Registration no: | | | | | | | | | | |

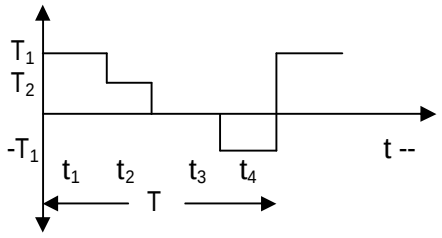
Total Number of Pages: 2 **M.TECH**
PEPC103

1st Semester M.Tech Regular/Back Examination – 2015-16
ELECTRIC DRIVE - 1
BRANCH(S): Power Electronics & Drive
Time: 3 Hours
Max marks: 70
Q.CODE:T1097

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: (2 x 10)

a) An electric train's torque is shown in figure below for one cycle. Determine the effective electromagnetic torque.



b) What is the difference between active and passive load? Give an example of active and passive load.

c) A single phase fully controlled rectifier is feeding a highly inductive load. Draw the input and output current waveform with a common reference axis.

d) A motor having moment of Inertia J_o is connected to the load having moment of inertia J_m through a set of gear having a teeth ratio $N_1 : N_2$. Calculate the equivalent Moment of Inertia referred to the motor side.

e) Derive the normalized torque equation for a chopper controlled dc motor drive.

f) Draw the circuit diagram for a reversible phase-controlled induction motor drive.

g) Can a slip-energy controlled induction motor be reversed in speed? How is it done?

h) Draw the output voltage, armature current and supply current waveform of the second quadrant operation of chopper circuit feeding the armature of a separately excited dc motor drive.

i) A 3-phase fully controlled rectifier is feeding a resistive load. Draw the output current and input (any one line current waveform) with a common reference axis.

j) Draw the gating pulses for a three-phase thyrister converter fed to a resistive load.

Q2 a) A separately excited dc motor with the following parameters: R_a=0.5Ω, (5)

L_a=0.004H, and K_b=0.8V/sec is driving a load of J=0.0167kg-m^2, B_1=0.01 N.m/rad/sec with a load torque of 100Nm. Its armature is connected to a dc supply voltage of 210V and is giving the rated field current. Find the speed of the motor.

b) If the separately excited dc motor with the specification above is started directly from a 210V dc supply with no load. Find the mathematical equation of its starting speed. (5)

Q3 a) Derive the expression for normalized torque of the three phase converter controlled by the DC motor drive in steady state. (5)

b) Consider a motor drive with R_{an}=0.1p.u, ϕ_{fn}=1 p.u, V_n=1.1 p.u. and extreme load operating point $T_{e1(min)}$ = 0.1 p.u., $w_{mn(min)}$ =0.1 p.u., $T_{e2(max)}$ =1 p.u., and $w_{mn(max)}$ =w_{mn2}=1p.u. Find the normalized control voltage to meet these operating points. (5)

Q4 Derive the output current equation for a chopper controlled dc motor drive in continuous conduction mode. (10)

Q5 a) Explain with the suitable block diagram the control circuitry for a four quadrant dc motor drive. (5)

b) A dc motor is driven from a chopper with a source voltage of 24V dc and at a frequency of 1kHz. Determine the variation in duty cycle required to have a speed variation of 0 and 1 p.u. delivering a constant 2 p.u. load. The motor details are as follows (5)
1hp, 10V, 2500rpm, 78.5% efficiency, Ra=0.01Ω, La=0.003H, Kb=0.038V/rad/sec.
The chopper is one-quadrant, and the on-state drop voltage across the device is assumed to be 1V regardless of the current variation.

Q6 a) Explain with a suitable block diagram, how to decouple the inner current loop from the dc motor-inherent induced-emf loop. (5)

b) Draw the gate pulses for a bipolar sinusoidal pulse width modulated – VSI feeding an induction motor drive for a modulation index = 1 and modulating frequency = 7. (5)

Q7 a) Derive the output current equation of a 3-phase converter feeding a dc motor drive in steady state. Neglect the commutation effect. (5)

b) Explain the speed control of 3-phase Induction motor drive using constant volts/Hz control. (5)

Q8 Answer any two. (5 x 2)

a) Steady state stability of a drive depends on relative characteristic of the motor and load and not just on motor (or load) characteristic.

b) Rectifier-inverter power stages for slip-power recovery scheme.

c) Variable frequency CSI Drives

d) Impact of Non-Sinusoidal excitation on Induction motor.