

Total number of printed pages – 7

B. Tech
CPEE 5403

Eighth Semester Examination – 2008

ELECTRICAL DRIVES

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
- (i) A three-phase induction motor is started by means of a star/delta switch. What is the starting current with respect to DOL starting.
- (ii) When operated with variable frequency a synchronous motor has an advantage over and induction motor ? What is it ?

- (iii) While operating on a phase controlled converter the commutation capability of the motor deteriorates. Explain why.
- (iv) What kind of converters is used for four quadrant operation of dc motors ?
- (v) Where cycloconverter are used ?
- (vi) What is short time rating of a machine ?
- (vii) What are the disadvantages of CSI Induction motor drive ?
- (viii) Why a machine is equipped with flywheel while driving a pulsed torque load ?
- (ix) A system has a transfer function given by $G(s) = 1/(s^2 + 3s + 6)$. When it is excited by a step input of $4u(t)$, what is the steady state output of the system ?
- (x) A three phase induction motor operates at constant rotor frequency when the

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stator frequency is varied from zero to rated value. How the torque developed by the motor will vary with respect to the speed.

2. (a) What are the advantages of electric drives ? 3

(b) A 3-phase induction motor has a full load slip of 4%. It has resistance and standstill reactance per phase of 0.02Ω and 0.1Ω respectively. The motor drives a constant load torque load. The speed has to be reduced to 50% of rated speed.

(i) Determine the percentage reduction in stator voltage.

(ii) Repeat the problem if $T_d \propto \omega^2$. 7

3. (a) Explain the principle of counter-current braking of dc motors. 4

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(b) A 400 V, 750 rpm, 70 A d.c. shunt motor has an armature resistance of 0.3Ω . When running under rated conditions, the motor is to be braked by plugging with armature current limited to 90 A. What external resistance should be inserted in series with the armature ? Calculate the plugging and total braking torques (i) at the time of plugging and (ii) when the speed has fallen to 300 rpm. Neglect rotational losses and saturation.

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4. (a) Use the equal area criterion to determine the maximum load that can be suddenly thrown on to a synchronous motor without affecting stability assume that the motor is initially under no-load. 5

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- (b) A 500 kW, 10 pole, 50Hz, synchronous motor has a torque angle of 35° on full load. Determine the natural frequency of oscillation if the moment of inertia is 1200 kg.m^2 . 5
5. (a) Describe how the speed of a separately excited dc motor is controlled by a three phase full converter. Illustrate your answer with waveforms and appropriate expressions. 5
- (b) The speed of a 50 kW, 500 V, 120 A, 1500 rpm separately excited dc motor is controlled by a three-phase full converter fed from 400 V, 50 Hz supply. Motor armature resistance is 0.1Ω . Find the range of firing angle required to obtain speeds between 1000 rpm and (-1000 rpm) at rated torque. 5
6. (a) Induction motor speed control with constant supply voltage and reduced supply frequency is rarely used in practice. Justify this statement. 3
- (b) Describe stator frequency control for the speed control of 3-phase induction motor. Derive expressions for motor torque, maximum torque and the slip at which it occurs. State the various assumptions made. 5
- (c) Discuss, why during this method of speed control, an induction motor is said to be working in field weakening mode. 2
7. A motor has a heating time constant of 90 minutes and cooling time constant of 120 minutes and final steady-state temperature rise on full load of 60°C . The motor has repeated load cycle of full load for 30 minutes followed