DD Rayan Kamal (57) @ 01/12/2022

Roll No.....

National Institute of Technology, Hamirpur (H.P.)

Examination: B.Tech. End Semester Examination, Nov.-Dec. 2022

Branch : Electrical Engineering | Semester : Vth

Course : Electrical Machines-II | Code : EE-312

Time: 03:00 Hours | **Maximum Marks: 50**

Each question carries Five marks.

[1] Describe the production of rotating field in a three-phase induction motor through analytical method. Show that the three-phase currents of a balanced supply system produce a resultant flux of constant magnitude in the air gap and the resultant flux is rotating in nature.

[2] A 3-phase, 400 V, 50 Hz star-connected induction motor gave the following test results:

No load : 400 V, 7.5 A, 0.135 power factor

Blocked rotor : 150 V, 35 A, 0.44 power factor

The ratio of standstill leakage reactance of stator and rotor is estimated as 2. If the motor is running at a speed of 960 rpm, determine (a) net mechanical power output (b) the net torque and (c) efficiency of the motor. Assume rotor and stator copper losses to be equal.

[3] A 20 kW, 400 V, 3-phase, 50-Hz, Y-connected, 4-pole squirrel-cage induction motor has the following parameters in ohms referred to stator: $r_1 = 0.2$, $x_1 = x_2 = 0.45$, $X_m = 18$. When this motor is energized at rated voltage and frequency, it develops full load internal torque at a slip of 0.04. Rotational and core losses are neglected. Calculate (a) maximum internal torque and internal starting torque at rated voltage and frequency (b) slip at maximum torque.

[4] A 230 V, 50 Hz, 4-pole single-phase induction motor has the following equivalent circuit parameters: $R_{1m} = 2.2\ \Omega$, $R_2' = 4.5\ \Omega$, $X_{1m} = 3.1\ \Omega$, $X_2' = 2.6\ \Omega$, $X_M = 80\ \Omega$. Friction, windage and core loss = 40 W. For a slip of 0.03 p.u., calculate (a) input current (b) power factor (c) developed power (d) output power (e) efficiency.

[5] Describe the construction and operation of a synchronous hysteresis motor and show that it develops a running torque both at synchronous and asynchronous speed of the motor.

[6] Develop the equivalent circuit of single-phase, single-winding induction motor based on two-revolving-field theory. Derive for the current in the stator winding.

[7] A 3-phase, star-connected, round-rotor synchronous generator rated at 10 kVA, 230 V has an armature resistance of 0.5 Ω per phase and a synchronous reactance of 1.2 Ω per phase. Calculate the percent voltage regulation at full load at power factor of 0.8 lagging. Determine the power factor such that the voltage regulation is zero on full load.

[8] From the equivalent circuit of a cylindrical rotor synchronous motor, derive expressions for the power input and power output in terms of load angle, synchronous impedance, excitation voltage etc. Draw the appropriate phasor diagram for the derivation. Show that the difference in power input and power output is equal to ohmic loss.

[9] Derive the voltage equation for a salient pole synchronous generator using two-reaction theory. Draw its phasor diagram at lagging power factor load.

[10] What is the necessity of parallel operation of alternators? State the conditions necessary for paralleling alternators. Describe any one method of synchronizing the alternators.