Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech.

Branch	: Electrical & Electronics Engg.	Semester	: VII
Title of the Course	: Solid State Drives	Course Code	: EE401

Time: 3 Hours | Maximum Marks: 50

SECTION-A (10 Marks)

Note: All parts of this question are compulsory and carry one mark each. Answer should be precise and to the point.

Q1.

i. Can a motor-load system with (a) passive load torque and (b) active load torque have an equilibrium speed in quadrant-II? Explain both cases with suitable concept.

ii. (a) Which speed control method preferred for constant torque drive?
(A) Field control
(B) Armature voltage control
(C) Mechanical loading system
(D) None of above

(b) A four quadrant operation requires
(A) two full converters in series
(B) two full converters connected in parallel
(C) two full converter connected in back to back
(D) two semi converters connected in back to back

iii. Explain how the operation of synchronous motor shifts from motoring to regenerative braking.

iv. Classify different load torques with suitable characteristics.

v. Explain the significance of speed and current sensing in closed-loop drive operation. Explain common methods for current and voltage sensing.

vi. Draw the characteristics between speed and maximum allowable torque in a dc machine and mark different controls in various regions.

vii. Explain the significance of determination of motor duty in the selection of drives.

viii. State and explain the disadvantages of using a motor of wrong rating?

ix. Explain the different types of braking employed for electrical motors.

x. Differentiate between constant power and constant torque drive.

SECTION-B (20 Marks)

Note: Attempt any four questions, each question carries 5 marks.

Q2. Derive the expression of speed and instantaneous current drawn by the separately excited dc motor when it is supplied by Single-phase fully controlled rectifier. Also obtain the expression for critical speed that separates continuous and discontinuous conduction mode.

Q3. Explain the different types of solid-state power modulators employed for industrial drives with suitable block diagrams indicating the nature of voltage for all intermediate stages.

Q4. Explain, with the help of suitable block diagram, different control schemes used for the closed-loop control of drives. Also explain the closed-loop speed control of multi-motor drive with suitable block diagram along with the two schemes used for changing the reference signal.

Q5. Explain with the help of a neat block diagram the four quadrant operation of solid-state Ward-Leonard dc drive. Elaborate how the regenerative braking takes place in the drive? Also explain the working of Ward-Leonard Ilgener drive used for intermittent heavy load with suitable block diagram.

Q6. A 25 kW, 2-pole, 3-phase induction motor is fed from a 3-phase voltage controller for speed control. The motor has a stator and rotor resistance ratio of 0.7. The speed control is required from 3000 to 1400 rpm. Determine derating of this motor when it derives: (i) constant torque load, (ii) loads having $T \alpha N$, and (iii) loads having $T \alpha N^2$ where 'N' is speed. Assume the efficiency of the motor to be 84%.

SECTION-C (20 Marks)

Note: Attempt any two questions, each question carries 10 marks.

Q7. Explain Slip-Power Recovery method of speed control of Induction Motor. Describe the working of Static Scherbius Drive with the help of relevant schematic diagram. Also derive the expression of torque if the copper loss of the motor are neglected.

Q8. A 2200 V, 50 Hz, 3-Phase, 6-pole, Y-connected squirrel cage induction motor has following parameters: R_1=0.075 ohms, R_2'=0.12 ohms, $Xs=X_2'$=0.5 ohms. The combined inertia of motor and load is 100 Kg-m^2. Calculate (i) time taken and energy dissipated in the motor during starting, (ii) time taken and energy dissipated in the motor when it is stopped by plugging and (iii) what resistance should be inserted in the rotor to stop motor by plugging in the minimum time? Also calculate stopping time and energy dissipated in the motor during braking.

Q9. A three-phase six pulse bridge converter working on a 500 V, 50 Hz supply feeds a dc motor having a rated voltage of 250 V. The motor is separately excited and draws an armature current of 181 Amps at 250 V and runs at 1500 rpm. The motor drives a load having torque-speed characteristics given by $T_L = 0.64\omega^2$. If the speed control of this motor is required from 1500 to 500 rpm determine the range of firing angles. If the firing angle α=0 for operation at rated speed, determine the line voltage. What is the range of firing angle in this case? Explain which of the two way of speed control is advantageous.

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