Total number of printed pages – 10

B. Tech
BENG 1102

Second Semester Examination – 2007

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) Explain briefly the superposition principle of finding out current in one particular branch of a network containing several voltage and current sources.

P.T.O.

(b) A coil has a resistance of 10 ohms and inductance of 1 henry. What will be the value of current after 0.1 second of switching this coil to a 100 V d.c. supply?

(c) A condenser of 8-microfarad capacitance is connected to a d.c. source through a resistance of one mega-ohm. Calculate the time taken for the condenser to receive 95% of its final charge.

(d) What is the equation of a sinusoidal current of 60 Hz frequency having an rms value of 50 A ?

(e) Calculate the power dissipated in a 15-ohm resistance when a voltage of (225 + 225 sin 314t) is applied across it.

(f) Calculate the bandwidth and quality factor of a series R-L-C resonant circuit having R = 10 ohm, L = 0.5 mH and C = 0.15 microfarad.

(g) Three similar resistors connected in star draw a line current of 10 A from a 3-phase, 415 V, 50 Hz balanced supply. What should be the value of the line voltage to obtain the same line current with the resistors connected in delta ?

(h) An electromagnet has an airgap of 5 mm and the flux density in the gap is 1.5 Tesla. Calculate the ampere-turns required by the gap.

(i) Explain, in brief, why the torque developed by a three-phase induction motor becomes zero at synchronous speed.

(j) Draw and briefly explain the block diagram showing the principle of generation of electrical power in a nuclear power plant.

2. (a) Compute the current in the 0.1-ohm resistor connected between nodes A and B in Fig.1 using Kirchoff's Laws. 6

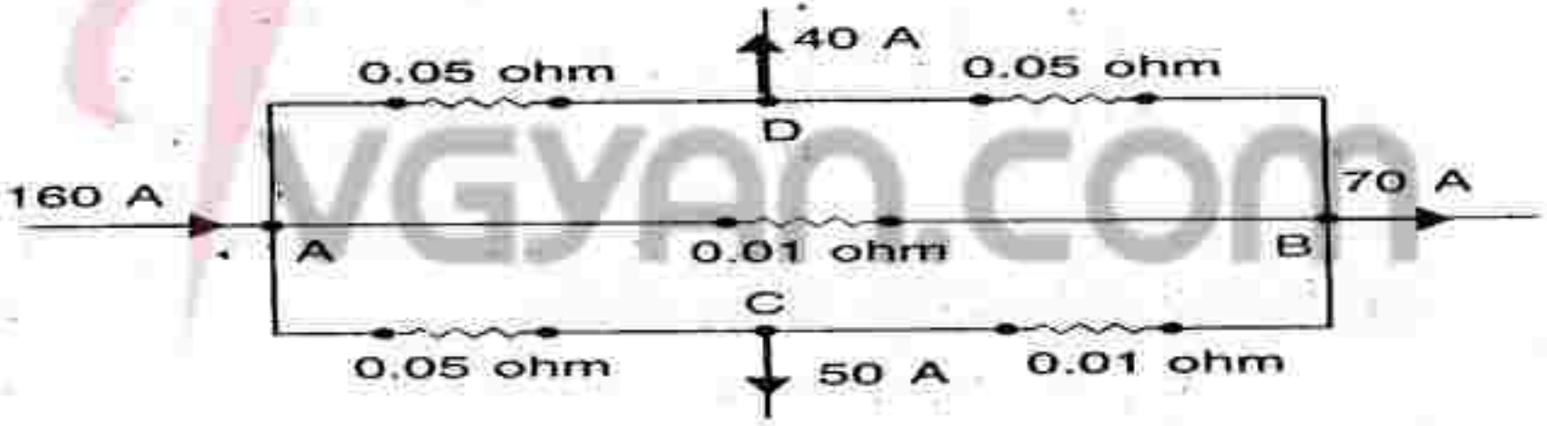

Figure - 1

(b) State and explain the Thevenin's theorem with an example. 4

3. (a) Explain the terms 'rms value' and 'average value' for an alternating quantity and determine these values for a sinusoidal voltage. 4

(b) In the parallel circuit shown in Fig.2, the voltage across the 3-ohm resistor is 45 volts. Calculate the total current I and draw the complete phasor diagram. 6

Figure - 2

4. (a) A 3-phase, 3-wire, 240 volts, 50 Hz, RYB system of supply has a delta connected load with $Z_{RY} = Z_{YB} = Z_{BR} = 15 \angle -30^{\circ}$ ohms.

Obtain the three line currents and draw the complete phasor diagram showing the line voltages, phase currents and line currents. 5

(b) An iron ring has a mean diameter of 30 cm and a cross sectional area of 5 cm^2. It is wound with a coil of 1500 turns. An airgap of 1.6 mm width is cut in the ring. Determine the current required in the coil to produce a flux of 0.45 milli-weber in the airgap, if the relative permeability of iron under these conditions is 900. Neglect leakage and fringing. Given, $\mu_0 = 4\pi \times 10^{-7}$ H / m. 5

5. (a) Explain the principle of operation of a single-phase two winding transformer. Derive its EMF equation. 4

(b) What is an autotransformer ? A single-phase, two-winding, 250/150 V, 50 Hz transformer is to be reconnected as an autotransformer to get a voltage of 400 V from a 250 V source supply. Show clearly the connection diagram. 3

(c) Calculate the loss of energy caused by hysteresis in one hour in 50 kg of iron, the hysteresis loop area of which is equivalent to 250 J/m^3. The operating frequency is 50 Hz and the density of iron is 7.8×10^3 kg/m^3. 3

6. (a) Describe the principle of operation of a d.c. generator. Write down and explain the expression for its 'induced emf'. 4

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

(c) Explain how the operating speed of a d.c. shunt motor can be changed by varying its field flux. Can the speed of the motor be reduced below its rated value by this method of speed control ? Explain. 3

7. (a) Explain in brief the construction and principle of operation of a three-phase squirrel-cage induction motor. Draw neatly its speed-torque characteristics. 6

(b) A 3-phase, 50Hz, 415 V, 6-pole induction motor runs at a speed of 960 RPM.

Calculate its 'slip' and the speed of its rotor mmf with respect to the rotor structure. 2

(c) Explain in brief how a single-phase induction motor is different in construction as compared to a 3-phase induction motor. 2

8. (a) State the merits and demerits of moving iron instruments. 2

(b) A permanent magnet moving coil instrument gives reading of 30 mA when the potential difference across its terminal is 90 mV. Calculate 4

(i) the shunt resistance for a full-scale deflection corresponding to 180 A

(ii) the series resistance for a full-scale reading with 600 V.

(c) A generator supplies a variable frequency voltage of constant amplitude 150 V (rms) to a series R-L-C circuit having R= 10 ohm, L= 5 milli-henry and C= 0.15 micro-farad. The frequency is to be varied until maximum current flows in the circuit. Predict the maximum current, the frequency at which it occurs and the resulting voltage across the inductance and capacitance. 4