DEPARTMENT OF ELECTRICAL ENGINEERING
M. Tech. POWER ELECRONICS, ELECRTICAL MACHINES AND DRIVES (PEEMD)
EEL841: Solid State Controllers of Drives
Major Test

TIME – TWO HOURS **MAXIMUM MARKS-300**

Q.1. (a) Draw circuits of (i) 6-pulse thyristor bridge rectifier-GTO based CSI, (ii) 12-pulse thyristor bridge rectifier-IGBT based PWM CSI, (iii) 18-pulse thyristor bridge rectifier-GTO based PWM CSI, (iv) GTO based PWM current source converter feeding GTO based CSI for feeding synchronous motor drives. [16]

(b) Draw circuits of (i) 6-pulse diode bridge rectifier-PWM voltage source inverter (VSI), (ii) 12-pulse diode bridge reetifier-PWM VSI, (iii) 18-pulse diode bridge rectifier-PWM VSI, (iv) 24-pulse diode bridge rectifier-PWM VSI, (v) PWM voltage source converter feeding PWM voltage souree inverter (VSI) for feeding three-phase cage induction motor drives. [20]

(c) Draw two converters circuits for the control of each of (i) four phase viable reluctance step motor, (ii) three-phase PM step motor and (iii) two phase hybrid motor. [24]

Q.2. A 3-phase, 1.5 kW, 4-pole, 1500 rpm permanent magnet brushless dc motor is fed from 3-phase 415 V, 50 Hz ac mains fed 3-phase diode rectifier with 1500 μF eapacitor dc shunt filter and its dc bus is feeding a 3-phase PWM-VSI connected to stator winding of the motor. Per phase winding resistance is 3 ohms/phase. It has open circuit peak back emf per phase of 220 V at rated speed. If it desired to get double the rated torque at starting, calculate (a) peak current of the winding, and (b) rms current of the winding. [20]

Q.3. In a battery-driven truck, the battery voltage is 240 V. It employs a dc motor with armature resistance of 0.50 ohms through step up dc chopper. During regenerative braking, when truck is moving down hill at some speed its back-emf is 160 V and braking motor eurrent is 25A. Calculate (i) the duty ratio, (ii) value of peak, rms, and average current in the battery, and (iii) values of peak, rms, and average current of the solid-state switch and diode. [40]

Q.4. A thrce-phase, 1.93 kW, 8.1 A, 3325 rpm, 4-pole, star eonnected permanent magnet synehronous motor has the following parameters: L_d=9.1 mH, L_q= 11.5 mH, J=0.0015 kgm^2, Flux linkage=0.191 Tesla and R_s=1Ω. It is controlled in vector controlled mode with single-phase power factor corrected (PFC) ac-dc eonverter having an input supply of 230V, 50 Hz at almost unity power factor feeding VSI at 400V dc bus voltage. The motor is controlled with constant flux below base speed and constant rated voltage above base speed. Calculate supply rms current, supply power, average de bus current, reference d-q components of stator eurrent, rms stator current at starting if starting torque is required the rated torque. [60]

Q.5. A variable frequency cage motor drive consists of a 3-phase, 7.5kW, 415V (line), 50Hz, Y-conneeted, 4-pole cage induction motor having the following parameters: R_s = 1 Ω, R_r =0.77 Ω, X_{lr}= X_{ls}= 1.5 Ω, X_m= 35Ω, J = 0.1384 kg-m^2. Its full load speed is 1455 rpm. The motor is controlled with constant flux below base speed and constant rated voltage above base speed. The speed of the motor is eontrolled using indireet vector eontrol scheme through a thrce-phase PWM VSC fed PWM VSI with an almost unity power factor at ac mains of 415V, 50 Hz and dc bus voltage of 650V. Calculate the supply rms current, supply active power, average dc link eurrent, reference d-q components of stator eurrent, rms stator current at 50% of rated speed and at rated torque. Neglect eore and friction and windage losses. [60]

Q.6. A 4-phase, 1.5 kW, 500 rpm switched reluetance motor (SRM) with 8-stator and 6-rotor poles has a stator pole arc of 30° and rotor pole arc of 22.5°. The aligned induetance is 25 mH and the unaligned inductanee is 2.5 mH. The resistanee per phase is 0.25Ω. Saturation can be neglected. An eight device eonverter is fed from a battery of 48V used to supply 4-phase stator winding of the motor. The motor is used in an industry as pallet truck. Calculate (a) average battery current, peak and rms winding current to obtain the instantaneous torque eight times the rated torque at starting when two phases are excited simultaneously, (b) average battery current, and peak and rms winding eurrent at the rated torque at 50% of the rated speed when only one phase is excited. [60]

*****BEST OF LUCK*****