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NEW SCHEME

Eighth Semester B.E. Degree Examination, May / June 2006
Electrical & Electronics Engineering
Industrial Drives and Applications

Time: 3 hrs.] [Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***

1 a. What is an electric drive? Compare group drives with individual drives. **(05 Marks)**

b. A motor costing Rs.80,000/- (rupees eighty thousand only) is employed for group drive for a certain installation. How will its total annual cost compare with the case where 5 individual motors each costing Rs.20,000/- are used? The annual energy consumption is 40,000 KWh with group drive whereas it is 30,000 KWh with individual drive. The cost of energy is Rs.5/- per KWh. Assume depreciation, maintenance and other fixed charges at 12 % in case of group drive and 18 % in case of individual drive. **(05 Marks)**

c. Derive and draw the speed-torque characteristics of,
(i) D.C. Shunt motor and (ii) 3-phase Induction motor. **(06 Marks)**

d. A 220 V, 21 A, 1500 RPM D.C.Shunt motor has an armature resistance of 0.05 Ω and a field resistance of 220 Ω. The magnetization characteristic of the machine is as follows.

Field current (A)	0.2	0.4	0.6	0.8	1.0	1.2	1.4
EMF at 1500 RPM (V)	50	100	150	190	219	235	245

Plot the speed-torque characteristic of the motor when no external resistance is included either in armature or in field circuit. **(04 Marks)**

2 a. Define quadrilateral and trapezoidal speed-time curve of an electric drive. Sketch the characteristics and obtain the expression of maximum speed, V_m. **(06 Marks)**

b. What are the factors responsible for selection of motors? State with adequate reasons the type of motor to be used for an electric clock. **(04 Marks)**

c. An electric train weighing 300 tonnes runs at 8 % upgradient having a tractive resistance of 50 N/tonne, rotational inertia effect 10 % of dead weight, duration of station stop 15 S and overall efficiency of transmission gear and motor as 80 %. The drive exhibits the following speed-time characteristics:

- uniform acceleration from rest at 1.5 Kmphps for 30 S;
- Constant speed for 40 S;
- Coasting for 30 S
- Braking at 2.5 Kmphps to rest.

Calculate (i) Schedule speed (ii) Distance traversed
(iii) Specific energy consumption of the drive. **(10 Marks)**

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3 a. A motor having a suitable control circuit develops a torque given by the relationship $T_M = aw + b$, where a and b are positive constants. This motor is used to drive a load whose torque is expressed as $T_L = cw^2 + d$ where c and d are some other positive constants. The M.I of the rotating masses is J.

i) Determine the relations amongst the constants a, b, c and d in order that the motor can start together with the load and have an equilibrium operating speed;

ii) Calculate the equilibrium operating speed;

iii) Determine the initial acceleration of the drive. **(10 Marks)**

b. Describe the four quadrant operation of a motor driving a hoist load. **(05 Marks)**

c. A synchronous motor connected to an infinite bus bar is driving a load corresponding to its rated capacity with a torque angle of 30°. If the load is increased suddenly to $\sqrt{2}$ times the rated load, determine whether or not the drive is stable. **(05 Marks)**

4 a. Define (i) Continuous duty (ii) Short time duty
(iii) Intermittent periodic duty of an electric drive. **(06 Marks)**

b. Derive the expressions of heating and cooling time constants of an electric motor. **(06 Marks)**

c. The heating and cooling time constants of a 100 KW motor are 90 and 120 minutes respectively. Find the rating of the motor when subjected to a duty cycle of 18 minutes on certain load and 30 minutes on no load. Assume the losses are proportional to the square of the load. **(08 Marks)**

5 a. Describe the functions of a (i) Continuous mill (ii) Reversing mill in respect of duties to be performed. **(04 Marks)**

b. Describe with figures the processes involved in reversing hot rolling mills. What type of drive is to be used for such mills? State reasons. **(10 Marks)**

c. Make a comparison between line shaft drive and sectional drive as used for paper plant. **(06 Marks)**

6 a. What are the types of braking used in electric traction? What are the advantages of regenerative braking? **(06 Marks)**

b. Define tractive effort and coefficient of adhesion as used in electric traction. **(06 Marks)**

c. A train weighing 400 tonnes has speed reduced by regenerative braking from 40 to 20 kmph over a distance of 2 km on a down gradient of 20 % . Calculate the electrical energy and average power returned to the line. Tractive resistance is 40 N/Tonne, rotational inertia is 10 % and efficiency of conversion is 75 %. **(08 Marks)**

7 a. A D.C. Shunt motor is connected to a constant voltage mains of supply voltage V and drives a load torque which is independent of speed. Prove that,

if E_b (Back emf)$> \frac{1}{2}$ V, increasing the airgap flux per pole decreases the speed of the motor; while if $E_b < \frac{1}{2}$ V increasing the airgap flux per pole increases the speed.

(08 Marks)

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b. A 220 V, D.C. Shunt motor draws an armature current of 50 A and runs at 800 RPM. Calculate the additional resistance to be inserted in the field circuit to raise the speed to 1000 RPM at an armature current of 75 A. Assume linear magnetization characteristic; also assume armature resistance as $0.15\,\Omega$ and the field resistance as $250\,\Omega$. **(05 Marks)**

c. A 3000 KW, 2300 V, 30-pole, 3-phase, Y-connected, unity power factor synchronous motor has a stator resistance and synchronous reactance of $0.2\,\Omega$ and $2.0\,\Omega$ per phase respectively. Compute the magnitude of the stator resistance per phase to be added to brake the motor so that the initial braking current does not exceed the rated current of the motor, if the field excitation is kept constant at the value which result in unity power factor at rated load.
Also determine the initial braking torque. **(07 Marks)**

Write short notes on

a. Load equalization
b. Time variant load torque
c. Type of drive used for cement mill
d. Advantage and superiority of 25 KV, 50 Hz, 1-phase AC traction over other types of traction system. **(20 Marks)**