Roll No. ..... Total Pages : 4

451101

December, 2019

M.Tech. (Power Electronics and Drives) - 1st Semester

Electrical Drives System (MPED-101)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Assume any missing data.*

PART - A

1. (a) Variable frequency control yields high torque to current ratio during starting, why? (1.5)

(b) What are the main factors which decide the choice of electrical drive for a given application? (1.5)

(c) What are the components of load torques? (1.5)

(d) What is an active load torque? (1.5)

(e) Write the fundamental torque equation. (1.5)

(f) What are the reasons for using load equalization in an electrical drive? (1.5)

(g) What do you understand by constant torque drive and constant power drive? (1.5)

(h) Define coefficient of adhesion. (1.5)

(i) A motor of smaller rating can be selected for a short time duty, Why? (1.5)

(j) What are the disadvantages of induction motor operation with unbalanced supply voltages? (1.5)

PART - B

2. A 230 V, 500 rpm, 90A separately excited dc motor has the armature resistance and inductance of 0.115 and 11 mH respectively. The motor is controlled by a chopper operating at 400 Hz. If the motor is regenerating (i) Find the motor speed and the regenerated power at the rated current and a duty ratio of 0.5. (ii) Calculate the maximum safe speed if the minimum value of the duty ratio is 0.1. s(15)

3. A 220 V, 1500 rpm, 11.6A separately excited dc motor is controlled by a single-phase fully controlled rectifier with an ac source voltage of 230 V, 50 Hz. Enough filter inductance is added to ensure continuous conduction for any torque greater than 25 percent of rated torque, $R_a = 2\Omega$. (i) What should be value of the firing angle to get the rated torque at 1000 rpm (ii) Calculate the firing angle for the rated braking torque and –1500 rpm (iii) Calculate the motor speed at the rated torque and $\alpha = 160°$ for the regenerative braking in the second quadrant. (15)

4. A 415 V, 50 Hz, 6-pole, 980 rpm, 3-phase, Y-connected squirrel cage induction motor has the following parameters per phase referred to the stator: Rs = 0.19, Rr' = 0.07, Xs = 0.75, Xr' = 0.67 and Xm = 20 Ω. The motor is fed by a 6-step inverter, which in turn is fed by a 6-pulse fully controlled rectifier. (i) If the rectifier is fed by an ac source of 415 V and 50 Hz, what should be the rectifier firing angle to get the rated fundamental voltage across the motor (ii) Calculate the percent increase in copper loss of the machine at 50 Hz, compared to the value when fed by a sinusoidal supply. Neglect skin effect. (15)

5. (a) Explain the multiquadrant operation of a separately excited DC motor with regenerative braking. (6)

(b) Discuss 25 kV ac traction drive employing thyristor converter controlled dc motors. (9)

6. A 3-phase, Y-connected, 415 V, 50 Hz, 4-pole induction motor has the following parameters of the equivalent circuit per phase referred to the stator : $R_s = R_r' = 0.024\ \Omega$ and $X_s = X_r' = 0.12$, $X_m = 15\ \Omega$. The motor is controlled by the variable frequency control with a constant (V/F) ratio. For an operating frequency of 12 Hz. Calculate (i) The breakdown torque as a ratio of its value at the rated frequency for both motoring and braking (ii) The starting torque and rotor current in terms of their values at the rated frequency. (15)

7. Discuss any *three* of the following :
   (i) Brushless dc motor drive.
   (ii) Slip power recovery scheme.
   (iii) Electric braking.
   (iv) Digital control of electric drives. (15)