`INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMOUS)

Code No: BPE001

MODEL QUESTION PAPER-2

I M. Tech I Semester Regular Examinations, February 2017

POWER ELECTRONIC CONTROL OF DC DRIVES

(Power Electronics and Electric Drives)

Time: 3 hours Max. Marks: 70

Answer ONE Question from each unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1 a) Explain the use of freewheeling diode in the converter fed DC drives. Take an example of 1-phase fully controlled converter fed for explanation. How it is going to affect the machine performance. [7M]

b) A 220V, 1500RPM, 10A separately excited DC Motor has an armature resistance of 1Ω. It is fed from a single phase full converter with an AC source voltage of 230V, 50Hz. The motor EMF constant is 1.337N-m/A. Assume continuous load current at the firing angle of 30° and torque of 5N- m, calculate the motor speed. [7M]

2 a) Describe the operation of single phase fully controlled rectifier control of DC series motor and obtain the expression for motor speed for continuous mode of operation. [7M]

b) The speed of a 15HP, 220V, 1000RPM DC series motor is controlled using a single-phase half controlled bridge rectifier. The combined armature and field resistance is 0.2Ω. Assuming continuous and ripple free motor current and speed of 1000 rpm and K=0.03 Nm/Amp determine [7M]

i. A Motor current
ii. Motor torque for a firing angle α=30° AC source voltage is 250V.

UNIT – II

3 a) Explain the motoring and braking operation of three phase fully controlled rectifier control of dc separately excited motor with aid of diagrams and waveforms. Also obtain the expression for motor terminal voltage speed. [7M]

b) A 600V, 1500RPM, 80A separately excited DC motor is fed through a three-phase semi converter from 3-phase 400 supply. Motor armature resistance is 1Ω the armature current assumed constant. For a firing angle of 45^0 at 1200RPM, compute the RMS value of source and thyristor currents, average value of thyristor current and the input supply power factor. [7M]

4 a) Explain the operation of three phase half controlled rectifier fed DC separately excited motor drives with waveforms and characteristics. Find out the average, RMS valves and the harmonic spectrum of the output voltage / current waveforms of the converter and find out the displacement factor, distortion factor and the power factor of the input current as well as its harmonic spectrum. [7M]

b) A 230V, 1500RPM, 20A separately excited DC Motor is fed from 3-phase full converter. Motor armature resistance is 0.6Ω. Full converter is connected to 400V, 50Hz source through a delta-star transformer. Motor terminal voltage is rated when converter firing angle is zero. Calculate the transformer phase turns-ratio from primary to secondary. [7M]

UNIT – III

5 a) Draw the circuit diagram and explain the operation of closed loop speed control with inner current loop and field weakening. [7M]

b) A 200V, 1500RPM, 50A separately excited motor with armature resistance of 0.5Ω is fed from a circulating current dual converter with AC source voltage 165V. Determine converter firing angle for the following operating points [7M]

i. Motoring operation at rated motor torque and 1000RPM
ii. Breaking operation at rated motor torque and 1000RPM.

6 a) Distinguish between circulating current and non circulating current mode of operation and their application. [7M]

b) Speed of a dc series motor coupled to a fan load is controlled by variation of armature voltage. When armature voltage is 400V, motor takes 20A and the fan speed is 250RPM. The combined resistance of armature and field is 1.0Ω. Calculate [7M]

i. Motor armature voltage for the fan speed of 350RPM
ii. Motor speed for the armature voltage of 250V.

UNIT – IV

7 a) Develop the mathematical expression for minimum and maximum currents for a class A chopper operated DC motor with back EMF. [7M]

b) A chopper used for ON and OFF control of a DC separately excited motor has supply voltage of $230V_m$ T_{on} = 10ms, T_{off} = 15ms. Neglecting armature inductance and assuming continuous conduction of motor current, Calculate the average load current when the motor speed is 1500 rpm, has a voltage constant K_v = 0.5V/rad/sec. The armature resistance is 2Ω. [7M]

8 a) Explain the operation of chopper for forward motoring and braking control of separately excited DC motor aid of diagram, waveforms and speed torque curves. [7M]

b) A DC chopper controls the speed of DC series motor. The armature resistance R^a = 0.04Ω, field circuit resistance R_f = 0.06Ω, and back EMF constant K_v = 35M v/rad/sec. The DC input voltage of the chopper V_s = 600V. If it is required to maintain a constant developed torque of T_d = 547N-m, plot the motor speed against the duty cycle K of the chopper. [7M]

UNIT – V

9 a) Show how can the input current of the rectifier fed booster converter be made sinusoidal and in phase with the input voltage. [7M]

b) The step up converter has R=10Ω, L= 6.5mH, E = 5V and K=0.5, find I_1, I_2 and ΔI. Use SPICE to find these values and plot the load, diode and switch current. [7M]

10 a) Compute the multi output boost converter be operated with time multiplexing control? [7M]

b) A DC Regulator is operated at a duty cycle of K=0.4. The load resistance is R=150Ω, the inductor resistance is RL=1Ω and resistance of the filter capacitor is R_c=0.2Ω. determine the voltage gain for [7M]

i. Buck converter
ii. Boost converter and
iii. Buck boost converter.