

Tutorial 4 and solutions

Q1. What are the methods of speed control of dc motors?

Armature resistance control, Flux control, Voltage control.

Q2. 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 method of speed control only applicable for speed less than no load speed.

Q3. What are the advantages and disadvantages of armature resistance control of dc shunt motor?

Advantages:

Simple method of speed control.

Disadvantages:

1. This method is highly inefficient, because more power is wasted in controller resistance.
2. Change in speed with Change in load becomes large.

Q4. 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.

Q5. What are the methods of speed control of dc series motor?

1. Variable resistance in series with motor
2. Flux control method
 - i. Field diverter
 - ii. Armature diverter
 - iii. Tapped field control
 - iv. Paralleling field coils and
 - v. Series parallel control

Q6. 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.

Q7. What are the advantages and disadvantages of Ward Leonard system?

Advantages:-

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.

Disadvantages:

High initial cost.

Overall efficiency low (less than 80%, because of the additional MG set).

Costly foundation and large amount of space is required.

This produces noise.

It requires frequent maintenance

Q8. What are the methods of speed control of induction motors?

Stator voltage control, frequency control, Pole changing method, Cascaded control, slip power control.

Q9. What it is meant by voltage control?

The induction motor speed can be controlled by varying the stator voltage. This can be done by using auto transformer. Using this method speed below rated speed is only possible.

Q10. What is frequency control?

$$N = 120f/P$$

Where N= speed of the motorf = 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.

Q11. What are the different types of slip power control system?

Kramer system, Scherbius system.

Q12. What is meant by slip power?

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 (P_{ag})

Slip power = $s (P_{ag})$

Q13. What are the advantages of slip power recovery system?

The slip power can be recovered and fed back to the supply. The overall efficiency also improved.

Q14. What are the different types of slip power recovery system?

These are classified two types.

1. Kramer system

i. Conventional Kramer system

ii. Static Kramer system

2. Scherbius system

i. Conventional Scherbius system

ii. Static Scherbius system

iii. DC link static Scherbius system

iv. Cycloconverter Scherbius system

Q15. What is meant by Kramer system?

The Kramer system is only applicable for sub-synchronous speed operation because the slip power is fed back to the supply.

Q16. What are advantages of conventional Kramer method?

1) 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.

2) 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.

Q17. 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.

Q18. Define slip power control. What is meant by slip power recovery system?

In slip ring induction motor the rotor power (slip power) can be recovered and fed back to supply or can be used to supply an additional motor which is mechanically coupled to the main motor. This type of drive is known as slip power recovery system and improves overall efficiency of the system.

Q19. What is the function of conventional Kramer System?

In conventional Kramer system, the slip power is converted into dc by rotary converter. The dc voltage is fed to dc motor. The dc motor is coupled with slip ring induction motor. The speed of the SRIM can be controlled by varying the field regulator of the dc motor.

Q20. Where static Kramer drive is used?

In large power pump and fan type drives, where speed control within narrow range and below synchronous speed.

Q21. 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.

Q22. What are applications of static Scherbius drive system?

1. Multi-MW, variable speed pumps/generators.

2. Flywheel energy storage system.

Q23. What are the advantages and disadvantages of static Scherbius drive?

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.
4. The cyclo-converter is to be controlled so that its output frequency tracks precisely with the slip frequency.

Disadvantages:

1. The cyclo-converter cost is increases.
2. The control of the Scherbius drive is some what complex.

Q24. Compare conventional method of Kramer and Scherbius system

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

Q25. What is meant by controlled rectifier?

It converts fixed ac voltage into variable dc output voltage.

Q26. 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 of electric device.

Q27. What is meant by electric-drive system?

An electric drive together with its working machines constitutes an electric drive system.

Q28: What is meant by dc drives?

A dc motor speed can be controlled by using power-electronic converters. It is called as dc drives.

Q29. What are the different types of dc drives?

Single phase dc drives, three phase dc drives, Chopper drives.

Q30. What are the two basic methods of speed control of dc motors?

The dc motor speed controlled by (1) armature voltage control (below base speed)

(2) Flux control (above base speed).

Q31. What are the different types of single phase dc drives?

Single phase half controlled dc drives.

Single phase full controlled dc drives.

Q32. What are the different types of chopper?

1. First quadrant chopper-motoring control
2. Second quadrant chopper-braking controls
3. Two quadrant chopper
4. Four quadrant chopper.

Q33. What is meant by duty cycle?

Duty cycle is defined as the ratio between on time of chopper and total time of chopper

$$\alpha = T_{on}/T$$

Q34. What are the advantages of dc chopper drives?

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.