

5.1-08

Total number of printed pages – 8

B. Tech
BENG 1102

First 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 margin indicate full
marks for the questions.

1. Answer the following questions : 2×10
 - (a) A voltmeter V of 25 kilo-ohm resistance connected across a load resistance R Reads 250 volts. What is the value of R if the total current supplied to V and R combination is 0.0725 ampere ?

P.T.O.

- (b) A resistor of 5 ohms is connected across a potential difference of 20 volts. Calculate the power dissipated and the energy transferred to heat in 3 minutes.
- (c) A direct voltage of 150 V is applied to a coil of resistance 15 ohm and inductance 15 H. What is the value of the current 0.1 second after switching on ?
- (d) A 10 microfarad capacitor is connected to a constant voltage source through a resistance of 2.5 mega-ohm. Calculate the time taken for the capacitor to lose 50% of its charge when the voltage source is short-circuited ?
- (e) A current of 20 A flows in a circuit with a 30 degree angle of lag when the applied voltage is 200 V. Find the resistance and the reactance.
- (f) A resistor of 150 ohms is connected in series with a 75 microfarad capacitor to a supply at 250 V, 50 Hz. Find the current and the power factor.

- (g) A balanced star-connected load of $10 + j8$ ohms per phase is connected to a 3-phase 250 V supply. Find the line current and the power factor.
- (h) An iron ring has a circular cross section of 3 cm diameter and a mean circumference of 75 cm. Calculate the reluctance offered by the iron ring assuming its relative permeability to be equal to 500. ($\mu_0 = 4\pi \times 10^{-7}$ H/m).
- (i) Write down the expression for the emf induced in the primary winding of a single-phase two winding transformer. Name the various terms in the emf expression.
- (j) What do you mean by the term 'slip' of a three-phase induction motor ? Calculate the slip of a 4-pole induction motor running at 1470 RPM while being connected to a 50 Hz three-phase source.

2. (a) A coil of 15 ohms resistance is in parallel with a coil of 25 ohms resistance. This combination is connected in series with a third coil of 10 ohms resistance. If the whole circuit is connected across a battery having an emf of 50 V and an internal resistance of 1.5 ohm, calculate

(i) the terminal voltage of the battery

(ii) the power dissipated in the 15-ohm coil. 4

(b) State and briefly explain both 'Superposition Theorem' and 'Thevenin's Theorem'. Give one example in each case. 3+3

3. (a) Explain the terms 'effective value' and 'average value' for a sinusoidal alternating quantity. 3

(b) A resistor and an inductor are connected in series and the combination is

connected across a single-phase a.c. supply voltage of 230 V at 50 Hz. The voltage across the inductor is measured and found out to be equal to 150 V. The current drawn by the circuit is 5 A lagging 37 degrees behind the supply voltage. Find the resistance of the resistor, and the resistance and inductance of the inductor. What is the power factor of the inductor? 7

4. (a) A 3-phase induction motor operating from a 415 V system develops an output of 25 kW at an efficiency of 0.88 per unit with an operating power factor of 0.85 lagging. Calculate the input line current of the motor. How much phase current will flow in each phase of the motor winding if it is delta connected? 3

(b) A coil of resistance 60 ohms and inductance 0.8 H is connected in series with a capacitor. The resonant frequency of

the circuit is 60 Hz. If the supply given to the above series combination is 230 V, 50 Hz, find

- (i) line current
- (ii) the power factor and
- (iii) the voltage across the coil. 7

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

- (i) iron of length 75 mm and c.s.a. 60 mm^2 .
- (ii) iron of length 50 mm and c.s.a. 80 mm^2 .
- (iii) an airgap of length of 0.6 mm and c.s.a. 140 mm^2 .

A coil of 3500 turns is wound on part (ii), and the flux density in the airgap is 0.25 T. The relative permeability of iron is 1500. Estimate the coil current assuming all the flux to pass through the given magnetic circuit. 8

(b) The emf per turn of a single phase 3.3 kV/440 V, 50 Hz transformer is 11 V. Calculate the number of turns in the high voltage and low voltage windings. 2

6. (a) Derive the emf equation of a d.c. generator from first principles. 4

(b) Describe how the speed of a d.c. shunt motor can be controlled by varying its field flux and applied voltage to its armature. 6

7. (a) A moving coil instrument requires 27 mA current for a full-scale deflection. It has a resistance, of 6 ohm. Calculate the resistance required

(i) in parallel to enable the instrument to read up to 3A

(ii) in series to enable it to read up to 15 V. 3+3

(b) What are the functions of a dynamometer wattmeter and an energy meter ? Show their connection diagrams in case of single-phase a.c. circuits. 2+2

8. (a) Draw neatly and explain the 'torque-slip' characteristic of a 3-phase squirrel cage induction motor. 4

(b) Explain the transmission of electrical energy from a thermal power plant to a domestic consumer. 4

(c) Why a capacitor is required in a single-phase induction motor ? 2

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