Total number of printed pages – 8

B. Tech

BENG 1102

Second 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-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) A voltmeter V of 23 kilo-ohm resistance in series with a resistor R across a 230 V supply reads 92 volts. Calculate the value of resistor R.

   (b) A resistance R is connected across a potential difference of 110 volts and dissipates energy at the rate of 220 watts. Calculate the value of resistance R.

(c) Calculate the voltage at the terminals of the coil of resistance 5 ohms and inductance 10 henries at the instant when the current is 15 amperes and increasing at the rate of 5 ampere per second. What is the stored energy in the coil ?

(d) A 5-microfarad capacitor is connected to a constant DC voltage source of 230 volts through a resistance R. Across the capacitor a neon lamp is connected that strikes at 130 volts. Calculate R to make the lamp strike 4 seconds after switch has been closed.

(e) A circuit consists of a resistor of 15 ohms in series with an inductor of 0.2 H. The frequency is 50 Hz. Calculate the conductance and the susceptance of the circuit.

(f) A resistor of 115 ohms is connected in series with a 50 microfarad capacitor to a supply at 230 V, 50 Hz. Find the voltage across the capacitor.

(g) A 3-phase balanced star-connected load is connected to a symmetrical 3-phase 415 V balanced supply. The current in each phase is 45 amperes and lags 45 degrees behind the corresponding phase voltage. Find the phase voltage and the total power.

(h) An iron ring with a circular cross section of 4 cm diameter and a mean circumference of 80 cm is wound with a coil of 400 turns. For an exciting current of 2.5 A in the coil, the flux is found out to be 1.5 mWb. Calculate the relative permeability of iron. ($\mu_0 = 4\pi \times 10^{-7}$ H/m).

(i) What do you mean by the term 'slip' of a three-phase induction motor ? Calculate the slip of a 6-pole induction motor running at 1140 RPM while being connected to a 60 Hz three-phase source.

(j) Write down the expression for the 'emf per turn' induced in the windings of a single-phase two winding transformer. Explain the various terms in it.

2. (a) Using star-delta transformation, find the current drawn from the 20 V battery shown in Fig. 1 below. 6

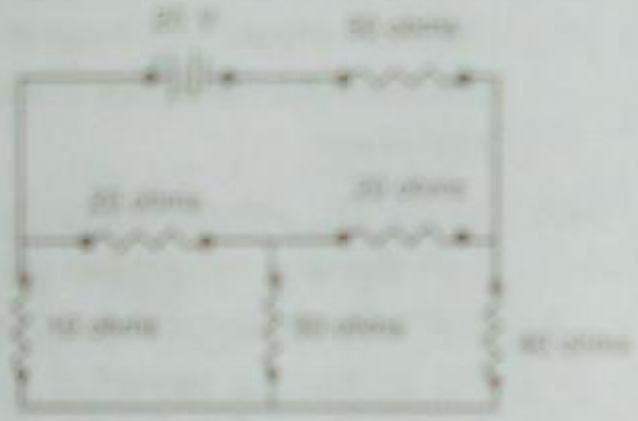

Fig. – 1

(b) State and briefly explain both 'Superposition Theorem' and 'Norton's Theorem' with one example in each case. 3×3

3. (a) A coil of resistance of 5 ohms and inductance of 0.5 H is connected in series with a capacitance of 0.25 microfarad. Find the impedance of the circuit when the frequency is (i) 60 Hz, and (ii) 3 kHz. 3

(b) The current taken by a coil is 6 A when a voltage of 120 V at 50 Hz frequency is applied across its terminals. The power absorbed by the coil is 180 W. When this voltage of 120 V at 50 Hz is applied to a second coil, the current drawn is 4 A and the power absorbed is 160 W. Now both the coils are connected in series and the series combination is connected across the same supply voltage of 120 V, 50 Hz. Find the current taken and power absorbed by this series combination of both the coils. 7

4. (a) A 3-phase delta connected induction motor operating from a three-phase 11 kV system develop an output of 750 kW at an efficiency of 0.9 per unit with an operating power factor of 0.86 lagging. Calculate the individual phase currents of the motor. How much phase current will flow in each phase of the motor winding if it is star connected ? 3

(b) A series resonant circuit is formed by connecting a coil of resistance 30 ohms

and inductance 0.6 H in series with a capacitor. The resonant frequency of the circuit is 65 Hz. If the supply given to the above series combination is 300 V, 70 Hz, find

(i) the line current

(ii) the power factor and

(iii) the voltage across the capacitor. 7

5. (a) A magnetic circuit comprises two parts in series, each of uniform cross sectional area (c,s.a.). They are

(i) iron of length 90 mm and c.s.a.75 mm^2

(ii) an airgap of length of 0.6 mm and c.s.a. 82 mm^2.

A coil wound on the iron part takes a current of 100 A to produce a flux density of 0.56 Tesla in the airgap, The relative permeability of iron is 2500. Estimate the number of turns required in the coil assuming all the flux to pass through the given magnetic circuit. 7

(b) A 4-pole d.c. shunt generator supplies a load of 20 A at 220 V. The field current of the generator under this condition is 2 A. The armature resistance of the generator is 0.5 ohm. Calculate the generated emf under no-load. Neglect the brush-contact drops as well as armature reaction and field saturation. 3

6. (a) Derive the 'emf equation' for the emfs induced in the windings of a single-phase two winding transformer from first principles. 5

(b) How does a single-phase autotransformer differ from a single-phase two winding transformer ? Show the way a single-phase two winding transformer is connected to obtain a single-phase autotransformer. 5

7. (a) A moving coil instrument requires 25 mA current for a full-scale deflection. It has a resistance of 5 ohms. Calculate the resistance required in parallel to enable the instrument to read up to 5 A. 3

(b) Derive the expression for the 'emf generated' by a d.c. generator. What are the various methods of excitation adopted in case of a d.c. machine ? 4+3

8. (a) Draw neatly the 'torque-slip' characteristic of a 3-phase wound rotor induction motor and show therein the stable region of operation. How the curve will change if an external resistance is added in series with each phase of the rotor circuit ? 5

(b) Explain with the help of a block diagram the principle of power generation in a nuclear power plant. 4

(c) What is the starting torque in case of a single-phase induction motor ? 1