First Semester Examination – 2012-13

BASIC ELECTRICAL ENGINEERING

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions :   2×10

    (a) A voltmeter with an internal resistance of one mega ohm is connected across the series combination of a 20 kilo-ohm resistance and a 30 V ideal battery. Calculate the reading of the voltmeter.

    (b) Find the energy dissipated by a heater in a 48 hours when it takes 25 A at 220 V.

    (c) A voltage of 30 V is applied to a resistance R in series with an ammeter A of 0.15 ohm resistance. Calculate the value of the resistance R if the reading of A is 60 ampere.

    (d) An alternating voltage of $(100 + j100)$ V is applied to a circuit and the current flowing is $(-10 + j10)$ A. Find the impedance of the circuit.

    (e) A resistor of 25 ohms in series with a 0.75 H inductor is connected across a supply at 250 V, 50 Hz. Find the current through the inductor.

    (f) What is the equation of a sinusoidal current of 250 Hz frequency having an rms value of 20 A ? What is the peak value of the current ?

    (g) A balanced 3-phase, star connected load of 75 kW takes a lagging current of 75 amperes when connected to a line voltage of 415 V, 50 Hz. Find the impedance of the load per phase

(h) Explain the terms 'self-excited' and 'separately excited' as regards to direct-current machines.

(i) Calculate the 'synchronous speed' in revolutions per minute (RPM) of a four-pole AC motor drawing power from a 60 Hz three-phase balanced a.c. supply.

(j) An iron ring has a circular cross-section of 4 cm diameter and a mean circumference of 80 cm. Calculate the reluctance offered by the iron ring assuming its relative permeability to be equal to 800. ($\mu_0 = 4\pi \times 10^{-7}$ H/m).

2. (a) What is the potential difference between points A and B in Fig.1 ? The values of the resistances are : R1 = 11 kilo-ohms, R2 = 220 kilo-ohms, R3 = 6.8 kilo-ohms and R4 = 0.22 mega-ohms.   5
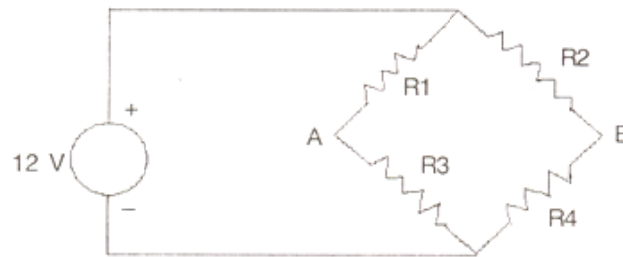

Fig. 1

(b) State and explain the 'Superposition Theorem' with an example.   5

3. (a) Using the Node-Voltage Analysis method, find the voltages V1 and V2 for the circuit of Fig. 2. The voltage source Vs = 20 V and the resistances are : R1 = 30 ohms, R2 = 10 ohms, R3 = 20 ohms, R4 = 30 ohms and R5 = 30 ohms.   6
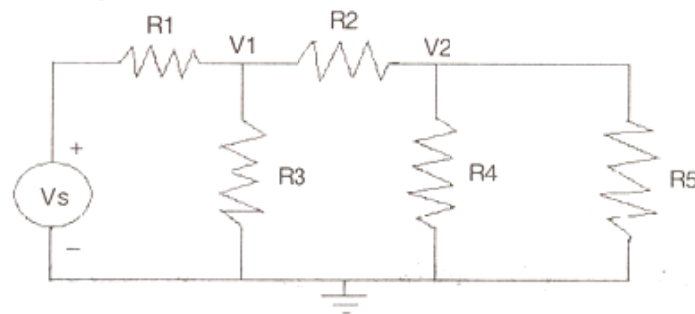

Fig. 2

(b) An inductance of 0.63 H is in series with a capacitance of 0.95 micro-farad. Find the impedance of the circuit when the frequency is (i) 70 Hz, and (ii) 15 kHz. 4

4. (a) In the parallel circuit shown in Fig. 3, the voltage across the 5 ohms resistor is 25 volts. Calculate the total current I and draw the complete phasor diagram. 6
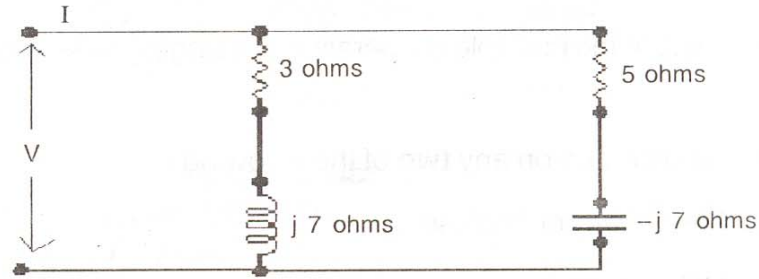

Fig. 3

(b) A 3-phase, 3-wire, 440 volts, 50 Hz, RYB system of balanced supply is connected to a star connected load with Z_{RN} =100 $\angle 30°$ ohms Z_{YN} = 110 $\angle -30°$ ohms and Z_{BN} = 105 $\angle 45°$ ohms, where 'N' is the neutral point of the star connection. Obtain the three line currents. What is the voltage across Z_{RN} ? Assume the supply neutral to be earthed. 4

5. (a) An iron ring has a mean diameter of 35 cm and a cross-sectional area of 5 cm². It is wound with a coil of 2000 turns. An air gap of 1.5 mm width is cut in the ring. Determine the current required in the coil to produce a flux of 0.75 milli-weber in the air gap, if the relative permeability of iron under these conditions is 1000. Neglect leakage and fringing. The value of μ_0 equals to $4\pi \times 10^{-7}$ H/m. 6

(b) Describe the series and shunt methods of excitation provided in d.c. machines. Show the field connection diagram in both the cases. .4

6. (a) Explain how an analog voltage signal gets converted to its digital form (i.e. to a binary word) using an analog-to-digital converter (ADC). 6

(b) A 4-pole d.c. shunt generator has 1000 armature conductors in four parallel paths. The average flux per pole in the air gap is 0.075 weber. Calculate the

generated emf if the prime mover coupled to this generator runs at a speed of 1000 RPM.   4

7. (a) Calculate the torque developed at rated conditions in a separately excited 75 kW, 220 V, 1500 RPM d.c. generator having an armature resistance of 0.1 ohm. Assume the flux per pole in the airgap of the machine to be equal to 0.5 weber.   6

    (b) Explain the principle of operation of a single-phase two winding transformer.   4

8. Write short notes on any **two** of the following :   5×2

    (a) Mesh Current Analysis

    (b) D/A conversion

    (c) Magnetic materials and B-H curves

    (d) Principle of Maximum Power Transfer

    (e) Transient Response of second order circuits.