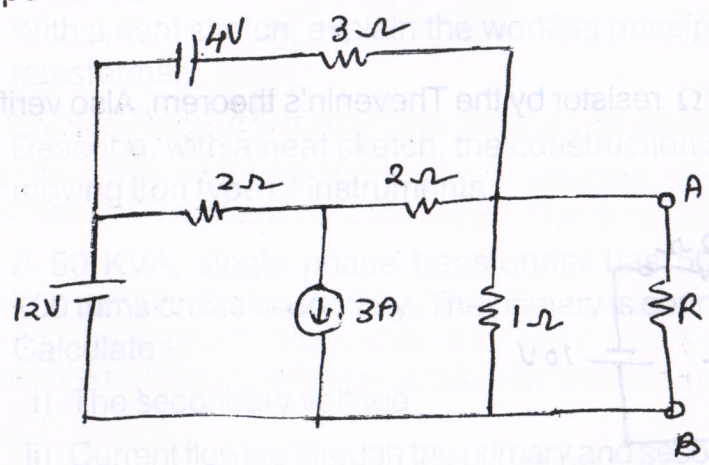

Fig. (2c)

MODULE – II

3. a) Explain the following : 6
   i) Flux density
   ii) Reluctance
   iii) Magnetic field strength
   iv) Magnetic potential
   v) Magnetomotive force
   vi) Flemings left hand rule.

   b) Explain how energy is stored in a magnetic field. Derive the expression for energy stored in the magnetic field. 6

c) A cast steel magnetic structure made of a bar of section 8cm×2cm is as shown in fig. (3c).

Determine the current that the 500 turns magnetising coil on the left limb should carry so that a flux of 2mwb is produced in the right limb. Take relative permeability as 600 and neglect leakage. Dimensions of the magnetic structure are shown in the figure.

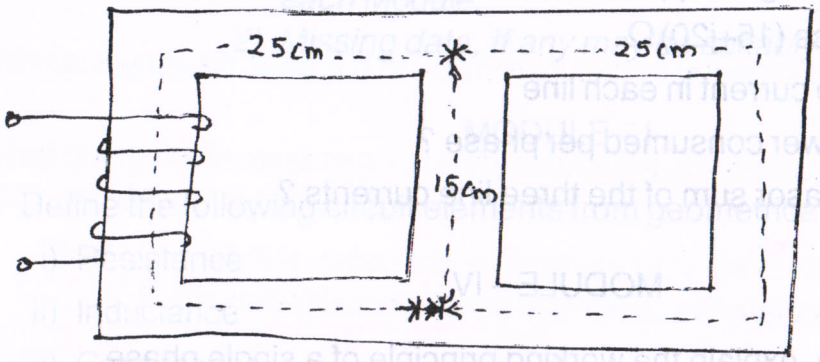

Fig. (3c) 8

4. a) State the similarities and differences between electrical and magnetic circuits. 8

b) Derive expression for force between two current carrying conductors. Comment on the direction of force with respect to the direction of current in the conductors. 6

c) When two identical coils are connected in series, the inductance of the combination is found to be 80mH. When the connection to one of the coil is reversed, a similar measurement indicates 20mH. Find the coupling coefficient between the two coils. 6

MODULE – III

5. a) Define phase difference. Explain the concept of leading and lagging phase angle. 5

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

c) A 60 Hz sinusoidal voltage V = 141 Sinωt is applied to a series RL circuit. The values of the resistance and inductance are 3Ω and 0.0106 H respectively. 7

i) Compute the rms value of the current in the circuit and its phase angle with respect to voltage.

ii) Write the expression of the instantaneous current in the circuit.

iii) Compute the rms value and the phase angle of the voltages appearing across the resistance and inductance.

iv) Find the average power dissipated by the circuit.

v) Calculate the power factor of the circuit.

6. a) Derive a relationship between current and voltage in a RC circuit. Draw the waveforms of instantaneous values of voltage and current. 7

b) Graphically show the representation of a three phase system and explain the concept of phase sequence. 6

c) A 220V, 3-phase voltage is applied to a balanced delta connected 3-phase load of phase impedance $(15+j20)\Omega$. 7

i) Find the phase current in each line

ii) What is the power consumed per phase ?

iii) What is the phasor sum of the three line currents ?

MODULE – IV

7. a) With a neat sketch, explain the working principle of a single phase transformer. 6

b) Describe, with a neat sketch, the construction and principle of operation of moving iron type of instruments. 9

c) A 50 KVA, single phase transformer has 500 turns on the primary and 100 turns on the secondary. The primary is connected to 2100V, 50Hz supply. Calculate :

i) The secondary voltage

ii) Current flowing through the primary and secondary windings on full load and

iii) Peak value of flux. 5

8. a) A 3-phase, 500V motor load has a power factor of 0.4. Two wattmeters are connected to measure the power. They show the input to be 30 kW. Find the reading on each wattmeter. 5

b) Write a short note on open and short circuit test on a single phase transformer. 8

c) Explain how primary current changes, when load current is set up in the secondary winding of a transformer. 7

For a single phase transformer, explain the following terms :

i) Magnetic leakage

ii) Copper loss.