**DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY**

**Mamallapuram, Chennai-603104.**

 **DEPARTMENT OF MECHANICAL ENGINEERING**

**QUESTION BANK**


# Subject Code: EE8353 Year / Semester: II / III

 **Subject Name:** Electrical Drives and Controls

**UNIT 1 – INTRODUCTION**

**PART A**

1. **What is meant by electrical drives? (Dec 2016) (Dec 2018) (Apr 2018)**

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

# What are the different types of drives? (Dec 2014)

1. DC drives 2. AC drives

# 3. What are the different types of electrical drives? (June 2013) (Nov 2019)

1. Group drive 2. Individual drive 3. Multi motor drive

# What are the advantages of electric drives? (Nov 2020)

* 1. They have flexible control characteristics. The steady state and dynamic characteristics ofelectrical drives can be shaped to satisfy load requirements.
	2. Drives can be provided with automatic fault detection systems. Programmable logiccontrollersand computers can be employed to automatically control the drive operations in a desired sequence.
	3. They are available in wide range of torque, speed and power.
	4. It can operate in all the four quadrants of speed-torque plane. Electric braking gives smooth deceleration and increases life of the equipment compound to other forms ofbraking
	5. Control gear enquired for speed control, starting and braking is usually simple and easy tooperate.

# Mention the different factors for the selection of electric drives. (or) What are the requirements of electrical drives? (May 2013) (May 2014) (April 2017, 2019) (Nov 2020)

1. Steady state operation requirements
2. Transient operation requirements
3. Requirements related to the source
4. Capital and running cost, maintenance needs, life
5. Environment and location and 6. Reliability

# What are the parts of electrical drives?(May 2014)(Dec 2018)

1. Electrical motors and load 2. Power modulator3.Sources 4. Control unit

5. Sensing unit.

# 7. What are the applications of electrical drives? (Apr 2019)

1. Paper mills 2. Electric traction 3.Cement mills 4. Steel mills

# What is an individual drive?( May 2015) (Dec 2018)

If a single motor is used to drive a single machine and all the connected mechanisms belonging to the same machine then the system is called individual drive system. In this drive, there will be a separate driving motor for each process. One motor is used for transmitting motion to various parts or mechanisms belonging to signal equipment. Eg: Lathe machine.

# What are the disadvantages of an individual drive?

The drawbacks of Individual drive are,

* + The initial cost of investment is very high
	+ Due to power loss in transmitting devices, the efficiency of this drive is poor.

# What are the advantages of group drive? (Dec 2018)

a) Initial cost is less b) Less space is required in group drive c) Maintenance cost is less) Group drive system is useful because all operation are stopped simultaneously

# Draw the basic block diagram of Electric drive.( Dec 2013)(Nov 2015) (Apr 2018)



1. **Define equivalent current method.**

The equivalent current method is based on the assumption that the actual variable current may be replaced by an equivalent current ieq which produces the same losses in the motor as the actual current.

# What is meant by cooling time constant?(April 2017) (Dec 2018)

Cooling time constant is defined as the time required to cool the machine down to 0.368 times the initial temperature rise above the ambient temperature.

# What are the different types of classes of duty?

* Continuous duty
* Short time duty operation of motor Main classes of duties
* Intermittent periodic duty
* Intermittent periodic duty with starting
* Intermittent periodic duty with starting & braking
* Continuous duty with intermittent periodic loading
* Continuous duty with starting & braking
* Continuous duty with periodic load changes

# What are the assumptions made while performing heating & cooling calculation of an electric motor?

* The machine is considered to be a homogeneous body having a uniform temperature gradient. All the points at which heat generated have the same temperature. All the points at which heat is dissipated are also at same temperature.
* Heat dissipation taking place is proportional to the difference of temperature of the body and surrounding medium. No heat is radiated.
* The rate of dissipation of heat is constant at all temperatures.

# What are the factors that influence the choice of electrical drives? (Dec 2011) (Nov 2015)

1. Shaft power & speed 2.Power range 3.Speed range 4.Starting torque 5.Efficiency 6.Starting torque7.Influence on the supply network 8. Maintenance 9.Special competence 10. Total purchase cost 11.Cost of energy losses 12. Influence on power supply13.Environment 14.Availability 15.Accessibility 16.Nature of electric supply

17.Nature of load 18.Typesof drive19.Electrical Characteristics 20.Service cost21. Service capacity & rating.

# Why the loss at starting is not a factor of consideration in a continuous duty motor?

While selecting a motor for this type of duty it is not necessary to give importance to the heatingcaused by losses at starting even though they are more than the losses at rated load. This is because the motor does not require frequent starting it is started only once in its duty cycle and the losses during starting do not have much influence on heating.

# What is meant by “short time rating of motor”? (Dec 2016)(April 2017)

An electric motor of rated power P subjected to its rated load continuously reaches its permissible temperature rise after due to time. If the same motor is to be used for short time duty, itcan take up more loads for a short period without increasing the maximum permissible temperatureof the motor during this period.

# Define continuous duty.

Continuous duty is defined as the load that may be carried by the machine for an indefinite timewithout the temperature rise of any part exceeding the maximum permissible value.This type drive is operated continuously for a duration which is long enough to reach its steadystate value of temperature.

# What is meant by “load equalization”?

In the method of “load Equalization” intentionally the motor inertia is increased by adding aFlywheel on the motor shaft, if the motor is not to be reversed. For effectiveness of the flywheel, the motor should have a prominent drooping characteristic so that on load there is a considerable speed drop.

# What is short time duty?

In short time duty the period of motor operation is so short that the temperature rise of the motor does not reach its final steady value and the period of rest is so long that the motor returns to cold condition (ambient temperature) before it required to operate again.

# Write the expression for thermal overload factor. (Dec 2014)

1 + −

1 − −𝑟/

K =

 K- Thermal Overload Factor,

α – ratio between load independent loss and load dependent loss, tr– duration of running period, and

τ – heating time constant.

# What is heating time constant?

Heating time constant is defined as the time taken by the machine to attain 0.632 of its finalsteady temperature rise. The heating time constant of the machine is the index of the time takenby the machine to attain its final steady temperature rise.

# How heating occurs in motor drives? (May 2015)

An electric motor has various power losses, mainly copper losses in the winding and core losses due to the hysteresis losses and eddy current losses, in the core. These lossesappear in the form of heat. The mechanical losses due to the friction also contribute to such heat development.

# What are the different types of Mechanical Load?

* 1. Load torque remaining constant irrespective of the speed.
	2. Load torque increasing with the square of the speed.
	3. Load torque increasing with speed.
	4. Load torque decreasing with speed.

# Write the basic equation of losses in the motor. (Nov 2019)

Total Losses= CopperLosses+Coreloss+Mechanical losses

* Copper losses – Armature Cu loss – Field Cu loss – Loss due to brush contact resistance
* Iron Losses – Hysteresis loss – Eddy current loss
* Mechanical losses – Friction loss – Windage loss

Armature copper loss = Ia2Ra (where, Ia = Armature current and Ra = Armature resistance) Field copper loss = If2Rf (where, If = field current and Rf = field resistance)

Hysteresis loss is given by, Steinmetz formula:

Wh=ηBmax1.6fV (watts), where, η = Steinmetz hysteresis constant,V = volume of the core in m3 Eddy current loss Pe = KeBmax f2 t2 V

whereKe = Constant depending upon the electrical resistance of core and system of units used Bmax = Maximum flux density in Wb/m2 , f = Frequency of magnetic reversals in Hz,

t = Thickness of lamination in m, V = Volume of core in m3

**PART-B**

1. Explain the factors governing the selection of motors.**(Dec 2014)(May 2015) (Dec 2016) (Apr 2018) (Nov 2020)**
2. (a)Demonstrate the basic elements of an electrical drive using static elements. **(Nov 2019)**

(b)Explain the four quadrant operation of a drive **(Nov 2019)**

1. Discuss in detail the determination of power rating of motors.**(May 2014)(Nov 2015)**
2. Explain the different types of loading of drives.
3. Describe the simplifications based on which the heating and cooling calculations of an electric motor are made. Derive the heating and cooling curves of an electrical machine. **(Dec 2011) (Nov 2013)(Dec 2014) (May 2015) (Apr 2018,2019) (Nov 2020)**
4. Write a brief note on classes of duty for an electric motor and also compare the D.C and A.C drives.**(Dec 2013) (May 2014) (Dec 2014)(Nov 2015) .(Dec 2016) (April 2017) (Apr 2018,2019))(Nov 2019) (Nov 2020)**
5. Draw the typical temperature rise-time curve and derive the equation for temperature rise in an electric drive.
6. The enclosure of 20 KW motor is equivalent to a cylinder of 70 cm diameter and 100 cm length. The motor weighs 500kg. Assuming the specific heat is 700J/kg/oC and that the peripheral surface of the enclosure of the motor alone is capable of heat dissipation of 12.5W/sq.m/oC, calculate the heating time constant of the motor and its final temperature rise. Efficiency of motor is 80%.
7. Explain in detail about the various types of electric drives.**(May 2013)(Nov 2015)(May 2015,2019)**
8. Select the power rating of a motor of 750 rpm, which has the following load pattern. A constant speed drive operating at a speed of 500 rpm has a cyclic loading as given below,
	1. 200Nm for 10 minutes b) 300 Nm for 20 minutes

c) 150 Nm for 20 minutes d) No Load for 10 minutes

1. Estimate the power rating of the motor.**(Dec 2013)(Nov 2015)**
2. Draw the pattern of temperature rise characteristic under steady state for (i)Short time duty (ii) intermittent duty and explain the equivalent current method of estimating motor rating. **(Dec2016)**
3. A motor has a thermal time constant of 45 minutes. When the motor runs continuously on full load, its final temperature rise is 800C. (i) What is the temperature rise after 1 hour if the motor runs continuously on full load? If the temperature on one hour rating is 800C, find the maximum steady state temperature at this rating.**(Dec 2016, Apr 2019)**
4. The temperature rise of an electric motor is 40⁰C after 1 hour and 60⁰ C after 2 hours.The motor current is 100A. Determine approximately its final temperature rise when it works on load cycle of 4 minutes working, 8 minutes rest with a current of 125A.Neglect the effect of iron losses. **(Nov 2019)**

**UNIT 2 - DRIVE MOTOR CHARACTERISTICS PART A**

1. **What is meant by mechanical characteristics?**

The increase in flux would decrease the speed but increase the armature torque. It cannot be so because torque always tend to produce rotation. If torque increases, motor speed must increase rather than decrease. An apparent inconsistent will occur between speed and torque. This characteristic between speed and torque is called mechanical characteristics.

# A series motor should never be started without some mechanical load why? (or) What is the significance of DC series motor ? (Apr 2019) (Nov 2020)

On light load or no load, the armature current drawn by the motor is very small.

In case of a d.c. series motor, Φ α Ia and

on no load as Ia is small hence flux produced is also very small. According to speed equation,

N α 1/Φ as Eb is almost constant.

So on very light load or no load as flux is very small, the motor tries to run at dangerously high speed which may damage the motor mechanically. This can be seen from the speed-armature current and the speed-torque characteristics that on lowarmature current and low torque condition motor shows a tendency to rotate with dangerously high speed.

# Draw the speed-torque characteristics of dc shunt motor and series motor.(May2013) (May 2014) (April 2017)



1. **What is Rheostatic braking (or) dynamic breaking?**

In Rheostatic braking the armature is disconnected from the supply and is connected across a variable resistance. The electrical energy produced by the motors is dissipated as heat by a variable resistance. The braking is controlled by varying the series resistance.

# What are the different types of dc motor?

I. DC series motor 2. Shunt motor

3. Compound motor 4. Separately excited de motor

# What is meant by electrical characteristics?

It represents relation between torque and armature current in the DC motor. It is known as electrical characteristic of the DC motor.

1. **What is the relation between speed and flux of a dc motor?**

Thespeed of a dc motor is inversely proportional to the flux per pole. Thus by decreasing the flux, speed can be increased and vice versa. To control the flux, a rheostat is added in series with the field winding.

# What is the application of dc motor? (Dec 2018)

DC shunt motor:-

1. For driving constant speed operations 2. Machine tools 3. Lathes 4. Blowers and fans 5. Centrifugal pumps 6.Reciprocating pumps

DC series motor:-

1.Electric locomotives 2. Rapid transit systems 3.Trolley cars 4.Cranes and hoists 5.Conveyors

DC compound motor:-1. Elevators.2. Air compressors3.Rolling mills4. Heavy planers

# A dc shunt motor is called as constant speed motor-why?( May 2015, 2017)

A DC shunt motor (also known as a shunt woundDC motor) is a type of self-excited DC motor where the field windings are shunted to (or) connected in parallel to the armature winding of the motor. Since they are connected in parallel, the armature and field windings are exposed to the same supply voltage. Hence the speed of the shunt motor can be assumed almost constant under normal running conditions.

# What is mean by braking?

Whenever an electric drive is disconnected from the supply, the speed of the driving motor gradually decreases and becomes zero. Braking is a generic term used to describe a set of operating conditions for electric drive systems. It includes rapid stopping of the electric motor holding the motor shaft to a specific position, maintaining the speed to a desired value of preventing the motor from over speeding.

# What are the two types of braking?

The two types of braking are

1. Mechanical braking and 2. Electrical braking.

# What is meant by mechanical braking?

In mechanical braking, the frictional force between the rotating parts and brake drums provide the required brake.

# What is meant by electric braking?(Dec 2016)

A system in which a braking action is applied to anelectric motor by causing it to act as a generator.In electric braking, the motor is made to work as generator. So it produces a negative slip and negative torque (braking torque). This is achieved by suitably changing the electrical connections of the motor.

# What are the different types of electric braking?(Nov2013)(May 2013) ( May 2015)

The three different types of electric braking are,

1. Regenerative braking 2. Dynamic braking and 3. Plugging

# What are the advantages of electric braking?

* + Electric braking is fast and cheap.
	+ In electric braking there is no maintenance cost for replacing brake shoes periodically.
	+ By using electric braking the capacity of the system (like higher speeds, heavy loads) can be increased.
	+ A part of energy is returned to the supply consequently the running cost is reduced.
	+ In electric braking negligible amount of heat is generated whereas in mechanical braking enormous heat is produced at brake shoes which leads to failure of brakes.
1. **What is meant by regenerative braking? (Dec 2011, Apr 2019) (Nov 2019)** Regenerative braking is an energy recovery mechanism which slows a vehicle or object by converting its kinetic energy into a form which can be either used immediately or stored until needed. It is a form of braking in which the kinetic energy of the motor is returned to the power supply system.

# Mention the various types of electrical machines. (Apr 2018)

1. AC generator.
2. DC generator.
3. AC motor.
4. DC motor.
5. Permanent magnet machines.
6. Brushed machines.
7. Induction machines.

**18. What is meant by plugging?** (Dec 2014).

The plugging operation can be obtained by changing the polarity of the motor. For AC machine the phase sequence of the stator windings and for DC machines the polarities of the field or armature terminals have to be reversed.

# What are the disadvantages of dc machine?

1. Higher cost 2. Higher rotor inertia 3.Electromagnetic Compatibility problems

1. Maintains problems with commutatorand brushes
2. Tough to operate in dirty and explosive environments.

# 20. What are the advantages of squirrel cage induction motor?

1. Rugged 2. Cheaper 3. Weight is much lighter4.More efficient

5. Less maintenance6. Can operate in dirty environments.

# What are the two types of rotors in three phase induction motors? (April 2017)

There are mainly two types of three phase Induction Motor based on rotor construction: Squirrel Cage induction motor and Slip Ring or Wound Rotor Induction Motor.

# What is the necessity of braking?(Dec 2014)

Braking is a generic term used to describe a set of operating conditions for electric drive systems. It includes rapid stopping of the electric motor holding the motor shaft to a specific position, maintaining the speed to a desired value of preventing the motor from over speeding. The quickness and accuracy of braking techniques determine the productivity and quality of the manufactured goods. Braking controls the motor for our optimum requirement.

# What are different methods of Braking of DC series motor? (Nov 2015)

1. Dynamic braking and 2. Plugging. In case of DC Series motor, as the speed of Motor increases, the armature current and hence the field flux will decrease and therefore Back-emf E can never be greater than the supply voltage V. Therefore, Regenerative Braking is not possible in DC Series Motor.

# A 220V DC shunt motor having the armature current of 10A, runs at 1500 rpm. Find the armature current if the source voltage drops to 150V. Assume the load torque is constant.(Nov 2015)

Given, V1=220V, Ia1=10A, V2=150V,Ia2=?.

For Shunt motor, Ia1Φ1= Ia2Φ2 (since torque is constant) Φ2=(150/220) Φ1 -------> Φ2=0.68 Φ1.

Therefore,

Ia2=(10 Φ1/0.68 Φ1) = 14.67A.

# What are the various components of load torque?(Dec 2016)

* The various Components of load torque are: Friction and Windage torque.
* Friction at zero speed is called stiction or static friction
* Coulumb (Tc)+Friction at stand still (Ts)+Viscous Friction (Bωm)
* Windage torque is proportional to square of speed Tω = C(ωm2)
* TL = TL + Bωm + Tc + C(ωm2)

# Why a series motor is more suited to deal with torque overloads than other DC motors? (Dec 2018)

In a series wound DC motor, the armature and field windings are connected in series, and the current through them is equal: Itotal = Ia = If.In a series wound motor, the increased voltage causes both the armature and field currents to increase. This allows the series motor to produce very high torque on startup, for short durations.

# Draw the speed torque characteristics of (a)Fan (b) constant power loads. (Dec 2018)

1. **How slip-ring induction motor is advanced over squirrel cage induction motor? (Apr 2018)**

|  |  |  |
| --- | --- | --- |
| **Basis For Comparison** | **Slip Ring Motor** | **Squirrel Cage motor** |
| Definition | The rotor of the motor is constructed as a slip ring type. | The rotor of the motor is a squirrel cage type. |
| Rotor type | Cylindrical laminated core with parallel slots and each slot consist one bar. | The slots of the rotor are not parallel, but are skewed. |
| Additional Resistance | Added external to the rotor | The rotor bar is permanently shorted at the end of the ring, thus it is not possible to add anyexternal resistance. |
| Construction type | Complicated structure | Simple structure. |

1. **Write the effect of variation of armature voltage in a series motor (Nov 2019)** The armature voltage variation to a series motor can be achieved by means of an additional resistance in the armature circuit or by using a thyristor power converter. On doing this the torque-speed curve moves towards the right when the voltage is increased. For a given torque developed, the motor speed increases with an increase in voltage. The

speed-torque curves for different armature voltages (for different armature resistances) are shown in Fig.



# What are the three regions in the speed torque characteristics (for 0<s<1), (s<0), (1<s<2) of an induction motor? (Dec 2018)

1. **What are the different methods of braking applied to the induction motor ? (Nov/Dec 2020)**

The different methods of braking applied to the induction motor are

* Regenerative Braking.
* Plugging or reverse voltage braking.
* Dynamic Braking. AC dynamic braking. Self-dynamic braking. DC dynamic braking. Zero sequence braking.

**PART –B**

1. Explain about the speed-torque characteristics of a DC Compound Motor with suitable graph and equations**.(Dec 2013)**
2. Draw and explain the speed torque characteristics of dc series motor and three phase induction motor**.(Dec 2011,Apr 2019)**
3. Explain about the speed-torque characteristics of a DC Shunt Motor with suitable graph and equations.**(Dec 2014) (Dec 2018) (Apr 2018,2019)**
4. Explain about the quadrant diagram of speed-torque characteristics for a motor driving hoist load**.(Nov 2015) (May 2015)(Dec 2016)**
5. Explain how an induction motor is brought to stop by (i) Plugging and (ii) dynamic braking.**(Dec 2014)**
6. Explain the various methods of braking of induction motors**. (June 2014) (Apr 2018, 2019)**
7. Describe the speed Torque characteristics of DC Dynamic braking of three phase induction motor.

# (May 2014)

1. Explain speed- torque characteristics of different types of load with graph.**(May 2013)**
2. A 220 V dc series motor runs at1200 rpm (clockwise) and takes an armature current of 80 A when driving a load with constant torque. Armature resistance is 0.05Ω and field resistance is 0.05Ω. Find the magnitude and direction of motor speed and armature current if the motor terminal voltage is reversed and number of turns in field winding is reduced to 80%. Assume linear magnetic circuit.**(Dec 2013)**
3. What is meant by Braking? Explain various methods of braking of DC Motors with neat diagrams**.(May 2013,2019)(Nov 2020)**
4. Discuss the dynamic braking of DC shunt motor. **(Nov 2015) (April 2017) (Dec 2018)** 12.List the advantages and disadvantages of Electrical braking over mechanical braking. Discuss any one method of electrical braking of DC machines.**(May 2015) (Dec 2016)** 13.For drives, classify the types of load torques available and sketch few speed torque curves of typical loads**. (Dec 2016) (Dec 2018)**
5. (i) Obtain the torque – slip characteristics of single phase induction motors. (8)

(ii) Discuss any one method of electrical braking of Induction Machines. (5). **(Dec 2018)**

1. A 3-Phase, 50 Hz, 8 pole induction motor has a full load slip of 4%. The rotor resistance is 0.001Ω/phase and standstill reactance is 0.005Ω/phase. Find the ratio of maximum to full load torque and the speed at which the maximum torque occurs. **(Dec 2018)**
2. A 12 pole 50 Hz, 3 phase induction motor has rotor resistance of 0.15Ω and standstill reactance of 0.25Ω per phase. On full load it is running at a speed of 480 rpm. The rotor induced emf per phase at standstill is observed to be 32 V.

Calculate 1. Starting torque, 2.Full load torque, 3.Maximum torque, 4. Speed at maximum torque. **(Dec 2018).**

1. Draw and explain the speed Torque characteristics of three phase induction motor.

# (Apr 2019) (Nov 2020)

1. Compare the Electrical braking and mechanical braking of an electric motor.

# (Nov 2019)

1. Explain the characteristics of Shunt Motor and series motor **(Nov 2019)**
2. A 500V DC shunt motor with constant field, drives a load whose torque is proportional to the square of the speed. When running at 900rpm it takes an armature current of 45A.Find the speed at which the motor runs if a resistance of 8Ω is connected in series with the armature. The armature resistance may be taken as 1Ω. **(Nov 2019)**

**UNIT 3 - STARTING METHODS PART A**

1. **What are the different types of DC motor starters?(May 2014) (Dec 2014)**

There are various types of starting of D.C motor, such as 3 point starter, 4 point starter, no load release coil starter, thyristor controller starter etc. The basic behind every D.C motor starter is adding external resistance to the armature winding during starting.

# What is the basic principle of primary resistance starter used in 3 phase induction motor?(May 2014)

Primary resistor starters can be used to start motors where limited torque or inrush current is required. Primary resistor starters have resistors connected in series, between each line

and the motor. The presence of resistors reduces the voltage applied to the motor, but they produce heat.

# Draw the basic starter arrangement for shut motor starting. (Dec 2013)



1. **Which type of starter is used for slip ring induction motor?**

Rotor resistance starter can be used as starter for slip ring induction motor.

# What are the applications of DC motor?

The various applications of DC shunt motor are in Lathe Machines, Centrifugal Pumps, Fans, Blowers, Conveyors, Lifts, Weaving Machine, Spinning machines, etc. The compound motors are used where higher starting torque and fairly constant speed is required.

# What are the advantages of DC drives?

The advantages of D.C. drives are:

* 1. Adjustable speed
	2. Good speed regulation
	3. Frequent starting, braking and reversing.

# Give some advantages and disadvantages of D.O.L starter. (Dec 2018)

Advantages:Highest starting torque, Low cost, Greatest simplicity

Disadvantages:It does not reduce the starting current of the motor. High Starting Current: Very High Starting Current (Typically 6 to 8 times the FLC of the motor). Mechanically Harsh: Thermal Stress on the motor, thereby reducing its life.

# What is the objective of rotor resistance starter in Three phase induction motor? (or) State the purpose of rotor resistance starter. (June 2013)(May 2015) (April 2017) (Nov 2020)

To include resistance in the rotor circuit there by reducing the induced rotor current at starting. This can be implemented only on a slip ring induction motor.

# Give the prime purpose of a starter for motors. (May 2015, 2017)

When motor is switched on to the supply, it takes about 5 to 8 times full load current at starting. This starting current may be of such a magnitude as to cause objectionable voltage drop in the lines. So Starters are necessary

# Mention the Starters used to start an three phase Induction motor. (Dec 2011)&(Dec 2014) (Dec 2016) (April 2017,2019) (Nov 2019)

\*D.O.L Starter (Direct Online Starter) \* Star-Delta Starter

\*Auto Transformer Starter \* Rotor Resistance starter (slip ring IM)

\*Stator Resistance Starter

# What are the protective devices in a DC/AC motor Starter. (May 2018) (Dec 2018)

\*Over load Release (O.L.R) or No volt coil \*Hold on Coil

\*Thermal Relays \*Fuses(Starting/Running) \* Over load relay

# What are the advantages of star delta starter?

* The operation of the star-delta method is simple and rugged
* It is relatively cheap compared to other reduced voltage methods.
* Good Torque/Current Performance.
* It draws 2 times starting current of the full load ampere of the motor connected

# What is the function of Over Load Release present in the starter?

If there is any overload conditions, then the motor will draw large current. This large current will flow through the over load release coil. Due to this, the electromagnet gets energized and pulls the iron piece upward which short circuits the coils of the hold on electromagnet. The hold on electromagnet gets de-energized and therefore the starter arm returns to the off position, thus protecting the motor against overload.

# What is the function of No-Load release present in the starter?

If there is no load or low load, the speed of DC series motor will be dangerously high. During this condition, no load release makes the control arm to return to OFF position and prevent the motor from over speeding.

# Draw the Speed-Torque characteristics of an Induction motor with various values of Rotor Resistance.



1. **What is the necessity of starters of electric motors? (Dec 2011, Nov 2015, Dec 2016, April 2017, May 2018, 2019) (Nov 2019) (Nov 2020)**

The main necessity of starters is to reduce the high starting current while starting the motor. In case of dc motor, Ia=(V-Eb)/Ra, at the time of starting Eb=0 Therefore when the motor is directly connected to the supply lines a heavy current will flow through the armature conductors will create serious problems. Hence the starter is necessary to protect the motor.

# State the basic principle in DOL for 3- phase induction motor. (May 2013)

The simplest form of motor starter for the induction motor is the Direct On Line starter. The Direct On Line Motor starter (DOL ) consists a Circuit Breaker, Contactor and an overload relay for protection. For this type of starter input directly given to the motor through protection arrangement.

# Draw the torque slip characteristics of an Induction motor (or) Draw the mechanical characteristics of three phase induction motor (Dec 2013)



1. **What are the problems of heavy inrush current at the time of starting?**

Problems of heavy inrush current at the starting time,

* Heavy sparking at the commutator and even flashovers.
* Damage to the armature windings.
* Damage to rotating parts of the motor.
* Large dip in supply voltage.
1. **Mention the advantages of four point starter over three point starter. (Nov 2015)** Here, for the three point starter the no volt coil is connected in series with the field winding. So any current change in the field circuit make a difference in the no-volt coil also , so the holding power of the coil varies with the speed control. This error is eliminated in four point starter as the field circuit is connected through an another resistor.

So speed control will be independent of the no-volt coil..

# What are the disadvantages of a three point starter? (Dec 2018)

The following drawbacks of a 3 point starter are as follows:-

* The 3 point starter suffers from a serious drawback for motors with a large variation of speed by adjustment of the field rheostat.
* To increase the speed of the motor, the field resistance should be increased. Therefore, the current through the shunt field is reduced.
* The field current may become very low because of the addition of high resistance to obtain a high speed.
* A very low field current will make the holding electromagnet too weak to overcome the force exerted by the spring.
* The holding magnet may release the arm of the starter during the normal operation of the motor and thus, disconnect the motor from the line. This is not a desirable action.

# What are the advantages of a electronic starter? (Apr 2019)

The various advantages of an electronic starter are,

* The moving parts and contacts get completely eliminated.
* The arcing problem gets eliminated.
* Minimum maintenance is required as there are no moving parts.
* The weight and size gets reduced considerably reduces the cost.
* The operation is reliable.

**PART – B**

1. What is the need for starters? Draw a neat schematic diagram of a three point starter and explain Its working.**(2013,2015,2016,2017,May 2018) (Nov 2020)**
2. Draw a neat schematic diagram of a four point starter and explain its working.**( 2011,2014,2015,May 2018,Dec 2018) (Nov 2020)**
3. Explain with neat circuit diagram, the star-delta starter method of starting squirrel cage induction motor. **(May 2015)(Dec2016) (Dec 2018)**
4. Explain different methods of starting of DC Motors.
5. Explain with neat diagram the starting of three phase slip ring induction motor**.(AU Nov/Dec 2011) (April 2017) (Dec 2018)**
6. Draw and explain the push-button operated direct-on line starter for three phase induction motor.
7. Draw and explain the auto-transformer starter for three phase induction motor.

# (May/June 2013) (Dec 2018)

1. Explain the different starting methods for three phase squirrel cage induction motor

# (Nov/Dec` 2013) (Nov 2015) (May 2018) (Nov 2020)

1. A Starter is required for a 220 V shunt motor. The maximum and minimum range of current values are 50 A and 30 A respectively. Find the number of sections of starter resistance required and resistance of each section. The armature resistance of the motor is 0.5Ω **(Nov/Dec 2013).**
2. Explain with Diagram, Construction, and Working of Rotor resistance starter? **(June 2014) (Dec 2014) (Apr 2019)**
3. Find the percentage tapping required on an auto-transformer required for a squirrel- cage motor to start the motor against ¼ of full load torque. The short-circuit current on normal/voltage is 4 times the full-load current and the full-load slip is 3%. **(Dec 2018)**
4. Sketch a schematic circuit diagram of a direct on line starter for a three phase induction motor and explain its working, also explain how the protection against over load works. **(Dec 2018).**
5. Discuss the electronics starter for induction motor. **(Apr 2019)**
6. Discuss the stator mechanism for controlling the speed of induction motor **(Nov 2019)**

15.A 3 phase squirrel cage induction motor has a starting current eight times the full load value. The full load slip is 4%. Compute the staring torque as a percentage of full load torque if the motor is started (a) direct online (b) by star- delta starter (c) using an auto transformer to limit the starting current to three times the full load value. What is the line current as a percentage of full load value? **(Nov 2019)**

16. With neat diagram, explain the working of DC motor starter using time delay relays.

# (Nov 2020)

**UNIT 4**

**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES PART A**

1. **Write down the speed equation of a dc motor.**

N = (V – IaRa) / Kbφ

Where, V = applied voltage, Ia = armature current, Ra = armature resistance, φ =flux, Kb= constant

# What are the methods of speed control of dc motors? (Dec 2014) (Dec 2018)

The Various speed control methods of dc motors are Armature resistance control, Flux control, Voltage control.

# What is meant by armature resistance control?(or) Why is armature voltage control used below rated speed? (Dec 2013) (May 2014)

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 method of speed control only applicable for speed less than no load speed.

# What are the advantages and disadvantages of armature resistance control of dc shunt motor? (Nov 2015)

Advantages: Simple method of speed control. Disadvantages:

* + A large amount of power is wasted in the external resistance Re.
	+ Armature resistance control is restricted to keep the speed below the normal speed of the motor and increase in the speed above normal level is not possible by this method.
	+ For a given value of variable resistance, the speed reduction is not constant but varies with the motor load.
	+ This speed control method is used only for small motors

# What is meant by flux control method?

The speed of the dc motor can be controlled by varying the field flux. This can be increasing the speed of the motor above its rated speed, because the speed is inversely proportional to the field flux.



# What are the methods of speed control of dc series motor? (Apr 2019)

Variable resistance in series with motor,Flux control method- Field diverter, Armature diverter,Tapped field control, Paralleling field coils and Series parallel control.

# What is meant Ward Leonard system?

The speed of the dc shunt motor can be controlled by above and below rated speed using the system. It consists of motor generator set. The armature voltage control can be achieved by varying the field of the dc generator. The flux control can be achieved by varying the field of the dc motor.



# What are the advantages and disadvantages of Ward Leonard system? (Apr 2019) Advantages:-

1. Full forward and reverse speed can be achieved. 2. A wide range of speed control is possible.

1. Power is automatically regenerated to the ac line to the mg set when speed is reduced.
2. Short time overload capacity is large. 5. The armature current is smooth.

# Disadvantages:

1. High initial cost. 2. Overall efficiency low (less than 80%, because of the additional MG set).3. Costly foundation and large amount of space is required. 4. This produces noise. 5. It requires frequent maintenance

# What are the methods of speed control of induction motors?

The various methods of speed control of induction motors are Stator voltage control, frequency control, Pole changing method, Cascaded control, slip power control.

# What are the advantages of solid state drives over conventional drives? (Dec 2011)

Wide variation of speed control is possible, less maintenance, simple, reliable, high efficiency, low initial cost and faster response.

# What is meant by electric-drive system?

Systems employed for motion control are called as Drives.It may employ any of the prime movers (Diesel engines, steam turbines and electric motors) for supplying mechanical energy for motion control. Drives employing electric motors are called as

Electrical Drives.In other words,A Drive is a combination of various systems combined together for the purpose of motion control.

# What are the different types of drives?

The various types of drives can be classified as Mechanical drive and Electrical drive Under electrical drive further it can be classified as DC drive and AC drive.

# What are the advantages of dc chopper drives? (Dec 2014)

Dc chopper drives has the advantages of high efficiency, flexibility in control, light weight, small size, quick response and regeneration down to very low speed.

# Draw the block diagram of phase controlled rectifier fed DC drives. (May 2013)

1. **What is stator voltage control?**



Three phase induction motor speed can be controlled by varying the stator voltage. This statorvoltage can be varied by using ac voltage controllers. This method of speed control of induction motor is called as stator voltage control.

# What is frequency control?

N = 120f/P

where N= speed of the motor , f = supply frequency, p= number of poles

Speed of the induction motor can be controlled by varying supply frequency as speed is directly proportional to supply frequency.

# What is meant by duty cycle? (Dec 2011) (May 2014)

Duty cycle is defined as the ratio between ON time of chopper into total time of chopper α= Ton/T

Where, Ton – ON time of chopper, T – Total time of chopper

# Draw the basic circuit for chopper controlled separately excited dc motor drive (Nov 2013)



1. **List the Application of Chopper fed DC drives. (Nov 2015, April 2017, May 2018)** The applications of chopper fed dc drives are Cranes, traction applications, Battery operated vehicles, Subway cars.

# Give the limitation of field control? (May2015) (April 2017)

* 1. The Speed control below normal rated speed is not possible as flux can be increased only upto its rated value.
	2. As flux reduces, speed increases. But high speed affects the commutation making motor operation unstable. So there is limit to the maximum speed above normal possible by this method.

# What are the main applications of Ward Leonard system? (May2015)

* Full forward and reverse speed can be achieved.
* A wide range of speed control is possible.
* Power is automatically regenerated to the ac line to the mg set when speed is reduced.
* Short time overload capacity is large.
* The armature current is smooth.

# List the various methods of conventional and solid state speed control of DC motors.(Dec 2016)

Conventional methods:

Armature resistance control, Flux control, Voltage control, Ward-Leonard Speed control. Solid State Methods:

Using Controlled and uncontrolled rectifiers, using Choppers.

# Compare armature control and field control. (Dec 2016)

|  |  |  |
| --- | --- | --- |
| ***Parameters*** | ***Armature control*** | ***Field control*** |
| *Speed control is achieved by* | Varying armature voltage | Varying field current |
| *Air gap flux* | Remains constant | Does not remain constant |
| *Torque* | Remains constant | Changes |
| *Range of Speed* | 0 to rated speed | Above the rated speed |
| *Efficiency* | Low | High |
| *Power loss in external Rheostat* | High | Less |

1. **What are the advantages of series motor? (May 2018)**
* Starting torque of DC Series motor is comparatively higher than other motors so this kind of motors are widely used for traction applications
* Series wound motors can use for AC or DC supply so it’s also known as universal motors.
* Compare with Shunt Motor DC series motor develop more power for the same construction size.

# Define Time-ratio control in a D.C. chopper circuit (Dec 2018) (Dec 2018)

As the name suggest, here the time ratio (i.e. the duty cycle ratio Ton/T) is varied. This kind of control can be achieved using 2 ways: • Pulse Width Modulation (PWM)

* Frequency Modulation Control (FMC)

# Why self-commutated devices are preferred over thyristor for chopper circuits. (Dec 2017)

Self-commutated devices such as power MOSFETs, power Transistors, IGBTs, GTOs and IGCTs are preferred over thyristor for building choppers because they can be commutated by a low power control signal and don’t need commutation circuit.

# Comment about the smoothness in speed control of separately excited DC motor using field control. (Nov 2019)

The speed of a separate excited DC motor will change in proportion to armature voltage and changing the polarity of the armature voltage will change its direction of rotation. The variable DC voltage was provided by a motor generator (MG set) which consisted of a motor driving a separately excited DC generator. By controlling the excitation of the DC generator, the voltage and polarity of the output of the DC generator was controlled, with the DC generator being connected to the load such as the elevator motor. It took

relatively little excitation power to the DC generator to control the speed and direction of the elevator. The system worked exceedingly well and provided smooth operation. It would also brake the elevator as required & send power back to the power lines while doing so.

# Which speed control methods gives very poor stability operation in DC series motor? (Nov 2019)

Field control of DC series motor has very poor stability, because when using the field control method for DC motors, the field is weakened to increase the speed or it can be strengthened to reduce the motor’s speed. Field controlled DC motors can only operate above the normal speed. Higher speeds can also result in less torque. Though the field control method allows operators to obtain higher speeds than the normal, its overall range should be lowered due to lack of stability. With a weaker field, we will be able to safely exceed certain speeds.

# What are the methods involved in armature voltage control ? (Nov 2020)

The methods involved in armature voltage control are

1. Multiple Voltage control
2. Ward - Leonard System

# 30. What is a chopper? (Nov 2020)

A chopper is a static device that converts fixed DC input voltage to a variable DC output voltage. On this basis, there are two types of chopper: Step-up and Step-down Chopper. A chopper whose average value of DC output voltage is more than the fixed DC input voltage is called Step-up Chopper

**PART – B**

1. Explain with neat sketch the chopper control method of speed control of DC Motors.

# (April 2017) (May 2018)

1. Explain with neat sketches about the DC Shunt Motor speed control by using single phase fully controlled bridge converter.
2. Discuss the Ward-Leonard speed control system with a neat circuit diagram. Also mention its advantages and disadvantages. **(Dec 2011) (May 2013) (May 2014) (Dec**

# 2014)(Nov 2015)(May 2015)(Dec2016) (April 2017) (May 2018) (Dec 2018) (Dec 2018) (Dec 2017)(Nov 2019)(Nov 2020)

4 Explain with neat sketch the operation of a chopper fed DC Series motor drive. Also derive the expression for average motor current.**(Dec 2014)(Dec2016)**

1. Explain first quadrant chopper control of separately excited motor for continuous conduction.

# (May 2013)

1. Explain in detail the single phase semi-converter speed control for DC drive for separately excited motor**. (Dec 2018)**
2. A 500V series motor having armature resistance and field resistance of0.2 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.
3. A 220V DC Shunt Motor takes 5A on no load and runs at 750 rpm. The resistances of armature and field winding are 0.2 ohms and 110 ohms respectively. Calculate the speed when the motor is loaded and taking a current of 50A. Assume the armature reaction weakens the field by 3%.**(Dec 2014)**
4. With neat circuit diagram, explain chopper fed four quadrant dc drive.**(Dec 2013)(Nov 2015) (Dec 2018) (Dec 2017, Apr 2019)**
5. Explain the operation of single phase full converter fed separately excited dc motor drive**(Nov2013)(May 2014)**
6. Explain with neat sketch the chopper control method of speed control of DC Motors.
7. A 220V DC shunt motor having a field flux of 0.8 wb, runs at a speed of 900rpm. Find the speed of the motor, if the field flux reduced to 0.6wb by field resistance control method. **(Nov 2015, Apr 2019).**
8. A 220V, 1200rpm , 1Φ full converter fed separately excited DC motor having a armature resistance and current of 0.25Ω and 40 A respectively. For the delay angle of 300 , find the speed of the motor . Consider motor constant KaΦ=0.18 N/rpm. **(Nov 2015)** 14.Explain the single phase half wave converter drive speed control for DC drive with waveforms.**(May 2015)**
9. A 220 V, 70A dc Series motor has combined resistance of armature and fieldResistance of 0.12 ohm. Running on no-load with field winding connected to a separate source it gave the following magnetization characteristics at 600 rpm:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| If(A) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| Vt(v) | 64 | 118 | 150 | 170 | 184 | 194 | 202 | 210 |

Motor is controlled by chopper with a source voltage=220V. Calculate (i) M o t o r speedforadutyratioof0.6andmotorcurrentof60A.(ii)Torqueforaspeedof400rpmand dutyratioof0.65.**(May 2015)**

1. A 220V dc shunt motor takes 22 A at rated voltage and runs at 1000 rpm. Its field resistance is 100 ohms and armature circuit resistance is 0.1 ohms. Compute the value of additional resistance required in the armature circuit to reduce the speed to 800 rpm when the load torque is proportional to speed. **(Dec 2016).**
2. Write short notes on DC chopper. **(May 2018)**
3. Explain the closed loop speed control of DC motor in above and below the rated speed with the block diagram. **(May 2018) (Dec 2018)(Dec 2017)**
4. What are the factors controlling the motor speed? Discuss the various speed control methods used for DC series motors. **(Dec 2018)**
5. Explain the speed control of DC series motors using controlled rectifiers. Also draw the transfer characteristics. **(Dec 2017)**
6. Explain in detail, the armature control method of speed control with neat diagram.

# (Apr 2019)

1. List out the methods of speed control in DC motors. **(Apr 2019)**
2. Compare the armature resistance and armature voltage type speed control of DC series motor. **(Nov 2019)**
3. Explain the speed control of dc shunt motor using fully controlled rectifiers. **(Nov 2020)**

**UNIT 5**

**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES PART A**

# What is meant by slip power? (Apr 2019)

The portion of air gap power, which is not converted into mechanical power, is called slip power. Slip power is nothing but multiplication of slip *(s)* and air gap power (Pag)

Slip power = s (Pag)

# What are the advantages of slip power recovery system?

In the rotor resistance control method, the slip power in the rotor circuit is wasted as I2R losses during the low-speed operation. The efficiency is also reduced. The slip power from the rotor circuit can be recovered and fed back to the AC source so as to utilize it outside the motor. Thus, the overall efficiency of the drive system can be increased.

# What are the different types of slip power recovery system?(Nov 2015) (April 2017)

These are classified two types. Kramer system

\*Conventional Kramer system \*Static Kramer system Scherbius system

\*Conventional Scherbius system \*Static Scherbius system

\* DC link static Scherbius system \*Cycloconverter 0Scherbius system

# What is meant by Kramer system?

The speed control method in which speed control is achieved by injecting an emf in rotor circuit is known as Kramer’s control system. The Kramer system is only applicable for sub-synchronous speed operation because the slip power is fed back to the supply.

# What are advantages of conventional Kramer method?

* The main advantage of this method is that any speed, within the working range, can be obtained instead of only two or three, as with other methods of speed control.
	+ If the rotor converter is over excited, it will take a leading current which compensates for the lagging current drawn by SRIM & hence improves the power factor of the system.

# What is the function of static Kramer system?

The slip power is converted into dc by diode bridge rectifier and the DC voltage is converted into AC by line commutated inverter and fed back to supply. As the slip power can flow only in one direction, static Kramer drive offers speed control below synchronous speed only.

# Define slip power control. What is meant by slip power recovery system? (Dec 2018,Dec 2017, Apr 2019)

In the rotor resistance control method, the slip power in the rotor circuit is wasted as I2R losses during the low-speed operation. The efficiency is also reduced. The slip power from the rotor circuit can be recovered and fed back to the AC source so as to utilize it outside the motor. Thus, the overall efficiency of the drive system can be increased.

# Where static Kramer drive is used?

The static Kramer drive used in large power pump and fan type drives, where speed control within narrow range and below synchronous speed.

# What are the advantages of static Kramer system?

* 1. The drive system is very efficient and the converter power rating is low, because it has to handle only the slip power.
	2. The drive system has dc machine-like characteristics and the control is very simple.

# What are applications of static Scherbius drive system?

The applications of static scherbius systems are variable speed pumps/generators, Flywheel energy storage system.

# What are the advantages and disadvantages of static Scherbius drive? (Dec 2018) Advantages:

1. In this method, the problem of commutation near synchronous speed disappears.
2. The cyclo-converter can easily operates as a phase-controlled rectifier, supplying dc current in the rotor and permitting true synchronous machine operation.
3. The near-sinusoidal current waves in the rotor, which reduce harmonic loss, and a machine over excitation capacity that permits leading power factor operation on the stator side. So the line's power factor is unity.

# Disadvantages:

a) The cyclo-converter cost is increases, b) The control of the Scherbius drive is somewhat complex.

# Compare conventional method of Kramer and Scherbiussystem(May 2015)

|  |  |
| --- | --- |
| Kramer Method | Scherbius Method |
| This system consists of SRIM, Rotary converter and dc motor and Induction | This system consists of SRIM, Rotary converter and dc motor |
| generator |  |
| Here, the return power is Mechanical | Here, the return power is mechanical |
| Less cost. | More cost |

1. **What are advantages of stator voltage control?**

1. The control is very simple 2. More compact and less weight

3. Its response time is quick 4. This is an economical method

# What are the variable frequency AC drive applications?(May 2013)

Variable Frequency Drive (VFD) can be used in lots of fields. Variable frequency drives are widely used to control the speed of AC motors, like conveyor systems, blower speeds, pump speeds, machine tool speeds, & other applications that require variable speed with variable torque.

# What is slip?

The difference between the synchronous speed Ns and the actual speed N of the rotor is known as slip.



# What are the various methods available for speed control of three phase induction motor?(Dec 2011) (Nov 2015)

Induction motors are of two types - Squirrel-cage motor and Wound-rotor motor. The various types of speed control methods of induction motorare –

1. Pole Changing, (ii) Stator Voltage Control, (iii) Supply Frequency Control,(iv) Rotor Resistance Control, (v) Slip Power Recovery.

# What are applications of three phase AC voltage controllers?(Dec 2011) (Dec 2014)

* Lighting / Illumination control in ac power circuits.
* Induction heating.
* Industrial heating & Domestic heating.
* Transformer tap changing (on load transformer tap changing).
* Speed control of induction motors (single phase and poly phase ac induction motor control).
* AC magnet controls.

# How can the direction of rotation of three phase induction motor be reversed. (Dec 2011)

The direction of rotation of three phase induction motor can be reversed by interchanging the input phase sequence from RYB to RBY.

# State the applications where stator voltage control is employed for three phase induction motor. (Dec 2013)

The applications of stator voltage control in induction motor are Fans, Centrifugal pumps, Compressor and etc.

# Draw the block diagram of conventional scherbius system. (May 2013)



1. **What is meant by v/f control? (May 2014)(Dec 2016)(April 2017) (Dec 2018) (Dec 2018, Apr 2019, Nov 2020)**

If the ratio of voltage to frequency is kept constant; the flux also remains constant. At low frequency, the air gap flux is reduced due to the drop in the stator impedance and the voltage has to be increased to maintain the torque level. This type of control is usually known as volts/hertz (v/f) control. The voltage at variable frequency can be obtained from three-phase inverter or cyclo-converter.

# 23. Draw a sketch of neat sketch of Speed- Torque Characteristics of Induction Motor with v/f control.(Dec 2014)



1. **What are the conventional methods of control of three phase induction motor from the stator side? (May 2014)**

The conventional methods of speed control of induction motor from stator side are Stator voltage control, primary resistance starter

# What is the function of an inverter? (May 2015)

The inverters are basically dc to ac converters. The inverters are used to convert a dc input voltage to a symmetrical ac output voltage of desired magnitude and frequency.

# Mention the advantages of squirrel cage induction motor over a DC motor. (Dec 2016, Nov 2020)

The advantages of squirrel cage induction motor over a DC motor are Low Cost, Wide Speed Variation, High power factor, Reliable operation.

# Rotor resistance control technique cannot be used for cage 1M – Justify (May 2018)

Rotor resistance control is one among the various methods for the speed control of induction motor. In this method of speed control, the rotor circuit resistance is varied by connecting a variable external resistance. This method is only applicable for slip ring or wound rotor induction motor (WRIM). As in squirrel cage induction motor (SCIM), rotor windings terminals are not available for external connection; its speed cannot be regulated by rotor resistance control. Therefore, this method is not applicable for squirrel cage induction motor.

# Compare 120̊ and 180̊ inverter mode. (May 2018)

|  |  |
| --- | --- |
| **120̊ inverter mode** | **180̊ inverter mode** |
| Each switch conduct for 120 only | Each switch conduct for 180 only |
| Only two switches are conducting at an | Three | switches | are | conducting | at | an |
| interval | interval |
| The phase voltage waveform in square type and line voltage waveform of stepped type | The line voltage waveform in square type and phase voltage waveform of steppedtype |

1. **List out the drawbacks of rectifier fed DC drives. (Dec 2017)**

The disadvantage of D.C. drives is the presence of a mechanical commutator which limits the maximum power rating and the speed.

# List the applications of rotor resistance speed control in induction motor. (Nov 2019)

Because of low cost and high torque capability at low speeds, rotor resistance control is employed in cranes, Ward Leonard Ilgener Drives, and other intermittent load applications.

# Draw the cyclo-converter used in the rotor circuit of static slip energy recovery scheme. (Nov 2019)



**PART-B(C205.5)**

* 1. **(i)** Draw the power circuit arrangement of three phase variable Frequency inverter for the speed control of three phase induction motor and explain its working. **(Dec 2018)**
1. List various industrial applications of three phase induction motor. **(Dec 2018)**
	1. Explain the V/f control method of AC drive with neat sketches.**(Apr 2019)**
	2. Discuss the speed control of AC motors by using three phase AC Voltage regulators.**(Apr 2019)**
	3. Explain in detail about Slip power recovery scheme.**(Dec 2011) (Dec 2014)(Nov 2015)(May 2015)(Dec 2016) (April 2017) (May 2018) (Dec 2018) (Nov 2019) (Nov**

# 2020)

* 1. Explain the different methods of speed control used in three phase induction motors.
		1. Control from stator side ii. Control from the rotor side**(May 2014)(Dec 2017)**
	2. Explain the working of following methods with neat circuit diagram.

i )Kramer system ii) Scherbius system**(Dec 2013)(May 2013) (May 2014) (Dec 2018, Apr 2019)**

* 1. (i) Explain the operation of Pole changing method of speed control.**(May 2015,2019) (Nov 2020)**

(ii) Explain the pole amplitude modulation method.

* 1. Explain in detail about the various methods of solid state speed Control techniques by using inverters.**(Dec 2014)**
	2. Explain the solid state stator voltage control technique for the Speed control of three phase induction motor. **(April 2017)**
	3. Explain the constant torque mode and constant power mode of operation of voltage source inverter fed induction motor drive with necessary diagrams. **(Dec 2013)**
	4. Explain the rotor resistance control employed in 3Φ induction motor. **(Nov 2015, May 2018) (Dec 2018)(Apr 2019)**
	5. Describe the variable voltage variable frequency method of speed control of 3 phase induction motors for full range of speed.**(Dec 2016). (Dec 2018)**
	6. Explain with a neat diagram, the solid state speed control of A.C. drives. **(Dec 2018)**
	7. Illustrate the static scherbius method of speed control of three phase induction motor.

# (Dec 2018)(Dec 2017)

* 1. A three phase induction motor is supplied from a 50 Hz supply and runs at 1200 rpm when the slip is 4%. Determine the synchronous speed.**(Apr 2019)**
	2. A 50 Hz induction motor uses a pole amplitude modulation method to control the speed. The stator has 16 poles while the pole modulating function has 4 poles. At what speeds motor can run? **(Apr 2019)**
	3. Explain the two types of speed control of Induction motor drive **(Nov 2019)**
	4. Analyse the speed control of a three phase induction motor using three phase bridge inverter. **(Nov 2020)**