Code No: NR410202 **NR**

IV B.Tech I Semester Supplementary Examinations, November 2005
POWER SEMICONDUCTOR DEVICES
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. A dc series motor has $R_a = 3\ \Omega$, $R_f = 3\ \Omega$ and $M_{af} = 0.15$ H. The motor speed is varied by a phase-controlled bridge. The firing angle is $^{\pi}/4$ and the average speed of the motor is 1450 rpm. The applied ac voltage to the bridge is 330 Sin wt. Assuming continuous motor current find the steady state average motor current and torque. Sketch the waveforms for output voltage, current and gating signals.

[16]

2. (a) Draw the circuit diagram and explain the operation of closed-loop speed control with inner-current loop and field weakening.

   (b) A single phase fully controlled double bridge converter is operated from 120v, 60Hz supply and the load resistance is 10 ohms. The circulating inductance is 40mH. Firing delay angle for converter I and II are 60^0 and 120^0 respectively. Calculate the peak circulating current and the current through converters.

[8+8]

3. A class-A chopper, operating in time-ratio control, is supplying the armature of the separately excited dc motor. Show that the motor speed-torque relationship is $\omega_m = \frac{\delta.V}{K} - \frac{R_a}{K^2}T_a$, Where V - chopper input voltage, R_a - Armature resistance, Ta - motor torque, K- torque constant. [16]

4. The voltages to the terminals of a three phase, 50 KW, 240V induction motor are to be controlled by pairs of inverse-parallel connected thyristors in the supply lines. If the motor full-load efficiency is 0.9 p.u. and the full-load power factor is 0.85, calculate the rms current, mean current and maximum voltage ratings of the thyristors. [16]

5. A 460V, 100-HP (74.6 KW), 1775 RPM, three-phase, squirrel cage Induction motor has the following equivalent circuit parameters.
   $R_s = 0.060$ ohm R'$_r = 0.0302$ ohm
   $L_{1s} = 0.638$mH, $L_{ms} = 23.3$ mH, L_{1r}' $= 0.957$ mH
   The motor is to be driven from a current source inverter with the rotor frequency controlled at the rated value. Maximum output power is to be limited to 80% of the rated value. Motor friction, windage, and core losses may be neglected. The load is to consist of a pump presenting a load characteristic described by the equation. $T = \frac{\omega_m^2}{110}N.m$Determine the maximum values of motor speed, inverter frequency, rms motor line current, and fundamental line-to-line motor terminal pd at maximum power output. [16]

6. A 440V, 50Hz, 6 pole star connected, wound rotor induction motor has the following parameters referred to the stator.
   $R_1 = 0.08\Omega$, R_2' $= 0.12\Omega$, $X_1 = 0.25\Omega$, X_2' $= 0.35\Omega$, $X_0 = 10\Omega$.
   An external resistance is inserted into the rotor circuit so that the T_{max} is produced at $S_m = 2.0$. The motor connections are now changed from motoring to single phase AC dynamic braking with three lead connection (one phase in series with other two phases in parallel). Calculate the braking current (line) and torque for a speed of 900rpm. [16]

7. Describe cycloconverter drive versus VSI drive for synchronous motor in detail and state their advantages and disadvantages. [16]

8. Draw the block diagram of a closed loop synchronous motor drive fed from VSI and explain. [16]

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