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Total number of printed pages – 8 B. Tech
BENG 1102/BE 2102

First Semester Examination – 2008

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 margin indicate full
marks for the questions.

1. Answer the following questions : 2×10
- (a) Three resistances of 10 ohms, 20 ohms and 25 ohms magnitude are connected in parallel across a 200 volts d.c. source. Compute the current and power drawn from the source.

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- (b) Four resistances of 5 ohms, 10 ohms, 15 ohms and 20 ohms magnitude are connected in series and the series combination is connected across a 200 volts d.c. source. Compute the voltage across each resistor.
- (c) An inductor of inductance 75 milli-henries carries a current of 10 A which reverses in 20 milliseconds. What is the average voltage induced in the inductor because of this current reversal ?
- (d) A 15-microfarad capacitor in series with a 15 kilo-ohm resistance is connected across a constant DC voltage source of 250 volts. The fully charged capacitor is disconnected from the supply and is discharged by connecting a 1000 ohm resistance across its terminals. Compute the initial value of the charging current and the initial value of the discharging current.

- (e) A resistor of 20 ohms in series with a 0.5 H inductor is connected across a supply at 250 V, 60 Hz. Find the current through the inductor.
- (f) A circuit consists of a resistor of 15 ohms in series with a capacitor of 50 microfarads. The frequency is 60 Hz. Calculate the conductance and the susceptance of the circuit.
- (g) A 3-phase balanced delta-connected load is connected to a symmetrical 3-phase 440 V balanced supply. The current in each phase is 50 amperes and lags 30 degrees behind the corresponding phase voltage. Find the line current and the total power.
- (h) An iron ring with a circular cross section of 5 cm diameter and a mean circumference of 100 cm is wound with a coil of 500 turns. Calculate the exciting current in the coil to establish a flux of 1.75 milli-weber in the magnetic circuit. The relative permeability of iron is 1200 and μ_0 equals to $4\pi \times 10^{-7}$ H/m.

(i) What do you mean by the term 'slip speed' of a three-phase induction motor? Calculate the 'slip speed' of an eight-pole induction motor running at 730 RPM while drawing power from a 50 Hz three-phase balanced source.

(j) Two impedances $25 \angle -50^\circ$ and $15 \angle 45^\circ$ are connected in parallel. Find out the resultant impedance in rectangular form.

2. (a) Using Thevenin's theorem, find the current flowing in the 40-ohm resistor in Fig. 1 below.

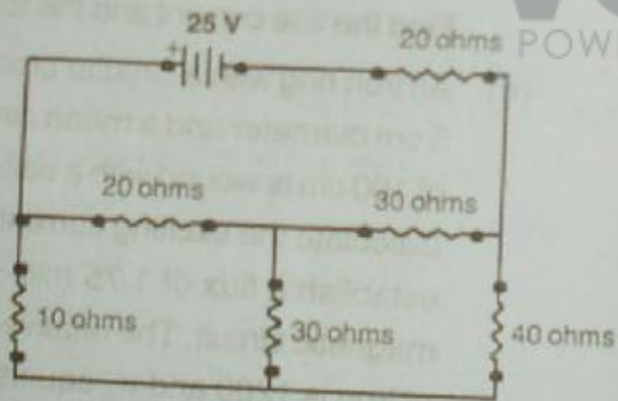


Figure - 1

(b) State and briefly explain Norton's Theorem with one example. 4

3. (a) Describe the principle of operation of a d.c. motor. Write down and explain the expression for the 'back emf' induced in the motor. 4

(b) A single-phase a.c. supply voltage of 230 V at 50 Hz is connected to a 30-ohm resistor in series with a coil. The reading of a voltmeter across the resistor is 150 volts and across the coil is 100 volts. Calculate the real power and reactive power of the coil and overall power factor of the circuit. 6

4. (a) A 3-phase, 3-wire, 415 volts, 50 Hz, RYB system of balanced supply is connected to a star connected load with $Z_{RN} = 110 \angle 40^\circ$ ohms $Z_{YN} = 105 \angle -50^\circ$ ohms and $Z_{BN} = 90 \angle 30^\circ$ ohms, where 'N' is the neutral point of the star connection. Obtain the three line currents and draw the complete phasor diagram showing the line voltages, phase

voltages and line currents. The supply neutral is earthed. 7

(b) Describe the various methods of excitation of a d.c. machine. Show the connection diagram in each case. 3

5. (a) An iron ring has a mean diameter of 45 cm and a cross sectional area of 10 cm^2 . It is wound with a coil of 2500 turns. An airgap of 1.5 mm width is cut in the ring. If the current flowing in the coil is measured to be equal to 2.5 A, then determine the flux produced in the airgap, if the relative permeability of iron under these conditions is 1400. Neglect leakage and fringing. Given, $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$. 5

(b) Write the expressions for the emfs induced in both the windings of a single-phase two winding transformer. Calculate the magnitude of the induced emf in each winding for a frequency of 50 Hz and a peak flux of 1.2 weber. The HV winding has

2200 number of turns while the LV winding has 440 number of turns. 5

6. (a) A coil of resistance 2.5 ohms and inductance 0.02 H is connected in series with a capacitor across 230 V mains. What must be the capacitance in order that maximum current occurs at a frequency of (i) 30 Hz (ii) 60 Hz and (iii) 120 Hz? Find also the voltage across the capacitor in each case. 6

(b) A balanced three phase star connected load of 200 kW takes a leading current of 150 A with a line voltage of 1100 V, 50 Hz. Find the circuit constants (resistance and capacitance) of the load per phase. 4

7. (a) Derive the mathematical expression of growth and decay of current in a R-L circuit subjected to a d.c. voltage. 4

(b) A single phase transformer has 500 primary and 1500 secondary turns. The net cross sectional area of the core is 100 cm^2 . If the primary winding be connected to a

50 Hz supply at 415 volts, calculate (i) the peak value of the flux density in the core and (ii) the voltage induced in the secondary winding. 3+3

8. (a) A moving coil instrument gives a full scale deflection of 20 mA when potential difference across its terminals is 200 mV. Calculate (i) the shunt resistance for measuring currents up to 20 A and (ii) series resistance for measuring voltage upto 400 V. 5

(b) Explain with the help of a block diagram the principle of power generation in a thermal power plant. 5

