

National Institute of Technology, Delhi

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| Name of the Examination: B. Tech. | | | |
| Mid Semester Examination (Autumn, 2022) | | | |
| Branch | : Electrical Engineering | Semester | : V |
| Title of the Course | : Electrical Machines-II | Course Code | : EEB301 |

Time: 1.5 Hours

Maximum Marks: 25

Note:

1. Assume any missing data
2. Q1 to Q3 are compulsory. Attempt any one questions out of Q4 and Q5

- Q1 (a) Explain with suitable mathematical derivation how a rotating magnetic field is created in a 3-phase induction motor. 2 Marks
- (b) Draw and explain the Torque-Slip characteristics of 3-phase induction motor with constant supply voltage. 2 Marks
- (c) Explain the operation of three-phase Synchronous generator. 2 Marks
- (d) Explain the starting and operation of three-phase induction motor. 2 Marks
- (e) Draw the power flow diagram for a 3-phase induction motor and discuss the various losses taking place. 2 Marks
- Q2 A three-phase 230V, 60 Hz, 100 HP, six-pole induction motor operating at rated condition has an efficiency of 91% and draws a line current of 248A. The core loss, stator copper loss, and rotor conductor loss are 1697 W, 2803 W, 1549 W, respectively. Determine (a) input power, (b) total losses, (c) air-gap power, (d) shaft speed, (e) power factor, (f) combined windage, friction, and stray load loss, (g) shaft torque. 5 Marks
- Q3 A three-phase star-connected, 400 HP, four-pole, 380V, 50 Hz wound rotor induction motor operating at rated condition with the slip rings shorted has a slip of 0.0159. The machine parameters expressed in ohms are:
 $R_1 = 0.00536$, $R_2 = 0.00613$, $R_c = 7.66$
 $X_1 = 0.0383$, $X_2 = 0.0383$, $X_m = 0.5743$
Determine: (a) the rotor frequency, (b) slip at which maximum torque occurs, (c) rotor speed at one half the rated torque load, (d) external resistance per phase required to operate the machine at 1000 rpm and one half rated torque load (assume the motor is operating on the linear section of the curve and the stator to rotor turns ratio is 2.0), (e) rated torque. 5 Marks
- Q4 Explain, why the starting current of induction motor is high and briefly present a comparison between various starting methods. 5 Marks
- Q5 Explain with proper mathematic formulation why the starting current of slip-ring induction motor is low when maximum starting torque is developed. 5 Marks