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06EE74

Seventh Semester B.E. Degree Examination, December 2010
Industrial Drives and Applications

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting
at least TWO questions from each part.**

PART – A

- 1 a. State essential parts of electrical drives with block diagram and mention their functions. (06 Marks)
- b. Explain the speed torque conventions and four quadrant operation of a motor driving a hoist load. (10 Marks)
- c. Define active load torque and passive load torque. Give examples. (04 Marks)

- 2 a. A 6 pole, 50 Hz, 3 – phase wound rotor induction motor has a flywheel coupled to its shaft. The total moment of inertia of motor – load – flywheel is 100 kg-m^2 . Load torque is 1000 N-m of 10 sec. duration followed by a no – load period which is long enough for the drive to reach its no – load speed. Motor has a slip of 3% at a torque of 500 N-m . Calculate :
 - i) Maximum torque and (09 Marks)
 - ii) Speed at the end of deceleration period. (04 Marks)
- b. Mention the classes of motor duty for different applications. (04 Marks)
- c. Explain the method of determination of motor rating for short time duty loads. (07 Marks)

- 3 a. Explain with diagrams the regenerative braking of a separately excited d.c. motor. (06 Marks)
- b. Explain with dynamic equivalent circuit the transient analysis of dynamic braking of separately excited d.c. motor. (07 Marks)
- c. A 220V, 1500 rpm, 10A separately excited d.c. motor is fed from a single – phase fully – controlled rectifier with an a.c. source voltage of 230 V, 50 Hz. $R_a = 2\Omega$ and $L_a = 50 \text{ mH}$. Calculate no – load speed, speed and developed torque on the boundary between the continuous and discontinuous conduction for $\alpha = 60^\circ$. (07 Marks)

- 4 a. Explain with diagrams three phase fully – controlled rectifier control of d.c. separately excited motor. (07 Marks)
- b. Explain the chopper control of separately excited d.c. motor for regenerative braking. (07 Marks)
- c. A 230 V, 960 rpm and 200A separately excited d.c. motor has an armature resistance of 0.02Ω . The motor is operated in dynamic braking with chopper control with a braking resistance of 2Ω .
 - i) Calculate duty ratio of chopper for a motor speed of 600 rpm and braking torque of twice the rated value.
 - ii) What will be the motor speed for a duty ratio of 0.6 and motor torque equal to twice its rated value? (06 Marks)

2. Any revealing of identification, appeal to evaluator and / or questions raised

PART – B

- 5 a. What is single phasing? Explain the operation of a 3 – phase induction motor with unbalanced voltages. (06 Marks)
- b. Explain with diagrams reverse voltage braking of an induction motor. (06 Marks)
- c. A 500V, 3 ϕ , 50 Hz, 8 pole, Y – connected induction motor has : $R_1 = 0.13 \Omega$, $R_2 = 0.32 \Omega$, $X_1 = 0.6 \Omega$, $X_2 = 1.48 \Omega$, $R_0 = 250 \Omega$, $X_0 = 20 \Omega$. The full – load slip is 5%. The effective stator to rotor turns ratio per phase is 1/1.57. The machine is to be braked from full – load speed by changing the stator connections and inserting an external rotor circuit resistance, which in primary terms is 1.5 Ω /phase. Determine the initial braking torque, when the stator is disconnected from the a.c. supply and d.c. is fed into two of its terminals. (08 Marks)
- 6 a. Explain with diagrams variable frequency control of an induction motor and mention its features. (07 Marks)
- b. Explain the static rotor resistance control and mention its advantages. (06 Marks)
- c. A Y – connected squirrel – cage induction motor has the following ratings and parameters : 400V, 50 Hz, 4 pole, 1370 rpm, $R_s = 2 \Omega$, $R'_r = 3 \Omega$, $X_s = X'_y = 3.5 \Omega$, $X_m = 55 \Omega$. It is controlled by a current source inverter at a constant flux. Calculate the motor torque, speed and stator current when operating at 30 Hz and rated slip speed. (07 Marks)
- 7 a. Explain pull – in process in synchronous motor operation from fixed frequency supply. (06 Marks)
- b. Explain the operation of self controlled synchronous motor drive employing load commutated thyristor inverter. (09 Marks)
- c. How the operation of a synchronous motor shifts from motoring to regenerative braking? (05 Marks)
- 8 a. Explain the modes of variables frequency control of synchronous motor. (08 Marks)
- b. Explain the following industrial drives :
- i) Rolling mill drives and
- ii) Paper mill drives. (12 Marks)

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