

Code: A-10

Subject: ELECTRICAL ENGINEERING

**December 2005**

Time: 3 Hours

Max. Marks: 100

**NOTE: There are 9 Questions in all.**

- Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
  - Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
  - Any required data not explicitly given, may be suitably assumed and stated.
- 

**Q.1 Choose the correct or best alternative in the following: (2x10)**

- a. In a three phase transformer, if the primary side is connected in star and secondary side is connected in delta, what is the angle difference between phase voltage in the two cases.
- (A) delta side lags by  $-30^\circ$ .                      (B) star side lags by  $-30^\circ$ .  
(C) delta side leads by  $30^\circ$ .                      (D) star side leads by  $-30^\circ$ .
- b. To achieve low PT error, the burden value should be \_\_\_\_\_.
- (A) low    (B) high  
(C) medium    (D) none of the above
- c. Slip of the induction machine is 0.02 and the stator supply frequency is 50 Hz. What will be the frequency of the rotor induced emf
- (A) 10 Hz.    (B) 50 Hz.  
(C) 1 Hz.    (D) 2500 Hz.
- d. A 4 pole lap wound dc shunt motor rotates at the speed of 1500 rpm, has a flux of 0.4 mWb and the total number of conductors are 1000. What is the value of emf?
- (A) 100 Volts.    (B) 0.1 Volts.  
(C) 1 Volts.    (D) 10 Volts.
- e. The synchronous reactance of the synchronous machine is \_\_\_\_\_.
- (A) Ratio between open circuit voltage and short circuit current at constant field current  
(B) Ratio between short circuit voltage and open circuit current at constant field current  
(C) Ratio between open circuit voltage and short circuit current at different field current  
(D) Ratio between short circuit voltage and open circuit current at different field current

- f. A 3 stack stepper motor with 12 numbers of rotor teeth has a step angle of \_\_\_\_\_.
- (A)  $12^\circ$  (B)  $8^\circ$   
(C)  $24^\circ$  (D)  $10^\circ$
- g. In case of a universal motor, torque pulsation is minimized by \_\_\_\_\_.
- (A) load inertia (B) rotor inertia  
(C) both rotor and load inertia (D) none of the above
- h. Oil-filled cable has a working stress of \_\_\_\_\_ kV/mm
- (A) 10 (B) 12  
(C) 13 (D) 15
- i. Inverse definite minimum time lag relay is also called \_\_\_\_\_
- (A) pilot relay. (B) differential relay.  
(C) over current relay. (D) directional overcurrent relay.
- j. Specific heat of nickel–chrome is \_\_\_\_\_
- (A) 0.112 (B) 0.106.  
(C) 0.108. (D) 0.110.

**Answer any FIVE Questions out of EIGHT Questions.**  
**Each question carries 16 marks.**

- Q.2** The parameters of the equivalent circuit of a 150-kVA, 2400/240V transformer are:  
 $R_1=0.2\text{ohm}$ ,  $R_2=2 \times 10^{-3} \text{ohm}$ ,  $X_1=0.45 \text{ohm}$ ,  $X_2= 4.5 \times 10^{-3} \text{ohm}$ ,  
 $R_i=10 \text{kohm}$ ,  $X_m = 1.6 \text{kohm}$  as seen from 2400 volts side.  
 Calculate:
- (i) open circuit current, power and PF when LV side is excited at rated voltage. (8)
- (ii) The voltage at which the HV side should be excited to conduct a short-circuit test (LV side) with full-load current flowing. What is the input power and its power factor? (8)
- Q.3** a. How are the power angle characteristics of synchronous machine obtained. (8)
- b. A 3300 Volts, delta connected motor has a synchronous reactance per phase (delta) of 18 ohm. It operates at a leading power factor of 0.707 when drawing 800 kW from the mains. Calculate its excitation emf. (8)

- Q.4** a. How is a DC motor started? (8)
- b. A 250 Volts dc shunt motor has  $R_f=150$  ohm and  $R_a = 0.6$  ohm. The motor operates on no-load with a full field flux at its base speed of 1000 rpm with  $I_a = 5$  Amps. If the machine drives a load requiring a torque of 100 Nm, calculate armature current and speed of the motor. (8)
- Q.5** a. Describe Rotating Magnetic Field. (8)
- b. A 400Volts, 1450 rpm, 50 Hz, wound-rotor induction motor has the following circuit model parameters.
- $R_1=0.3$  ohm       $R_2=0.25$  ohm  
 $X_1=X_2=0.6$  ohm       $X_m= 35$  ohm
- Rotational loss =1500 W. Calculate the starting torque and current when the motor is started direct on full voltage. (8)
- Q.6** a. Derive the hystersis torque expression of the hystersis motor. (8)
- b. A universal motor (ac–operated) has a 2-pole armature with 960 conductors. At a certain load the motor speed is 5000 rpm and the armature current is 4.6 Amps, the armature terminal voltage and input power are respectively 100 Volts and 300 Watts. Compute the following, assuming an armature resistance of 3.5 ohm.
- (i) Effective armature reactance.  
(ii) Maximum value of useful flux/pole. (8)
- Q.7** Write short note about following:-
- (i) Power System structure with diagram. (8)  
(ii) Wave energy. (4)  
(iii) Ocean thermal energy. (4)
- Q.8** a. A single phase 50 Hz generator supplies an inductive load of 5,000kW at a power factor of 0.707 lagging by means of an overhead transmission line 20 km long. The line resistance and inductance are 0.0195 ohm and 0.63 mH per km. the voltage at the receiving end is required to be kept constant at 10 kV. Find the sending end voltage and voltage regulation of the line. (8)
- b. What are the factors which are involved in circuit breaker rating. (8)
- Q.9** a. A 37.7 HP, 220 V d.c shunt motor with a full load speed of 535 rpm is to be braked by plugging. Estimate the value of resistance which should be placed in series with it to limit the initial current to 200 A. (8)
- b. Give a list of the factors involved for selecting a factory drive. (8)