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Total number of printed pages – 3

B. Tech
PEEL 5303

Sixth Semester Regular Examination – 2014

ELECTRIC DRIVES

BRANCH : EEE, ELECTRICAL

QUESTION CODE : F 305

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any **five** from the rest.
The figures in the right-hand margin indicate marks.*



1. Answer the following questions : 2×10
- (a) What factors limit the maximum speeds of field controlled d.c. motor ?
 - (b) Which method of speed control for d.c. motor gives faster response ? Justify.
 - (c) What is Constant Power DC drive ?
 - (d) What are various types of load torques ?
 - (e) Why is CSI fed induction motor operated at constant rated flux ?
 - (f) Why is it necessary to maintain constant terminal voltage for variable frequency variable voltage control of induction motor drive above base speed ?
 - (g) When operating in regenerative braking, the induction motor slip should not exceed the breakdown slip. Why ?
 - (h) What are the factors which affect the coefficient of adhesion ?
 - (i) What is the nature of torque speed characteristics suitable for traction drives ?
 - (j) What is the function of a damper winding in a synchronous motor ?

2. (a) Explain the operation of a closed-loop speed control scheme with inner current control loop. What are various functions of inner current control loop? 5

(b) A constant speed motor has the following duty cycle : 5

Load rising linearly from 200 to 500 kW : 4 minutes

Uniform load of 400 kW : 2 minutes

Regenerative power returned to the supply reducing linearly

from 400 kW to 0 : 3 minutes

Remains idle : 4 minutes

Determine power rating of the motor assuming loss to be proportional to (power)².

3. (a) Calculate the starting time of a drive with following parameters : 5

$$J = 10 \text{ kg-m}^2, T = 15 + 0.5 \omega_m \text{ and } T_l = 5 + 0.6 \omega_m$$

(b) A 220 V, 24 A, 100 rpm, separately excited d.c. motor has an armature resistance of 2Ω . Motor is controlled by a chopper with frequency of 500 Hz and source voltage of 230 V. Calculate the duty ratio for 1.2 times rated torque and 500 rpm. 5

4. (a) Explain with neat circuit diagram, the regenerative braking of separately excited d.c. motor using a d.c. chopper. 5

(b) A 200 V, 875 rpm, 150 A separately excited d.c. motor has an armature resistance of 0.06Ω and armature circuit inductance of 2.85 mH. It is fed from a single-phase fully controlled rectifier with an a.c. source voltage of 220 V, 50 Hz. Calculate motor speed for $\alpha = 120^\circ$ and torque $T = 1200 \text{ N-m}$. 5

5. (a) Why stator voltage control is suitable for speed control of induction motors in fan and pump drives ? 5
- (b) A 440 V, 50 Hz, 4 pole, 1370 rpm, Y-connected squirrel cage induction motor has the following parameters : 5
- $R_s = 2\Omega$, $R_r' = 3\Omega$, $X_s = 3.5\Omega$, $X_r' = 3.5\Omega$, $X_m = 55\Omega$
- It is controlled by a current source inverter at a constant flux. Calculate :
- (i) Motor torque, speed and stator current when operating at 30 Hz and rated slip speed
- (ii) Inverter frequency and stator current for rated motor torque and motor speed of 1200 rpm.
6. (a) State the advantages and disadvantages of d.c. traction drive using PWM voltage source inverter fed induction motor drive. 5
- (b) A 500 tonnes train travels a down gradient of 20 in 1000 for 50 sec during which period its speed is reduced from 150 km/h to 100 kmph by regenerative braking. The tractive resistance is 40 N/tonne, effect of rotational mass is 10% and efficiency of the drive in regenerative braking is 80%. Calculate the energy returned to the line. 5
7. What is the advantage of microprocessor control over dedicated hardware control in Electrical Drives application ? Explain with schematic block diagram the control of d.c. drive using microprocessor. 10
8. Write short notes on any **two** of the following : 5x2
- (a) Energy loss in transient operations
- (b) slip power recovery induction motor drive
- (c) 25 kV a.c. Traction using Converter controlled d.c. motors
- (d) Drives for Sugar Mills.

