Roll No.....

NATIONAL INSTITUTE OF TECHNOLOGY, DELHI

Name of Examination: B. Tech (Mid-Semester September 2019)

Branch: Electrical & Electronics Engineering **Semester: V**

Title of Course: Electrical Machines-II **Course Code: EEB301**

Time: 2 Hrs **Maximum Marks: 25**

Note: Attempt all Questions.

Q1. Give to the point answers to following questions:

(i) Define cogging and crawling in three phase induction machine. **(2 marks)**

(ii) Why is it preferred to place the armature winding of synchronous machine on the stator while its field winding on the rotor? **(2 marks)**

(iii) How is the frequency transformation carried out in the rotor of three phase induction motor? **(1 marks)**

Q2. (a) Differentiate between a three phase inductor motor and a three phase synchronous motor based on the working principle. Why is the synchronous motor not self-starting **(3 marks)**

(ii) Explain with proper mathematical formulation, why starting current in a three phase induction motor is low when maximum starting torque is developed. **(2 marks)**

Q3. (a) Explain, with the help of neat and clear block diagram, various methods to control voltage and frequency to achieve speed control. (**2 marks**)

(b) Explain the V/f method of speed control of a three phase induction motor and derive the expression of torque in terms of new and rated frequency. (**3 marks**)

Q4. A three phase star connected 400 V, 50 Hz, 4-pole induction motor has the following per phase constants in ohm referred to stator r_1=0.15, x_1=0.45, r_2=0.12, x_2=0.45 and X_m=28.5. Fixed losses are 400 watts. Compute the stator current, rotor speed, output torque, and efficiency when the motor is operated at rated voltage and frequency at a slip of 4%. (**5 marks**)

Q5. A 400 V, 1450 rpm, 50 Hz wound rotor induction motor has the following circuit model parameters: R_1=0.3 ohms, R'_2=0.25 ohms, X_1=X'_2=0.6 ohms and X_m=35 ohms. The rotational losses are 1500 watts. (a) calculate the starting torque and current when the motor is started direct on full voltage, (b) calculate the full-load current, power and net torque. (**5 marks**)

Q6. Using the Thevenin's Equivalent circuit of an Induction motor, derive the following relations neglecting the stator resistance:

(i) $$\frac{I_{2st}}{I_2} = \sqrt{\frac{s^2 + s_{mT}^2}{s^2(1+s_{mT}^2)}}$$ (ii) $$\frac{I_{2.mT}}{I_2} = \sqrt{\frac{1}{2}\left[1+\left(\frac{S_{mT}}{s}\right)^2\right]}$$

where I_2.st is the stator load component of current at starting and I_2.mT is the stator load-component of current at maximum torque. **(5 marks)**

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