Paper No: EE – 305   Branch: CST

Time: 3 Hrs   Full Marks: 70

Use separate answer script for each half

*Answer **SIX** questions, taking **THREE** from each half.*
Two marks are reserved for neatness in each half.

First Half

1a) A 4KW, 230 V, 1000 rpm separately excited DC motor is fed from 260V ac source through a single-phase full converter. At no-load with zero firing angle delay, motor draws 2A and runs at 1100 rpm. The armature circuit resistance is 0.5 Ω . The net voltage drop in the conducting thyristors is 2V. If the motors runs at 908 rpm and draws an armature current of 20A, what is the converter firing angle?   [5]

b) A 230V shunt motor takes an armature current of 20A on a certain load. The resistance of armature is 0.5 Ω . Find the resistance required in series with the armature to halve the speed if load torque is proportional to the square of the speed.   [6]

2a) Derive the maximum efficiency condition for a DC motor.   [5]

b) A shunt motor operating on 200V mains takes 6A on no-load. The armature and field resistances are 0.5 Ω and 100 Ω respectively. Compute the efficiency of the motor when its output is 5KW. Also determine the maximum efficiency of the motor.

[6]

3a) Write down the torque equation and sketch the torque –slip characteristics of an induction motor.   Can an induction motor run at synchronous speed?
[6]

b) Determine the number of poles, the slip and the frequency of rotor current at rated load for a 3-phase, 3.7 KW induction motor rated at 220V, 50Hz, 1440 rpm.   [5]

4a) State the different methods of speed control of an induction motor? Sketch typical torque –slip characteristics for (i) frequency variation and (ii) rotor resistance variation schemes of speed control. Compare the advantages and disadvantages of these techniques.   [6]

b) The rotor of a 4-pole 50 Hz, slip ring induction motor has a resistance of 0.25Ω per phase and runs at 1440 rpm at full load. Calculate the external resistance per phase which must be added to lower the speed to 1200rpm, the torque being the same as before.   [5]

5. Write short notes on **any two** of the following: [5 ½ × 2]

a) Ward –Leonard method of speed control

b) Speed control of DC series motor

c) Braking of Induction Motor

6a) Explain the different types of transformer connection for converting a 3-phase supply to a six-phase supply. [5]

6b) Draw the phasor and connection diagrams for the following transformer connections:

(i) Yz11 (ii) Dz0 (iii) Yd11 [6]

7a) Explain with necessary diagrams how 2-phase supply is obtained from a balanced 3-phase supply using Scott-connected transformers [5]

7b) Scott-connected transformers supply two single-phase loads at 100 V. The load across the teaser transformer secondary is 300 KW at unity power factor. The load across the main transformer secondary is 200 KW at 0.8 p.f lagging. For a three-phase balanced input voltage of 11 kV calculate the primary line currents. Draw the phasor diagram. [Neglect magnetizing current of transformers] [6]

8a) Explain the constructional features and principle of operation of a universal motor when connected to a single phase A.C. supply. Mention some of its applications.
[5]

8b) Derive the expression of rotational e.m.f of a universal motor when fed from a single phase A.C. supply. Discuss the problems when a D.C. series motor is supplied from a single phase A.C. supply. [3+3]

9a) Explain the working principle of a capacitor-start single-phase induction motor with the help of connection and phasor diagram. Draw its speed-torque characteristics and mention some of its applications. [5]

9b) A single-phase single-winding universal motor does not have a staring torque. Justify the statement with proper reasoning. [6]

10a) What is a stepper motor? Explain briefly its constructional features and hence classify it. [5]

10b) Define the following terms in relation to a stepper motor:

(i) Step-angle (ii) steps/revolution (iii) steps/sec.

Explain the principle of operation of a permanent magnet stepper motor. [3+3]