Important Ques of Electric Drives and Control

(a) Write four advantage of an electric drive system.
(b) Draw the typical torque-speed characteristics of mechanical loads.
(c) What is a Group Electric Drive (Shaft Drive)?
(d) What is meant by "load equalization?
(e) Why stator voltage control is more suitable for speed control of induction motor in fan type load than constant type load ?
(f) A train driven by separately excited dc motors has better co-efficient of adhesion than driven by series motor. Justify the statement.
(g) Compare static Kramer and Scherbius drive system.
(h) Draw the simplified speed/time curve for the main line services and show all necessary periods.
(i) What is self control of synchronous motor ?
(j) A 440 V, 60 Hz induction motor is to be used on a 50 Hz supply. What voltage should be used?

2. a) Why flywheel is mounted on the shaft of the motor in non-reversible drive? Deduce the expression for the Moment of Inertia of the flywheel. [4]
b) A motor has a heating time constant of 45 minutes and cooling time constant of 75 minutes. The motor has final steady state temperature rise of 50^0C while delivering its continuous rating of 25 kW
i) Determine the load the motor can deliver for 15 minutes so that the temperature rise does not exceed 50^0C.
ii) The motor delivers 35 kW for a period of 15 minutes followed by a shutdown for 15 minutes. Determine the maximum temperature rise. [6]

3. a) Why braking is required ? Explain each of the electrical braking briefly.

b) A 220 V, 1500 rpm, 11.6 A separately excited motor is controlled by a l-phase fully-controlled rectifier with an ac source voltage of 230 V, 50 Hz. Enough filter inductance is added to ensure continuous conduction for any torque greater than 25 percent of rated torque, R_a = 2 ohm
i) What should be the value of the firing angle to get the rated torque at 1000 rpm?
ii) Ca1culate the firing angle for the rated braking torque and - 1500 rpm.
iii)Ca1culate the motor speed at the rated torque and $\alpha = 160^o$ for the regenerative braking in the second quadrant. [4+6]

4. a) Explain with sketch how the rheostatic braking is done in D.C. shunt and series motors [4]

b) The switching frequency of the chopper is 2 kHz. The source voltage is 80V and the duty ratio is 30%. The load resistance is 4 ohm. Assume that the inductance and capacitance are ideal and large enough to sustain the load current and load voltage with little ripple. Calculate

i) On time and switching period

ii) Average voltage across the load

iii) Average current of the load [6]

5. a) Formulate the expression for the tractive effort during acceleration period of a locomotive train.

b) Explain the speed control of induction motor by stator voltage/hertz control method. [5+5]

6. a) The distance between two stations is 1.92kms.The scheduled speed and the duration of stops respectively are 40kmph and 20sec. Assume the quadrilateral approximation of the speed-time curve and the coasting and braking retardation as 0.16kmphps and 3.2kmphps respectively. Determine the acceleration if the speed at the end of the accelerating period is 60.8kmph.Find also the duration of the coasting period. [6]

b) Sketch and explain the static Kramer's variable speed drive system [4]

7. a) How the operation of synchronous motor shifts from motoring to generative braking ?

b) Draw the speed-torque characteristics of a three phase induction motor in its 4-quadrant region. [5+5]

8. Write short notes on the following (Any two) [5x2]

a) Steady state stability of an electric drive

b) Static Ward-Leonard Drive System

c) Speed control by D.C. Chopper

9.Answer all the following questions. [2×10]

a) Differentiate between the active and passive load related to drive system.

b)Draw the torque-speed characteristics of a separately excited DC motor during dynamic braking.

c)Why regenerative braking is not possible in half controlled rectifier ?

d)What are methods to reduce the energy loss during starting of three phase induction motor ?

e)What is the limitation for static Kramer drive and how it will be improved ?

f)Differentiate between the CSI and VSI .

g)Why stator voltage control is more suitable for speed control of induction motor in fan type load than constant type load ?What is meant by "load equalization?

h)What is function of pantograph in electric locomotive train A train driven by separately excited dc motors has better co-efficient of adhesion than driven by series motor. Justify the statement.

i)A train driven by separately excited dc motors has better co-efficient of adhesion than driven by series motor. Justify the statement. Draw the simplified speed/time curve for the main line services and show all necessary periods.

j)What are merits and demerits of microprocessor based drive system ?

10 a) Derive the thermal modelling for heating and cooling curve ?

b) A motor has a heating time constant of 90 minutes. If the temperature rise of the motor is 100^0 C when it is continuously loaded with its rated load. Determine the temperature rise of the motor after 2 hour of its rated load. If the temperature after 2 hour reaches the maximum permissible temperature (final steady state temperature with rated load applied continuously) after it is overloaded, determine the permissible overloading ? Assume constant loss=0.5 of full load copper loss.

11. a) Draw the circuit diagram and briefly explain the dynamic braking of a three phase induction motor. [3]

b) Plot and briefly explain the torque-speed characteristics of dc shunt motor during regenerative braking.

12. Explain the speed control of three phase induction motor by rotor injection method.

13.Why braking is required ? Explain each of the electrical braking briefly.

b)A 2200V,50 Hz, three phase,6 pole ,Y- connected squirrel cage Induction motor has following parameters.

$R_s = 0.075\Omega, \quad R_r' = 0.12\Omega \quad X_s = X_r' = 0.5\Omega$

The combined inertia of motor and load is 100 kg-mt^2. Calculate

i)The time taken and energy dissipated in the motor during starting.

ii)The time taken and energy dissipated in the motor when it is stopped by plugging. [6]

14.a) Formulate the expression for the tractive effort during acceleration period of a locomotive train.

b) Explain the speed control of induction motor by stator voltage/hertz control method. [5+5]

15.a) The distance between two stations is 1.92kms.The scheduled speed and the duration of stops respectively are 40kmph and 20sec. Assume the quadrilateral approximation of the speed-time curve and the coasting and braking retardation as 0.16kmphps and 3.2kmphps respectively. Determine the acceleration if the speed at the end of the accelerating period is 60.8kmph.Find also the duration of the coasting period.

b) Sketch and explain the static Kramer's variable speed drive system [6+4]

16.a) How the operation of synchronous motor shifts from motoring to generative braking ?

b) Draw the speed-torque characteristics of a three phase induction motor in its 4-quadrant region. [5+5]

17. Write short notes on the following (Any two) [5x2]

a) Steady state stability of an electric drive

b) Static Ward-Leonard Drive System

c) Speed control by D.C. Chopper

19.Answer all the following questions. [2×10]

a)State the advantages of the electric drive?
b)How electric friction is necessary for drive ?
c)Chopper control drive have more advantages over phase controlled drive. Justify.
d)What are the advantages of V/f methods for speed control of induction motor ?
e)For good adhesion, the motor speed-torque characteristics should have low speed regulation and for good load sharing of loads between motors, the torque-speed curve should have high regulation, Why ?
f)Mention some of the drawback of conventional Ward-Leonard scheme over static Ward-Leonard scheme.
g)What are the advantages of single phase,25KV,50 hz transmission line for locomotive train.
h)Draw the speed-torque characteristics of a three phase induction motor in its 4-quadrant region.
i)Why regenerative braking is not preferred for dc series motor ?
j)Plot the torque-speed characteristics of dc shunt motor during dynamic braking.

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20.a) Derive the formula for overloading factor, when a motor is subjected to i) short time duty ii)intermittent periodic duty.

b) Derive the transfer function of an armature controlled dc motor and draw the closed loop block diagram. [5+5]

21. a) What are the various factors that influence the choice of electric drives ? [4]

b) A 230V,960 rpm and 200 amp separately excited dc motor has an armature resistance of 0.02 ohm. The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230V. Assuming continuous conduction

22. i)Calculate duty ratio of chopper for motoring operation at rated torque and 350 rpm.
ii)Calculate duty ratio of chopper for braking operation at rated torque and 350rpm.
iii) If the duty ratio of chopper is limited to 0.95 and the maximum permissible motor current is twice the rated, calculate maximum permissible motor speed and power fed to the source?

22.a) A 150 V, dc shunt motor drives a constant torque load at a speed of 1200 rpm. The armature and field resistances are 1 ohm and 150 ohm respectively. The motor draws a line current of 10 amp at the given load. Calculate i) the resistance that should be added to the armature circuit to

reduce the speed by 50%. ii)Assume the rotational losses to be 100W,Calculate the efficiency of the motor without and with the added resistance. [6]

b)Draw and explain the various torque-speed characteristics of three phase induction motor at below and above base frequency. [4]

23.a) A 2.8 kW,400V,50hz,4 pole,1370rpm delta connected squirrel cage induction motor has following parameters referred to the stator.

$R_S = 2\Omega \quad R'_r = 5\Omega \quad X_s = X'_r = 5\Omega \quad X_m = 80\Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate i) motor terminal voltage, current and torque at 1200 rpm ii) motor speed, current and for the terminal voltage of 300 V.

b) With neat diagram describe the static Kramer's method for slip recovery power for three-phase induction motor. What are the drawbacks seen. [5+5]

24. a) A train service consists of following uniform acceleration of 1kmphps for 2 minutes. Free running for 30 minutes. Coasting for 2 minutes at a deceleration of 0.1kmphps. Uniform braking at 1.2 kmphps to stop the train. Stopping time 5 minutes. Calculate i) Distance between the stations ii) The scheduled speed [6]

b) Describe the duty cycle of main line service of the traction drive. [4]

25. a) Draw and explain the phasor diagram of synchronous motor operating with constant load torque at different value of rotor excitation. [5]

b) Explain the speed control of three phase induction motor by rotor emf injection method.

26. Write short notes on the following (Any two) [5x2]

a)Load equalization

b)Tractive effort for train movement

c)Drive mechanism in textile mill

27. Define Electric Drives.(2 marks)
28. What is the importance of the dynamic torque? (2 marks)
39. What is meant by short, continuous and intermittent duty cycle of motor? (6 marks)
30. Define Heating and Cooling time constant. (4 marks)
31. Differentiate between the active and passive load related to drive system. (3 marks)
32.Explain different components of friction torque. (3 marks)
33.What is drive? Draw the block diagram of drive and explain about each block. What are the advantages of electric drives. (20 marks)

34(i)With the help of block diagram, discuss the main components and their functions for a microprocessor based speed control of Induction motor drive. (10 marks)

(ii) Discuss the advantages and disadvantages of microprocessor controlled electric drives. What is the impact of microprocessor controlled electric drive in the industry? (10 marks)

35. Draw the block diagram of closed loop speed control of electric drive. What is the role of speed and current sensors in the closed loop speed control of electric drive, which one is used in outer loop? Discuss a method for sensing the speed and current in closed loop speed control of electric drive.
(20 marks)
36. How many duty cycles of motors are there as per BIS. Explain them along with diagrams. (20 marks)
37(i) Explain in detail the multi quadrant dynamics in the speed-torque plane. (10 marks)
(ii) Discuss the different modes of operation of an electrical drives. (10 marks)
38(i)Explain in detail about load equalization in an electrical drive? (10 marks)
(ii) Derive expression of torque equation in case of load increasing or flywheel releasing energy.
(10 marks)
39(i) Derive the expressions for equivalent moment of inertia and torque when many rotational motion loads are connected to drive through gear mechanism. (10 marks)
(ii) Derive the expressions for equivalent moment of inertia and torque when many translational motion loads are connected to drive through gear mechanism. (10 marks)
40. The outside of a 10KW totally enclosed motor is equivalent to a cylinder of 0.7m diameter and 1.2m length. The motor weighs 450kg and may be considered to be of material having specific heat of 700J/kg℃. The outer surface is capable of dissipating heat at the rate of $12.5W/m^2$-℃. When the motor is operating at full load with an efficiency of 90%. Determine (a) final temperature rise (b) Heating time constant. (20 marks)
41.The initial temperature of a machine is 45° C. Calculate the temperature of the machine after 1.2 hour of its final steady temperature rise is 85° C and heating time constant is 2.4 hours. The ambient temperature is 25° C. (20 marks)