**SUBJECT NAME: ELECTRICAL DRIVES AND CONTROL**
**SUBJECT CODE : ME6351**

## UNIT- I INTRODUCTION

**PART-A (2 MARKS)**

**1. What is meant by electric drives?**

System employed for motion control are called "Drives" and many employ any of the prime movers such as, diesel or petrol engines, gas or stream turbines, hydraulic motors and electric motors for supplying mechanical energy for motion control. Drives employing electrical motors are known as "Electrical drives".

**2. What are the different types of drives?**

Group drive
Individual drive
Multimotor drive

**3. What are the different types of electrical drives?**

1. AC drives
2. DC drives

**4. What are the advantages of Electric Drives?**

- They have flexible control characteristics.
- Steady sate and dynamic characteristics of electrical drives can be satisfied load requirements.
- Automatic fault detection systems
- Available in wide range of torque, speed and power.



**5. What are the factors influencing the choice of electric drives?**

Reliability, Environment and location, space and weight restriction, Capital and running costs, maintenance needs, transient and steady state operation requirements.

**6. List out the various components used in electric drive systems.**

- Electrical motor and load
- Power modulater
- Sources
- Control unit
- Sensing unit

**7. What are the applications of electrical drives?**

Paper mills, electric traction, cement mills and steel mills.

**8. What are the types of elclosures?**

Screen protected type, drip proof type, totally elclosed type and flame proof type.

**9. What are the types of classes of duty?**

- Continuous duty,
- discontinuous duty,
- short time duty,
- intermittent duty.

**10. What is meant by overload current capacity of motor?**

It is generally greater than the full load current capacity of the motor. During the short time period, the motor can withstand by applying overload.

**PART-B** **(16 MARKS)**

**1. Explain the factors governing the selection of motors. (16)**
**2. Discuss in detail the determination of power rating of motors. (16)**
**3. Explain the different types of loading of drives. (8)**
**4. Explain the choice of selection of the motor for different loads. (8)**
**5. Describe the simplifications based on which the heating and cooling calculations of an electric motor are made. (3)**
**6. Establish the heating time constant and the heating curves. (13)**
**7. Compare the D.C and A.C drives. (6)**
**8. Write a brief note on classes of duty for an electric motor. (10)**
**9. Draw the typical temperature rise-time curve and derive the equation for temperature rise in an electric drive. (16)**
**10. Explain the loading of an electric motor and its duty cycle with a simple diagram. (16)**
**11. Explain in detail about the various types of electric drives. (16)**
**12. A 100 kW motor, having rated temperature rise of 60°C, has full-load efficiency of 80% and the maximum efficiency occurs at 85% full load. It has thermal time constants of 80 minutes and 65 minutes. It is cyclically loaded, 120% of full load for one hour and 50% of full load for the next hour. Find the temperature rise after 3 hours. (16)**
**13. The thermal time constant and final steady temperature of a motor on continuous running is 30 minutes and 60°C. Find out the temperature.**
**i) After 15 minutes at this load.**
**ii) After 1 hour at this load.**
**iii) If temperature rise at 1 hour rating is 60°C, find the maximum steady temperature.**
**iv)What will be the time required to increase the temperature from 40°C to 60°C at 1 hour rating. (16)**



**UNIT - II** **DRIVE MOTOR CHARACTERISTICS**

**PART-A** **(2 MARKS)**

**1. What is meant by mechanical characteristics?**
A curve is drawn between speed-torque.
**2. Why DC series motor should never be started on no-load?**
When the load current Ia falls to a small value, speed become dangerously high. Hence a DC series motor should never be started without some mechanical load.
**3. What are the applications of DC motors?**
DC shunt motor:
For driving constant speed line shafting.
Lathes
Centrifugal pumps
Machine tools
Blowers and fans
Reciprocating pumps.
DC series motor:
Electric locomotives
Trolly cars
Conveyors

DC compound motor:
Elevators
Air compressors
Rolling mills.

**4. What are the different types of electric braking?**

Regenerative braking
Dynamic braking
Plugging.

**5. What are the advantages of electric braking?**

High efficient method
Low maintenance
Braking is very smooth.

**6. Define synchronous speed.**

Three phase balanced power supply is fed to the three stator winding of three phase induction motor.it creates synchronously rotating magnetic field the speed of the is rotating field is called synchronous speed its given by

$N_s = 120f/p.$

**7. Define slip.**

$s=(N_s-N_r)/N_s$, where $N_s$ is synchronous speed in rpm
$N_r$ is rotor speed in rpm.

**8. Mention some application of stepper motor.**

Instrumentation application, computer peripherals an office equipment, electro medical numerical control of machine tools and robotics.

**9. Define holding torque.**

Holding torque($T_H$) is the maximum load torque in which the energized stepper motor can withstand without slipping from equilibrium position.

**10. Define detent torque.**

Detent torque($T_D$) is the maximum load torque which is unenergized stepper motor can withstand without slipping.



**PART-B** **(16 MARKS)**

**1. List out the advantages and disadvantages of electrical braking over mechanical braking. (8)**

**2. Discuss any one method of electrical braking of DC Machines. (8)**

**3. Explain the Speed-Torque characteristics of three phase induction motor with neat diagrams. (16)**

**4. Explain about the speed-torque characteristics of a DC Shunt Motor with suitable graph and equations. (16)**

**5. Explain about the quadrantal diagram of speed-torque characteristics for a motor driving hoist load. (16)**

**6. Explain how an induction motor is brought to stop by (i) Plugging and (ii) dynamic braking. (16)**

**7. Explain the various methods of braking of induction motors. (16)**

**8. Draw and explain various load characteristics of DC Shunt Motor. (16)**

**9. Explain Rheostat braking in DC Series Motor and Plugging in DC Shunt Motor. (16)**
**10. Explain various methods of braking of DC Shunt Motors with neat diagrams. (16)**
**11. Explain various methods of braking of DC Series Motors with neat diagrams. (16)**
**12. Explain the speed – torque curve of single phase induction motors in detail. (8)**
**13. Explain the method of regenerative braking employed in DC Motors. (8)**
**14. Explain about the speed-torque characteristics of a DC Compound Motor with suitable graph and equations. (16)**
**15. A 220V shunt Motor has an armature resistance of 0.062 Ω and with full field has an emf of 215V at a speed of 960 rpm, the motor is driving an overhauling load with a torque of 172 Nm. Calculate the minimum speed at which the motor can hold the load by means of regenerative braking. (16)**

## UNIT -III STARTING METHODS

**PART-A ( 2 MARKS)**

**1. Why starter is necessary for starting a DC Motor?**

A DC motor is directly switched on at the time of starting, the motor back emf is zero. Due to this the armature current is very high (nearly 25 times of rated current). Due to the very high armature current the motor become damaged. So the starting current can be limited by using starter.



**2. What are the types of starters used for starting an induction motor?**

DOL starter, primary resistance starter, star-delta starter, auto-transformer starter, rotor resistance starter.

**3. What are the starters used for starting DC Motors?**

Two point starter
Three point starter
Four point starter

**4. What is the function of starter in a DC Motor?**

To limit the starting current to provide against low voltage and overload conditions.

**5. Where three point starter and four point starter are recommended?**

3 point starter- For armature speed control of DC motor (below rated speed).
4 point starter- For field speed control of DC motor (above rated speed).

**6. What are the methods of starting 3 phase squirrel cage induction motor?**

DOL starter, primary resistance starter, star-delta starter, auto-transformer starter.

**7. What are the advantages and disadvantages of autotransformer starter?**

*Advantages*

Reduced line current
Smooth starting
High acceleration

*Disadvantages*

Cost is high
Used for large motors only

**8. What type of starter is used for slip ring induction motor?**

Rotor resistance starter.

**PART-C** **(16 MARKS)**

**1. Draw a neat schematic diagram of a three point starter and explain its working. (16)**
**2. Draw a neat schematic diagram of a four point starter and explain its working. (16)**
**3. Explain with neat circuit diagram, the star-delta starter method of starting squirrel cage induction motor. (16)**
**4. Explain the typical control circuits for DC Series and Shunt motors (16)**
**5. Explain the different starting methods of three phase squirrel cage induction motors with neat sketches. (16)**
**6. Explain different methods of starting of DC Motors. (16)**
**7. Explain with neat diagram the starting of three phase slip ring induction motor. (16)**
**8. Draw and explain the push-button operated direct-on line starter for three phase induction motor. (16)**
**9. Draw and explain the manual auto-transformer starter for three phase induction motor.(16)**

## UNIT IV
## CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C DRIVES

**PART-A** **( 2 MARKS)**



**1. What are the applications of dc motors?**
Electric traction, machine tools, steel mills, textile mills.
**2. What are the advantages of DC drives?**
Lower cost, Reliability, Simple control.
**3. What are the methods of speed control of dc motor?**
(i)Armature resistance control
(ii)Flux control.
(iii) Voltage control.
**4. What is meant by armature resistance control?**
A controller resistance is connected in series with armature. By varying the controller resistance R, the potential drop across the armature is varied. Therefore, the motor speed also varied. This the method of speed control only applicable for speed less than no load speed.
**5. What is meant by flux control method?**
The speed of the dc motor can be controlled by varying the field flux. This method od speed control can be used for increasing the speed of the motor is inversely proportional to the field flux.
**6. What are the methods of speed control of dc series motor?**
(i)Variable resistance in series with motor.
(ii) Flux control method.
**7. What is meant by ward leonard system?**
The speed of the dc shunt motor can be controlled by above rated speed and below rated by using ward leonard system. The armature voltage control can be achieved by varying the field of dc generator. The flux control method can be achieved by varying the field of the controlled dc motor.

**8. What is meant by controlled rectifier?**
It converts fixed ac voltage in to variable dc output voltage.
**9. What is meant by electric drive?**
An electric motor together with its control equipment and energy transmitting device forms an electric drive. A ceiling fan motor with its speed regulator but without blades is an example.
**10. What are the different types of dc drives?**
(i) single phase dc drives
(ii) three phase dc drives.
(iii) chopper drives.
**11. What is meant by dc chopper?**
It converts fixed dc voltage in to variable dc voltage.

**PART-C** **(16 MARKS)**

**1. Explain with neat sketch the chopper control method of speed control of DC Motors. (16)**
**2. Explain with neat sketches about the DC Shunt Motor speed control by using single phase fully controlled bridge converter. (16)**
**3. Discuss the Ward-Leonard speed control system with a neat circuit diagram. Also mention its advantages and disadvantages. (16)**
**4. Explain how the speed of a DC Shunt Motor can be varied both above and below the speed at which it runs with full field current. (16)**
**5. Explain with neat sketch the operation of chopper fed DC Series Motor drive. Also, derive the expression for average motor current. (10)**
**6. Explain Time ratio control and Current limit control. (6)**
**7. Explain the speed control schemes of DC Series Motor. (16)**
**8. Explain the different methods of speed control employed in DC Shunt Motor. (16)**
**9. Explain the control of DC drives using rectifiers and choppers. (16)**
**10. Explain the single phase half wave converter drive speed control for DC drive with waveforms. (16)**
**11. Explain in detail the single phase semi-converter speed control for DC drive for separately excited motor. (16)**
**12. A 500V series motor having armature resistance and field resistance of 0.2 Ω and 0.3 Ω respectively runs at 500 rpm when taking 70A. Assuming unsaturated field, find out its speed when field diverter of 0.684 Ω is used constant load torque. (16)**
**13. A 250V DC Series Motor takes 40A of current when developing a full load torque at 1500 rpm. Its resistance is 0.5 Ω. If the load torque varies as the square of the speed determine the resistance to be connected in series with the armature to reduce the speed to 122 rpm. Assume the flux is proportional to the field current. (16)**

## UNIT V

## CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C DRIVES

**PART-A** **(2MARKS)**

**1. How the variable frequency is obtained at the output of the inverter?**

In the inverter circuit, the output frequency can be varied by varying the on and off time period of the drives.

**2. List the different methods of speed control applicable to 3 phase slip ring induction motor.**

(i)rotor resistance control
(ii) cascade control
(iii)Slip power recovery scheme

**3. How speed is achieved by v/f control in 3 phase induction motor?**

In v/f method, motor can be varied by varying voltage and frequency but we can maintain v/f ratio is constant.

**4. What are the different methods of speed control of induction motor?**

Stator voltage control
Supply frequency control
Rotor resistance control
Slip power recovery control

**5. What is meant by stator voltage control?**

The speed of the I.M can be changed by changing the stator voltage. Because the torque is proportional to square of the voltage.

**6. What are the applications of stator voltage control?**

Fans, pump drives.

**7. What are the advantages of stator voltage control method?**

The control circuitry is simple.
Compact size.
Quick response time.
There is considerable savings in energy and thus it is economical method.

**8. Define base speed?**

The synchronous speed corresponding to the rated frequency is called the base speed.

**9. What type of motor is applicable for rotor resistance control?**

The rotor resistance control method is applicable for slip ring I.M

**PART-B** **(16 MARKS)**

**1. Draw the power circuit arrangement of three phase variable frequency inverter for the speed control of three phase induction motor and explain its working. (16)**

**2. Explain the V/f control method of AC drive with neat sketches. (16)**

**3. Discuss the speed control of AC motors by using three phase AC Voltage regulators. (16)**

**4. Explain the speed control schemes of phase wound induction motors. (16)**

**5. Explain the concatenation operation of three phase induction motors.Hence derive the speed experienced for the cascaded set. (16)**

**6. Explain in detail about Slip power recovery scheme. (16)**

**7. Explain the different methods of speed control used in three phase induction motors. (16)**

**8. Explain the working of following methods with neat circuit diagram.**
**i) Kramer system ii) Scherbius system (16)**

**9. Explain in detail rotor resistance method of speed control of a slip ring induction motor. (16)**

**10. Explain the operation of Pole changing method of speed control. (8)**

**11. Explain the pole amplitude modulation method. (8)**

**12. Explain the static Kramer method and static scherbius method of speed control of three phase induction motor. (16)**

**13. Explain in detail about the various methods of solid state speed control techniques by using inverters. (16)**

**14. Explain the solid state stator voltage control technique for the speed control of three phase induction motor. (16)**

**15. Explain the various methods of speed control of a three phase induction motor when fed through semiconductor devices. (16)**