

R07

Code: R7410202

B.Tech IV Year I Semester (R07) Supplementary Examinations, May 2013

POWER SEMICONDUCTOR DRIVES

(Electrical & Electronics Engineering)

Time: 3 hours

Max. Marks: 80

Answer any FIVE questions
All questions carry equal marks

1. The speed of a 20 HP, 210 V 1000 rpm DC series motor is controlled by a single phase.
(i) Semi converter. (ii) Full converter. The combined field and armature circuit resistance is 0.25Ω . Motor constants are $K_{af} = 0.03 \text{ N-mA}^2$ and $K_{res} = 0.075 \text{ V-S/rad}$. The supply voltage is 230 V. Assuming continuous and ripple free motor current. Determine the following for a firing angle $\alpha = 30^\circ$ and speed $N = 1000 \text{ rpm}$. (i) motor torque (ii) motor current (iii) supply power factor.
2. Derive the speed, torque equations of a 3- ϕ fully controlled converter connected to separately excited DC motor with continuous and discontinuous current operation with necessary waveforms.
3. Design a dual converter to achieve a four quadrant operation of the separately excited DC motor. Motor and converter specifications are given by
(i) Motor specifications: $E_a = 220 \text{ V}$, $I_a = 30 \text{ amps}$, $N = 1500 \text{ rpm}$.
(ii) Converter specifications:- supplied from 3- ϕ , 400 V, 50 HZ supply. Assume drop in the circuit is 15%.
4. (a) Derive the expressions for average motor current, RMS motor current, torque and average motor voltage for chopper fed DC series motor.
(b) A DC chopper is used to control the speed of a separately excited DC motor. The DC voltage is 220 V, $R_a = 0.2 \Omega$ and motor constant $K_e \phi = 0.08 \text{ V/rpm}$. The motor drives a constant load requiring an average armature current of 25 A. Determine (i) the range of speed control (ii) the range of duty cycle. Assume – continuous conduction.
5. Discuss in detail with suitable diagrams how the speed control of a 3- ϕ SQIM can be varied by using A.C. voltage controllers. Also draw the various types of AC voltage. Controllers which are used for speed control of induction motor.
6. Compare the performance of VSI and CSI fed induction motor drives. Mention advantages and disadvantages.
7. Draw the circuit diagram and explain the working of slip power recovery system using solid state Scherbius system.
8. (a) What is the basic difference between true synchronous mode and self control mode for variable frequency control of synchronous motor?
(b) When operating in true synchronous mode? Why the frequency may be changed in small steps?
