JUNE 2005

Code: D-05
Subject: ELECTRICAL ENGINEERING
Time: 3 Hours
Max. Marks: 100

NOTE: There are 11 Questions in all.

- **Question 1 is compulsory and carries 16 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Answer any THREE Questions each from Part I and Part II. Each of these questions carries 14 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1   **Choose the correct or best alternative in the following:** **(2x8)**

a.   The "Superposition theorem" is essentially based on the concept of

    (A) duality.   **(B)** linearity.
    (C) reciprocity.   **(D)** non-linearity.

b.   Cells are connected in parallel in order to

    (A) increase the voltage available.   **(B)** reduce cost of wiring.
    (C) increase the current available.   **(D)** reduce the time required to fully

                                charge them after use.

c.   The power factor of a purely resistive circuit is

    (A) zero.   **(B)** unity.
    (C) lagging.   **(D)** leading.

d.   The power taken by a 3-phase load is given by the expression

    (A) $3 V_L I_L \cos \phi$.   **(B)** $\sqrt{3} V_L I_L \cos \phi$.
    (C) $3 V_L I_L \sin \phi$.   **(D)** $\sqrt{3} V_L I_L \sin \phi$.

e. Which of the following generating stations has the minimum running cost?

(A) hydro-electric station.
(B) nuclear power station.
(C) thermal power station.
(D) diesel power plant.

f. Which of the following motors has a high starting torque?

(A) ac series motor.
(B) dc series motor.
(C) induction motor.
(D) synchronous motor.

g. A step-up transformer increases

(A) voltage.
(B) current.
(C) power.
(D) frequency.

h. The effect of increasing the length of the air gap in an induction motor will be to increase

(A) power factor.
(B) speed.
(C) magnetising current.
(D) air-gap flux.

PART I
Answer any THREE Questions. Each question carries 14 marks.

Q.2 a. Define the following and give their units of measurement:-
(i)   Resistance.   (ii) Electric Potential.
(iii)   Electric current.   **(2 x 3)**

b. Two coils when connected in series have a resistance of 18 Ω and when connected in parallel have a resistance of 4 Ω. Find the resistance of each coil.   **(8)**

Q.3 a. A Wheatstone bridge consists of AB = 4 Ω, BC = 3 Ω, CD = 6 Ω and DA = 5 Ω. A 2 volt cell is connected between B and D and a galvanometer of 10 Ω between A and C. Find the current through the galvanometer.
(8)

b. State the laws that are used to calculate the current in the above problem.   **(6)**

Q.4   A series R-L-C circuit consists of a 100 Ω resistor, an inductor of 0.318H and a capacitor of unknown value. When the circuit is energised by   230 $\angle 0°V$, 50 Hz sinusoidal a.c. supply, the current is found to be   2.3 $\angle 0° A$. Find
   (i)   value of capacitor in microfarad.
   (ii) voltage across the inductor.
                              (iii)   total   power consumed.   **(14)**

Q.5   a.   Explain the word back emf used for a dc motor and highlight its significance.   **(6)**

   b.   A 230 V, 1150RPM, 4-pole, DC shunt motor has a total of 620 conductors arranged in two parallel paths, and yielding an armature circuit resistance of 0.2 Ω. When it delivers rated power at rated speed, it draws a line current of 74.8 A, and a field current of 3A. Calculate the flux per pole, torque developed, armature and field copper losses.   **(8)**

Q.6   a.   Explain the principle of a transformer. **(6)**

   b.   A 25 KVA transformer has 500 turns on the primary and 40 turns on the secondary. If the primary is connected to a 3000V, 50 Hz mains, calculate (i) the primary and secondary currents at full load, (ii) the secondary   e.m.f.   and   (iii)   maximum   flux   in   the core.   **(8)**

PART II
Answer any THREE Questions. Each question carries 14 marks.

Q.7   a.   Differentiate between the 'squirrel cage' and 'phase wound' rotor types of induction motors.   **(8)**

   b.   A 3-phase induction motor has 6-poles and runs at 960 rpm on full load. It is supplied from an alternator having 4 poles and running at 1500 rpm. Calculate the full load slip of the motor. **(6)**

Q.8   a.   How does a three-phase synchronous motor differ from a three-phase induction motor? Give a few applications of synchronous motors.   **(8)**

b. Explain the different methods for the starting of a synchronous motor. **(6)**

Q.9 a. Name the types of motors used in: vacuum cleaners, phonographic appliances, vending machines, refrigerators, rolling mills, lathes, power factor improvement and cranes. **(8)**

b. A power station has a maximum demand of 15000kW. The annual load factor is 50% and capacity factor is 40%. Determine the reserve capacity of the plant. **(6)**

Q.10 a. With the help of a neat sketch explain the various parts of a nuclear reactor. **(8)**

b. Define the following terms:

(i) Diversity Factor. (ii) Annual Load Factor.
(iii) Capacity Factor. **(6)**

Q.11 Write notes on:

(i) Energy storage.
(ii) Need for starters in motors. **(7+7)**