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EE8601 SOLID STATE DRIVES

## IMPORTANT QUESTIONS AND QUESTION BANK

UNIT I - DRIVE CHARACTERISTICS

2-Marks

1. List the types of load torques.?
2. Compose the fundamental torque equation of motor load?
3. Explain the typical Elements of an Electric Drive?
4. Define electrical drive?
5. Define regenerative braking?
6. Compose the condition for steady state stability of motor?
7. Define Dynamic Braking?
8. Classify the different loads? Give the examples?
9. Explain the types of electric braking?
10. Give example is braking applicable for any type of motor?

Part-B

1. Label the essential parts of electric drive. Explain its Function?
2. Define how the following speed transitions are carried Out: (i) Increase in speed in same direction, (ii) Decrease in speed in same direction and (iii) Speed reversal.
3. Explain the fourth quadrant operation of low speed hoist in details (ii) Explain and derive an equation to find out equivalent Load torque in a motor load system with translational and rotational motion?
4. Compose the mathematical condition to obtain steady state stability of equilibrium point?
5. Explain in detail the multi quadrant operation of low speed hoist and speed torque plane?
6. Solve a motor drives two One has rotational Motion. It is coupled to the motor through a reduction gear with a = 0.1 and efficiency of 90%. The load has moment of inertia of 10 kg-m2 and a torque of 10 N-m. Other load has translational motion and consists of1000kg weight to be lifted up at a uniform speed of 1.5m/s. coupling between this load and the motor has an efficiency of 85%. Motor has inertia of 0.2 kg-m2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred to the motor shaft and power developed by the motor.
7. Define in detail about the braking of DC drives and AC Drives?
8. Explain the operation of electrical drives in three Different modes? Describe the typical load torque characteristics of electrical drive?
9. Explain the multi quadrant operation of a motor driving a load?
10. What are the factors governing selection of electric drives for any particular application? (ii) Write equation governing motor load dynamics?

11. Describe the mathematical condition for steady state Stability at equilibrium point based on the mathematical condition. Examine the
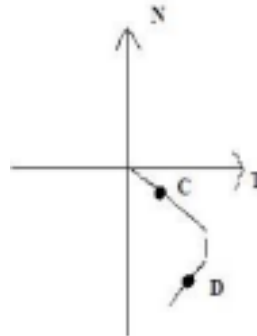
stability of equilibrium point A,B, C,D
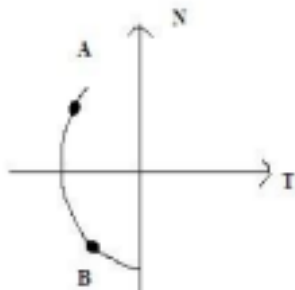
12. Discuss with the suitable mathematical model, the Analysis of steady state stability of an electrical drive?
13. Summarize the factors governing the selection of electric drives for any particular application?
14. Discuss in detail the different types of electrical barking applied for low speed hoist?
15. Analyze the multi quadrant dynamic of any suitable electrical drive in speed torque plane?

UNIT II - CONVERTER / CHOPPER FED DC MOTOR DRIVE

2-Marks

1. List the drawbacks of AC-DC Converter (rectifier) fed DC drives?
2. Show a semi converter fed DC drive operated in quadrant IV? Justify your answer?
3. Differentiate between continuous and discontinuous Conduction mode?
4. Evaluate the necessity of DC choke coil and freewheeling Diode in a converter circuit?
5. Compose the speed torque equation of single phase fully Controlled converter fed separately excited DC motor?
6. Define the speed control methods of DC Motor?
7. Tell whether discontinuous conduction will occur in the Operation of chopper fed dc drives?
8. Illustrate the speed torque equation of dc separately excited

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Motor fed drive?

9. Summarize the control strategies of chopper?
10. What are the advantages in operating choppers at Frequency??
11. Describe the advantages of chopper fed DC drive?
12. Discuss the Electrical and mechanical characteristics of Separately excited dc motors?

Part -B

1. Explain the steady state analysis of the single phase fully Controlled converter fed separately excited DC motor Drive for continuous current mode. Also explain Operation in motoring and regenerative braking mode.?

2. Solve a 450V separately excited dc motor has an armature Resistance of 4.5Ω when driving a load at 600 rpm. With constant torque, the armature takes 40 A. This motor is controlled by a chopper circuit with a frequency of 400and an input voltage of 450 V. (i) What should be the value of the duty ratio if one desires to reduce the speed from to 540 rpm. with the load torque maintained constant? (ii)Find out the value of duty ratio for which the per unit ripple current will be maximum?

3. Describe about Electrical –mechanical characteristics of Commonly used electric motors?

4. Describe the steady state analysis of the single phase fully Controlled converter fed separately excited DC motor drive for continuous and discontinuous conduction mode?

5. Explain in detail the single phase fully controlled rectifier Control of dc separately excited motor with heat Waveforms?

6. Compose the operation of single phase controlled converter Explain the operation of four quadrant operation of chopper fed DC Separately excited motor drive with necessary diagram Fed separately excited DC motor in continuous and Discontinuous modes with neat diagram, waveforms and comment the steady state analysis?

7. Explain the operation of four quadrant operation of chopper fed DC Separately excited motor drive with necessary diagram?

8. Define in detail about the operation of single phase fully-Controlled converter fed dc separately excited motor in Continuous and discontinuous modes of operation with Necessary waveforms and steady state analysis?

9. Discuss the different control techniques of chopper in Detail. (6)(ii) Discuss the fourth quadrant operation of DC-DC converter?

10. Solve a 440 V, 40 A, 1000 rpm separately excited motor has an armature resistance of 4.5 . The motor controlled by a step-down chopper with a frequency of 1kHz. The input dc voltage to the chopper is 450V. Identify what will be the duty cycle of the chopper for the motor to operate at a speed of 600 rpm delivering the rated torque?

11. A 400V, 875 rpm, 150A separately excited dc motor has An armature resistance of 0.06 . It is fed from a single phase fully controlled rectifier with an ac source voltage440V, 50Hz. Assuming continuous conduction, Calculate(i)Firing angle for rated motor torque and (-750) Rpm Motor speed for α=160 and rated torque?

12. List the uses of phase controlled rectifiers in DC drives?

13. separately excited dc motor of 400V, 150 A,=0.06 , =0.85mH is supplied from three phase, six phase Fully controlled converter. The line voltage connected to Converter is 148V and if the motor back emf is 160VRated current, find SCR firing angle. (7)(ii) A 440V, 1500 rpm, 50A separately excited motor with armature resistance of 0.5 is fed from a three phase fully controlled rectifier. Available ac source has a line voltage440V, 50Hz. A star delta connected transformer is used feed the armature so that motor terminal voltage equals rated voltage when converter firing angle is zero. Calculate transformer turns ratio. Determine the value of firing angle when i) motor is running at 1400 rpm and rated torque, ii)when motor is running at (-800) rpm and twice the rate torque. Assume the continuous conduction?

14. Analyze the steady state analysis of single phase converter Fed DC motor drive for continuous mode of conduction?

15. Solve a 440 V, 1500 rpm, 10 A separately excited DC motor has an armature resistance of. It is fed from a single phase fully controlled rectifier with a source voltage of 430V 50 Hz. Assuming continuous load current. Compute (1)Motor speed at the firing angle of 30 and Torque of 5 Nm. (4) Developed Torque at the firing angle of 45 and speed 1000 rpm?

UNIT III - INDUCTION MOTOR DRIVES

2-Marks

1. Justify Why stator voltage control is suitable for speed Control of induction motors in fan and pump drives?

2. Summarize different methods of braking applied to induction motor?

3. What are the advantages of induction motor over DC Motor ?

4. Discuss different methods of speed control of induction motor?

5. Tell the drawbacks of stator voltage controlled Induction Motor drive?

6. Define three regions in speed vs torque characteristics of induction motor?

7. List any two applications of ac drives?

8. Show the various applications of rotor resistance control?

9. Discuss stator voltage control method?

10. Compare CSI fed drives and VSI fed drives?

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Part-B

1. Discuss in detail with suitable diagrams and waveforms The v/f control technique of speed control method of Induction?
2. Tell Why a cyclo-converter fed induction motor drive is Preferred over inverter controlled synchronous motor Drive for low speed applications?
3. Define in detail about the principle of vector control of Induction motor drive?
4. Explain the four modes of operation of a Static Scherbius Drive with diagram?
5. Describe the VSI fed induction motor drive. (ii)What are the drawbacks of Stator Voltage Control Method?
6. Describe the concept of v/f control scheme(ii) Describe the variable frequency operation of induction Motor in closed loop with constant - gap flux?
7. Describe the v/f control scheme of induction motor Drive with a neat diagram(ii)Show and explain with a neat diagram the field weakening mode control of induction motor drives?
8. Explain the speed control scheme of induction motor drive With stator voltage control and stated is advantage of this Method(ii) Compare VSI and CSI fed induction motor drive?
9. Define the VSI fed induction motor drives(ii) Define the CSI fed induction motor drives?
10. A three phase 50Hz Induction motor has the following Parameters for its equivalent circuit R1 = R4 = 0.04 ohm and X1 = X4 = 0.1 ohm is to be operated at one half of it start d voltage and 45 Hz frequency. Calculate (i) the maximum torque at this reduced voltage and frequency operation in terms of its normal value and (ii) the starting torque at this reduced frequency and the voltage in terms of its normal value?
11. Analyze the operation of Voltage source inverter fed Induction motor drives?
12. Describe closed loop control speed control current source fed induction motor drive?
13. Discuss various types of the speed control scheme of induction motor drive?
14. Explain the operation of constant slip speed control?
15. Explain the stator voltage control scheme for speed control the three phase induction motor?

UNIT IV-SYNCHRONOUSMOTOR DRIVES

2-Marks

1. Justify why a self controlled synchronous motor is free from hunting oscillations?

2. Discuss why v/f ratio is kept constant up to base speed and V constant above base speed in variable frequency control?
3. Explain self control of synchronous motor?
4. List any two applications of synchronous motor drives?
5. Illustrate when a synchronous motor said to be self controlled?
6. Formulate the expression for torque equation of salient pole synchronous motor?
7. Define torque angle?
8. What is slip power recovery scheme?
9. Discuss the disadvantages of load commutation in the CSI fed synchronous motor drive?
10. What are the types and advantages of permanent magnet AC synchronous motor drives?

Part-B

1. Discuss briefly separate controlled mode of synchronous motor in detail? Explain Commutator less Dc motor?
2. A 7MW, three phase 14 kV star connected 6 pole 50Hz0.9 leading power factor synchronous motor has Xs=10 and Rs=0. The rated field current is 40A. Them achine is controlled by variable frequency control at constant V/f ratio up to the base speed and at constant Vabove base speed. Evaluate
   (i) Torque
   (ii) The field current for the rated armature current 750rpm and 0.8 leading power factor.
3. A 500kW, 5 phase, 5.5 kV, 50 Hz, 0.8 lagging power factor, 4 pole, star connected synchronous motor has the following parameters Xs=15 , Rs=0.Rated field current is10A. Calculate armature current and power factor at half the rated torque and field current?
4. Explain the constant marginal angle control technique of self controlled synchronous motor drive employing load commutated thyristor inverter?
5. Compose the closed loop control of synchronous motor with neat block diagram?
6. Describe using a diagram the working of a voltage source inverter fed synchronous motor drive?
7. Explain using a circuit and phasor diagram how the speed of a synchronous motor is controlled in the true synchronous mode?
8. Explain the forward motoring and braking operation of open loop V/f control of multiple PMSM with relevant phasor diagram?
9. Discuss using a block diagram the operation of a voltage source inverter fed synchronous motor in the true Synchronous mode(ii) Explain the self-control of Synchronous motor in detail?
10. Compare in detail V/F control strategies of induction motor and synchronous motor drive?
11. Discuss in detail with help of block diagram the closed loop control load commutated inverter fed synchronous motor drive?
12. 8 MW, 5 phase , 15 KV star connected 6 pole,0.9leading power

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factor synchronous motor has Xs equal to10 ohms and Rs equal to zero. The rated field current is65 Amps. The motor is controlled by variable frequency control at constant V/f ratio upto base speed and constant V above base speed. Identify the torque and field current for rated armature current, 750 rpm and 0.8

13. A 5phase, 400V, 50Hz, 6pole star connected round rotor synchronous motor has Zs=0+j4 Load torque proportion alto speed squared is 540Nm at rated synchronous speed. The speed of the motor is lowered by keeping v/f constant and maintaining unity power factor by field control of themotor. For the motor operation at 600 rpm, calculate supply voltage?

14. Discuss the various application of three phase voltage source inverter fed synchronous motor drive?

UNIT V - DESIGN OF CONTROLLERS FOR DRIVES

2-Marks

1. Discuss the roles of inner current control and outer speed control loops?
2. List the methods of speed sensing?
3. Write down the transfer function expression of converter?
4. Give the advantages of Pi controller?
5. Describe field weakening mode control?
6. Name any four simulation software packages that can be used for electrical drives?
7. List the advantages of closed loop speed control?
8. Show the transfer function of DC motor load system machine?
9. Explain how speed feedback achieved in speed controller design?
10. What are the modes of adjustable frequency control in synchronous motor drives?

Part-B

1. Derive and explain from basic principles the transfer function for separately excited DC motor load with converter old armature voltage system?
2. Explain the closed loop operation of armature voltage control method and field weakening mode control for Dc drive?
3. Discuss the design procedure for current controller of an electric drive(ii) Mention the factors involved in converter selection and equations involved in controller characteristics?
4. Give the design procedure for speed controller of an electrical drive system with necessary diagrams?
5. Discuss the use of simulation software package for design of controller for drives?
6. List the factors involved in converter selection and equation involved in controller characteristics?
7. A 50KW, 440V, 1700 rpm separately excited DC motor is controlled by a converter. The field current is maintained at If=1.4A and the machine

back EMF constant is Kv=.91VA rad/sec The armature resistance is Rm=0.1and the v is constriction constant is B=0.5Nm/rad/sec. The amplification of the speed sensor torque?

8. Describe the current controller design using (i)P controller (ii)PI controller for a separately excited dc motor drive system?

9. Design a speed controller Dc motor drive maintaining the field flux constant. The motor parameters and ratings area follow. 440V, 8.5A, 1470 rpm, Ra = 4
J = 0.0607 kg-m4, La = 0.074H Bt = 0.0869 Nm/rad/sec Kb = 1.46V/rad/sec The converter is supplied from450V, 5phase AC at 60 Hz. The converter is linear and its maximum control input voltage is ±10 V. The tacho generator has the transfer function Gw(s) =(0.065)/(1+0.004s).The speed reference voltage has a maximum of 10V. The maximum current permitted in the motor is 40A

10. Using suitable block diagram explain the following control (i)Current limit control
(ii)Closed loop torque control
(iii)Closed loop speed control

11. Derive the transfer function of DC Motor-load system with armature voltage control. (ii)How do you select the rating of the converter based on the drive application?

12. Derive the transfer function of separately excited dc motor with armature voltage control?

13. Design a current controller for small capacity constant speed drive?

14. Explain the design procedure and derive the transfer function of the Speed and Current controller?

15. Derive the closed loop transfer function of Dc motor with current feedback. Write in detail about the design of controller?