(Following Paper ID and Roll No. to be filled in your Answer Book)

Paper ID : 121521 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. V) THEORY EXAMINATION, 2015-16

ELECTROMECHANICAL ENERGY CONVERSION-II

Time:3 hours] **[Total Marks:100**

SECTION-A

1. Attempt all parts. All parts carry equal marks. Write answer of each part in short : (2×10=20)

(a) Why the power factor of the lightly loaded induction mechine is quite low?

(b) What do you understand by the term cogging?

(c) Calculate the speed in rpm of a 6 pole induction motor which has a slip of 6% at full load with a supply frequency of 50 Hz. What will be the speed of a 4 pole alternator supplying the motor?

(d) Give application areas of the cylindrical and salient pole type synchronous machine.

(e) Why in case of three phase synchronous machine, the armature windings put on stator and field windings put on rotor whereas in case of DC machine, the armature windings put on rotor and field windings put on stator poles?

(f) Draw the V-curves and inverted V-Curves at different loading conditions of synchronous motor.

(g) Define slip. Why the induction motor can't run at synchronous speed?

(h) What are the reasons for the Hunting phenomenon in synchronous machines?

(i) State some important application of the stepper motors.

(j) How will you reverse the direction of rotation of the single phase Induction motor?

SECTION-B

Note: Attempt any five questions from this section. (10×5=50)

2. Show that in a 3 phase induction motor :

$$\frac{\tau \max}{\tau fl} = \frac{1}{2}\frac{\beta^2 + sfl^2}{\beta\, sfl}$$

$$where \beta = \frac{R_2}{X_{20}}$$

A 3-phase, 400 V, 50 Hz induction motor take the power input of 35 kW at its full load speed of 890 rpm. The stator losses are 1 kW and friction and windage losses are 1.5 kW. Calculate :

(i) slip

(ii) Rotor ohmic loss

(iii) Shaft power

(iv) Shaft Torque

(v) Efficiency

3. From the first principles derive the equivalent circuit of a three phase induction motor. How the mechanical load is separated from rotor copper loss in the equivalent circuit.

4. Explain the operating principle and constructional aspects of Deep Bar and Double cage Induction motor. Explain how there motors can give higher starting torque in comparison to the conventional design.

5. Explain the phenomenon of armature reaction when alternator is delivering a load current at purely leading and purely lagging power factor. Also derive the EMF equation of an alternator.

6. Derive Torque, Mechanical Power and rotor output equations of a three phase induction motor connected from AC mains.

7. Define the term voltage regulation, for the synchronous generator. Determine the voltage regulation of a 2000 V, single phase alternator giving current of 100 A at (i) 0.8 pf leading and 0.707 pg lagging. Use the test data given below: Full load current of 100A is produced on short circuit by a field excitation of 2.5A. An EMF of 500 V is generated on open circuit by the same excitation. The armature resistance being 0.8 Ω

8. Why single phase induction motor is not self started? Discuss the different methods of starting a 1-phase Induction motor.

9. A 230 V, 50Hz, 4-pole single-phase induction motor has the following equivalent circuit impedances:

$R_{1m} = 2.2 ohm. X_{1m} = 3.1 ohm. R_2' = 4.5 ohm.$
$X_2' = 2.6 ohm. X_M = 80 ohm$

Friction, windage and core loss=40W.
For a slip of 0.03 pu, calculate:

i. Input current

ii. Power factor

iii. Developed power

iv. Output power

v. Efficiency

SECTION-C

Note: Attempt any <u>two</u> parts of the following:

(2×15=30)

10. (a) State the necessary conditions for parallel operation of alternators. Discuss two bright and one dark lamp method of synchronizing alternators.

(b) A 5000kVA, 10000V, 1500rpm, 50 Hz alternator runs in parallel with other machine. Its synchronous reactance is 20% Find for (a) No-Load,(b)Full load at p.f. 0.8 Lagging, synchronizing power per unit mechanical angle of face displacement and calculate the synchronizing torque if mechanical displacement is 0.5 degree.

11. (a) What are the effects of space harmonics in 3 phase induction motors?

(b) The stand still impedances of outer and inner cages of a double cage induction motors are (2+j1.2) Ω and (0.5+j3.5) Ω respectively. Determine the slip at which the 2 cages develop equal torques.

12. Discuss the construction detail & working Principle of the following :

a) Stepper Motors

b) Universal Motors

c) Shaded Pole type Induction Motor.

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