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Total number of printed pages – 3

B. Tech  
PEEL 5303 (New)

**Sixth Semester (Back) Examination – 2013**

**ELECTRIC DRIVES**

**BRANCH : EEE, ELECTRICAL**

**QUESTION CODE : B255**

**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 dc motor ?
- (b) Which method of speed control for dc motor gives faster response ? Justify.
- (c) What is Constant Power DC drive ?
- (d) What are various types of load torques ?
- (e) Which method of speed control for dc motor gives faster response ? Justify.
- (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 break down 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

**P.T.O.**

- (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)<sup>2</sup>.
3. (a) Calculate the starting time of a drive with following parameters: 5  
 $J = 10 \text{ kg-m}^2$ ,  $T = 15 + 0.5 \omega_m$  and  $T_l = 5 + 0.6 \omega_m$
- (b) A 220V, 24A, 100 rpm, separately excited dc motor has an armature resistance of  $2 \Omega$ . Motor is controlled by a chopper with frequency of 500 Hz and source voltage of 230V. 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 dc motor using a dc-chopper. 5
- (b) A 200V, 875 rpm, 150A separately excited dc motor has an armature resistance of  $0.06 \Omega$  and armature circuit inductance of 2.85 mH. It is fed from a single phase fully controlled rectifier with an ac source voltage of 220V, 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 440V, 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 dc 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 kmph 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 DC drive using microprocessor. 10
8. Write short notes on any two of the following : 5×2
- (a) Energy loss in transient operations
- (b) slip power recovery induction motor drive
- (c) 25 kV AC Traction using Converter controlled dc motors
- (d) Drives for Sugar Mills

