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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination – April, 2017

Program/course:BTECH PSE | **Semester – VIII**
Subject: ELECTRICAL DRIVES | **Max. Marks : 100**
Code : PSEG 329 | **Duration : 3 Hrs**
No. of page/s:2

SECTION – A

Note: All questions are compulsory **(5 x 4M = 20 M)**

Q1) Define plugging of 3 phase induction motor

Q2)What are the possible ways to change the maximum torque developed in 3 phase slip ring induction motor?

Q3) Draw the speed torque curves of separately excited and DC series motor in the case of plugging breaking.

Q4) What are the drawbacks associated with the operation of induction motor with unbalanced rotor impedances.

Q5) List out the different ways in which speed of induction motor can be controlled.

SECTION – B

Note: Attempt all the following questions **(4 x 10M = 40 M)**

Q6) Explain the closed loop slip controlled PWM inverter drive for VSI fed induction motor drive with the help of block diagram.

Q7) Explain the operation of Trapezoidal BLDC motor fed from a current regulated VSI with the help of induced voltage , Phase currents and torque waveforms .

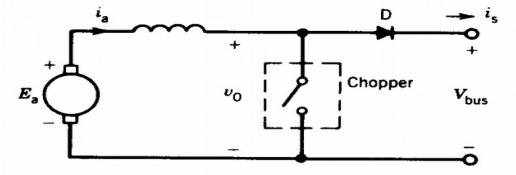
Q8) Explain the basic approach of closed-loop speed control of a separately excited DC-Drive for above and below base speed.

Q9) The power circuit configuration during regenerative braking of a subway car is shown in Fig. below. The dc motor voltage constant is 0.3 V/rpm and the dc bus voltage is 600 V. At a motor speed of 800 rpm and average motor current of 300 A,

a)Draw the waveforms of Vo, and is for a particular value of the duty cycle D= t_{on}/T.

b)Determine the duty ratio a of the chopper for the operating condition.

c)Determine the power fed back to the bus.



SECTION – C

Note: Attempt all the following questions **(2 x 20M = 40 M)**

Q10)A 3-ϕ star connected 6 pole 50 Hz ,440V 925 rpm ,Squirrel cage induction motor has the following parameters

Rs=0.2Ω, R_r'=0.3Ω , Xs=0.5 Ω, X_r'=1 Ω

Motor speed is controlled from a V/F control fed from a voltage source inverter with a constant V/f ratio from 0 to 50Hz.

Consider Voltage of 440V for above 50Hz

i) Determine the starting and maximum torque for a frequency of 100Hz as a ratio of its values at 50Hz

ii) Obtain the torque at rated motor current at 25Hz

Note: :consider approximate per phase equivalent circuit for the analysis

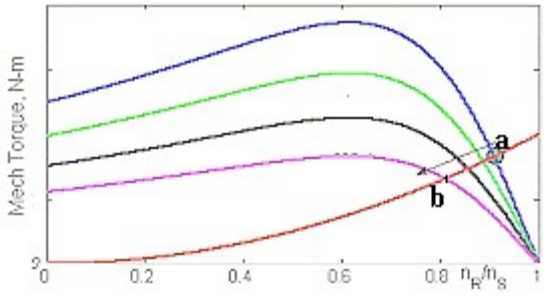
(OR)

Q10)A 2.8k W , 400V , 50Hz ,4Pole ,1370 rpm , delta connected squirrel-cage induction motor had a following parameters referred to stator : Rs=2Ω, R_r'= 5Ω , Xs=Xr'= 5 Ω , Xm=80 Ω.

Motor speed is controlled form a stator voltage control . when driving a load torque is proportional to speed square ($T_L=K*N_r^2$) at rated speed and at rated voltage .

Value of K= 57.7

Calculate (i) motor terminal voltage , input current & rotor current ,Input power and torque at operating point "b"



(ii)Motor speed , current and torque for terminal voltage of 200V

Note : Consider approximate per phase equivalent circuit for the analysis & neglect the no-load losses

Q11) Explain the concept of Four Quadrant operation can be achieved in the case of DCmotor driving a hoist load.

Note : Consider necessary assumptions if required for any question and mention the same clearly

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SECTION – A

Note: All questions are compulsory **(5 x 4M = 20 M)**

Q1) Define Regenerative braking of 3 phase induction motor
Q2)What are the possible solutions to improve the starting torque of 3 phase induction motor?
Q3)what are the advantages of V/F control.
Q4)What are the effects on the Induction motor if it is fed from a non-sinusoidal supply.
Q5) Explain the importance of "load equalization " and why it is required?

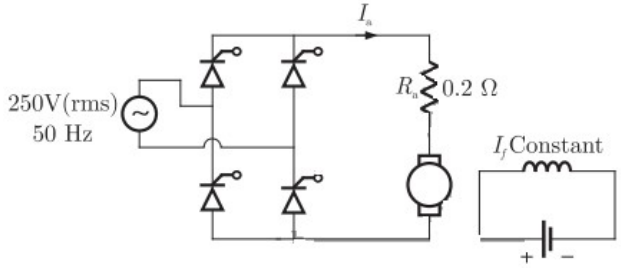
SECTION – B

Note: Attempt all the following questions **(4 x 10M = 40 M)**

Q6) Explain the operation of Brushless dc motor drive fed from a current regulated VSI with the help of induced voltage , Phase currents and torque waveforms .

Q7) For variable frequency operation considering the IEEE equivalent circuit ,Show that if the slip frequency is kept constant, the torque developed by an induction machine is proportional to the square of the input current

Q8) A separately excited dc motor is controlled by varying its armature voltage using a single-phase full-converter bridge as shown in figure. The field current is kept constant at the rated value. The motor has an armature resistance of 0.2 Ω, and the motor voltage constant is 2.5 V/(rad/sec). The motor is driving a mechanical load having a constant torque of 140 Nm. The triggering angle of converter is 60°. The armature current can be assumed to be continuous and ripple free.



(a) Calculate the motor armature constant. (b) Evaluate the motor speed in rad/sec. (c) Calculate the rms value of the fundamental component of the input current to the bridge.

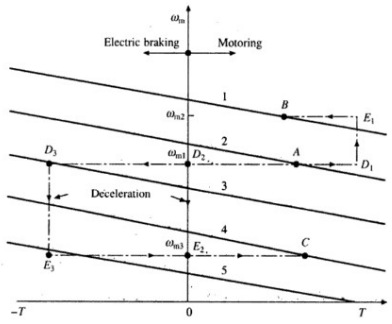
Q9) In Mass rapid transit (MRT) systems , the energy dissipated across the resistance may be used in heating the trains. Explain how rheostatic breaking can be achieved in the case of dc sperately excited motor and which quadrant of operation is achieved, with the help of diagram .

SECTION – C

Note: Attempt all the following questions **(2 x 20M = 40 M)**

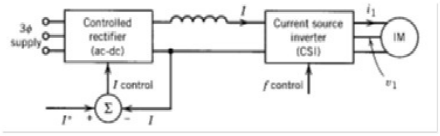
Q10) a) Explain which type of chopper circuit used to achieve four quadrant operation of a separately excited DC-motor driving a hoist load. Explain with the help of the circuit diagram and output wave forms,

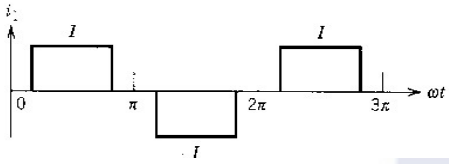
b) For the characteristics shown below explain how one can move from operating point i) A to B ii) A to C (with and without regenerative breaking) using the above mentioned chopper with the help of equivalent circuits.



Q11) The speed of a 3-Phase , 5 hp, 208 V, 1740 rpm, 60 Hz, four-pole induction motor is controlled by a current source inverter (Fig below). The phase current is a quasi-square wave of 120° pulse width as shown in Fig. below. The phase current can be expressed in a Fourier series as follows:

$$i = 1.1I \sin \omega t - 0.22I \sin 5\omega t - 0.16I \sin 7\omega t + \cdots$$





The parameters of the single-phase IEEE equivalent circuit of the induction machine at fundamental frequency (60 Hz) are R_1=0.5Ω , X_1=X_2^I=1.0 Ω R_2^I=0.5 Ω, X_m=35 Ω

At full load the induction machine draws a peak current of 10 amps (=I in Fig. below).

(a) Draw the equivalent circuit for the hit harmonic current.

(b) Determine the torques produced by the fundamental current.

(e) Determine the parasitic torques produced by the fifth and seventh harmonic currents.

(OR)

Q11) A 3ϕ ,11.2kW ,1750 rpm ,460v ,60 Hz , four pole Y-connected induction motor has the following parameters R_s=0.66 Ω , R_r^I=0.38Ω , Xs= 1.14 Ω, Xr^I=1.71 Ω and X_m=33.2 Ω. The motor is controlled by varying both voltage and frequency. The V/F ration , which corresponds to the rated voltage and rated frequency, is maintained constant (a) Calculate the maximum torque T_m and the corresponding speed ω_m for 60 and 30 Hz (b) Repeat (a) if R_s is negligible.

Note: :consider approximate per phase equivalent circuit for the analysis

Note : Consider necessary assumptions if required for any question and mention the same clearly