Subject Name:PSD

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Year and Sem, Department: IV-EEE SEM-I

Unit-I: (Title)
CONTROL OF DC MOTORS THROUGH PHASE CONTROLLED RECTIFIERS

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1What is meant by electrical drives?
2What are the advantages of electric drives?
3What are the functions performed by electric drives?
4Mention the parts of electrical drives.
5Mention the applications of electrical drives
6What are the requirements of an electric drive?
7Mention the different factors for the selection of electric drives?
8What are the advantages of three phase controlled converter fed DC Drives?
9What are the advantages of single phase controlled fed DC Drives?
10Write output voltage equations for single phase controlled converters and three phase controlled converters
11A separately – excited dc motor is require to be controlled from a 3-phase source for operation in the first quadrant only. The most preferred converter would be
12List out the drawbacks of rectifier fed DC drive.
13Draw the block diagram of a drive system

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1Derive an expression relating speed and torque of a single phase full converter fed separately excited DC motor drive operating in the continuous current mode
2Describe the operation of single phase fully controlled rectifier control of DC series motor and obtain the expression for motor speed for continuous mode of operation

3Describe the operation of single phase semi controlled rectifier control of DC series motor and obtain the expression for motor speed for continuous mode of operation
4Describe the operation of single phase Semi controlled rectifier control of DC separately excited motor and obtain the expression for motor speed for continuous mode of operation
5Explain the use of freewheeling diode in the converter fed DC drives. Take an example of 1-phase fully controlled converter fed for explanation. How it is going to affect the machine performance.
6What are the advantages of three phase drives over single phase drives
7Explain the motoring and braking operation of three phase fully controlled rectifier control of dc separately excited motor with aid of diagrams and waveforms. Also obtain the expression for motor terminal voltage speed.
8Explain the operation of three phase full controlled rectifier fed dc series motor drives with waveforms and characteristics
9Explain the operation of three phase half controlled rectifier fed dc series motor drives with waveforms and characteristics
10Explain the operation of three phase half controlled rectifier fed dc separately excited DC motor drives with waveforms and characteristics
11Derive an expression for an average output voltage of a 1-phase semi-converter. Assuming a very highly inductive load, draw the waveforms of output voltage, load current and voltage across thyristors
12Compare three phase drives and single phase drives
13A single phase fully controlled thyristor converter is supplying a DC separately excited DC motor. Draw the neat waveforms diagrams and explain various operating modes of the drive Both in motoring and regenerative braking for
$\gamma < \alpha$
$\gamma < \alpha$
Where α is the firing angle, γ is the angle at which the source voltage equal to the motor back emf. Assume the armature of the separately excited dc motor

Fill in the Blanks: (Minimum 10 to 15 with Answers)

1. what are the different parts of electrical drives---
2. full converter operates in the ----------------------- and ------------------------quadrant
3. the conduction period for a thyristor in 1-phase full converter connected to a high inductive load (continuous current) is--------------------------------------
4. the delay angle at which the average output voltage is half of the maximum output voltage for full converteris--------------------------------------
5. the delay angle at which the average output voltage is half of the maximum output voltage for semi converter is--------------------------------------
6. power will be dissipated as heat during -----------------breaking

7. for application of high starting torque ,---------------------------- motor is preferred.
8. which motor is not supported to start with out load--------------------------------
9. what is mean by dynamic breaking -----------------------------------
10. dual converter operates in-------------------quadrants
11. in dual converter fed dc motor , $\alpha_1 + \alpha_2 =$ -------------------
12. most efficient method of braking system is ----------------------
13. dual converter operation is possible in -------------------------------- quadrant
14. one advantage of regenerative braking-----------------------------
15. generally braking systems are --------------------- types
16. in --------------------------------mode load current is continuous
17. name any one of chopper device is----------------------
18. name any one controlling technic for varying duty ratio.---------------------------------
19. if f is the chopping frequency then duty ratio of chopper is------------------------------
20. maximum speed is obtained with chopper fed dc motor for duty ratio of --------------------
21. during regenerative breaking mode the back emf is ---------------------------- than supply voltage
22. both torque and speed will be negative while drive is operating in ------------------- quadrant
23. first quadrant operation of dc drive is called----------------------
24. second quadrant operation of dc drive is called -----------------------------
25. third quadrant operation of dc drive is called -----------------------------
26. fourth quadrant operation of dc drive is called -----------------------------
27. a chopper can be considered a dc equivalent to a--------------------
28. δ represents------------------------
29.the value of δ ranges from-----------------------------
30.the type A chopper is also called---------------------- chopper
31. the slip range for motoring operation of IM of torque vesus slip and speed curve is --------------
32. the per unit frequency K is equal to--------------------
32. write the formula for air gap power P_g=---------------------------
33. the number of thyristors required for fabrication of a 3-phase cyclo converter is-------------------
34. starting torque of IM occurs at slip S=-------------
35. what is mean by slip power-----------------------------
36. I_d equation of scherbius drive system is--
37.A synchronous motor is found to be more economical when the load is above -------------
38.The advantage of a synchronous motor in addition to its constant speed is--------------------
39. in conventional rotor resistance control method, --------------------------- is inserted in series with rotor winding.
40.the torque produced in 3-phase induction motor is given by------------------------
41. the maximum torque condition is ------------------------------

42. the maximum torque is proportional to----------------------
43. in rotor resistance control starting torque is reduced . (true/false)
44. in rotor resistance control starting torque increase. (true/false)
45. in rotor resistance control power factor of the line is improved. (true/false)
46. tn rotor resistance control ther is no hamonics in the line current. (true/false)
47. in rotor resistance control speed control is smooth and of wide range. (true/false)
48. in rotor resistance control efficiency is ---------------------------- due to wastage of slip energy in the rotor circuit.
49. if rotor resistances are not equal in rotor resistance control , it results unbalance I current and voltage. (true/false)
50. $R_2=X_2$ is the condition for getting ----------------------------
51. --------------------- is the condition for getting $T_{ST}= T_{max}$
52. the static rotor resistance method is preferable over the conventional rotor resistance (true/false)
53. quick response of system is possible in static rotor resistance control. (true/false)
54. smooth variation of resistance is possible in static resistance control. (true/false)
55. simplicity in operation using closed loop control is possible in static resistace control. (true/false)
56. the slip power recovery scheme is classified in ----------------------------------types.
57. name the slip power recovery scemes.---------------------------------------
58. the static scherbius drive is also known as---------------------------------
59. in static scherbius , the drive controls the speed in------------------------------------- speed range only.
60.in ac voltage control scheme --------------------------------- is obtained by dissipating the slip power in the motor.
61. in---------------------------- scheme the speed regulation is obtained by dissipating the slip power in the motor.

Fill in the Blanks: (Minimum 10 to 15 with Answers)
Choose the Best:

1. A single-phase half-wave controlled rectifier has 400 sin 314 t as the input voltage and R as the load. For a firing angle of 60° for the SCR, the average output voltage is
(a) 400/Π (b) 300/ Π
(c) 240/ Π (d) 200/ Π
2. A single-phase one-pulse controlled- circuit has resistance and counter emf load and 400 sin 314 t as the source voltage. For a load counter emf of 200 V, the range of firing angle control is
(a) 30° to 150° (b) 30° to 180°
(c) 60° to 120° (d) 60° to 180°
3. In a single-phase half-wave circuit with RL load, and a freewheeling diode across the load, extinction angle 13 is more than 1t. For a firing angle a, the BCR and freewheeling diode would conduct, respectively, for
(a) Π –α,β (b) β - α,Π- α
(c) Π –α,β- Π (d)) Π –α, Π - β

4. In a single-phase one-pulse circuit with RL load and a freewheeling diode, extinction angle 13 is less than 1t. For a firing angle a, the BCR and freewheeling diode would, respectively, conduct for

(a) β - α, 0° (b) Π –α, Π - β

(c) α ,β - a (d) β - α , α

5. A single-phase full-wave mid point thyristor converter uses a 230/200 V transformer with center tap on the secondary side. The P.I.V. per thyristor is

(a) 100 V (b) 141.4 V

(c) 200 V (d) 282.8 V

6. A single-phase two-pulse bridge converter has an average output voltage and power output of 500 V and 10 kW respectively. The SCRs used in the two-pulse bridge converter are now re-employed to form a single-phase two-pulse mid-point converter. This new controlled converter would give, respectively, an average output voltage and power output of

(a) 500 V, 10 kW (b) 250 V, 5 kW

(c) 250 V, 10 kW (d) 500 V, 5 kW

7. In a single-phase full converter, for continuous conduction, each pair of SCRs conducts for

(a) Π -α (b) Π (c) α (d) Π + α

8. In a single-phase full converter, for discontinuous load current and extinction angle □ > Π, each SCR conducts for

(a) α (b) β-α (c) β (d) α+β

9. In a single-phase semi-converter, for continuous conduction, each SCR conducts for

(a) α (b) Π

(c) α + Π (d) Π -α

10. In a single-phase semi converter, for discontinuous conduction and extinction angle β> Π, each SCR conducts for

(a) Π -α (b) β-α

(c) α (d) β

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(c) inverter for α =90° to 180° (d) inverter for α= 0° to 90°.

Unit-II: (Title)

FOUR QUADRANT OPERATION OF DC DRIVES THROUGH DUAL CONVERTERS

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1What is meant by regenerative braking?
2What is meant by dynamic braking?
3What is meant byplugging?

4Which braking is suitable for reversing the motor?
5Define four quadrant operations.
6Mention different types of braking methods.
7What are the advantages of closed loop control of dc drives?
8What are the advantages of Dual converters?
9In which type of applications regenerative braking is more useful?
10Mention the advantages of closed loop operation.
11What are the conditions for the operation of motor in regenerative braking
12What is counter current braking
13What is the operation of converter in third and fourth quadrants
14What is the operation of converter in first and second quadrants

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1What is a dual converter? Explain the principle of operation of a dual converter in a circulating current mode. How the same is used for speed control of DC drive
2What is 4-quadrant operation and explain with converters.

3Describe the relative merits and demerits of the following types of braking for DC motors, mechanical braking, dynamic braking and regenerative braking with neat diagram.
4Draw the circuit diagram and explain the operation of closed loop speed control with inner-current loop and field weakening.
5Explain how four-quadrant operation is achieved by dual converter each of 3ϕ full wave configuration for DC separately excited motor.
6Distinguish between circulating current and non-circulating current mode of operation.
7Explain the principle of closed-loop control of a DC drive using suitable block diagram.
8Draw and explain the torque-speed characteristics for dynamic braking operation of DC series motor. Why torque becomes zero at finite speed
9With a neat diagram, explain the operation of a DC drive in all four quadrants when fed by a single phase dual converter with necessary waveforms and characteristics.
10What are the advantages of electric braking over mechanical braking of DC motors? Explain with proper circuit diagram speed-torque characteristics of DC motor dynamic braking, for the following types
Separately excited DC motor

Series motor
11Explain how four-quadrant operation is achieved by dual converter each of 1ϕ full wave configuration for DC separately excited motor.
12Describe the operation of dual converter with circulation current mode
13Describe the operation of dual converter with non-circulation current model

Fill in the Blanks: (Minimum 10 to 15 with Answers)
Choose the Best:

1. In case of travelling cranes , the motor preferred for boom hoist is----------------
   a) AC slip ring motor b) ward leonard controlled dc shunt motor
   b) C) synchronous motor d)single –phase motor
2. The characteristics of the drive for crane hoisting and covering is--------------------
   a) Smooth movement b) precise control c) fast speed control d) all of these
3. The range of horse power of electric motor for rolling miles is of the order of-------------
   a) 1to 10hp b)15 to25 hp c)50 to 100 hp d)100 to 500 hp
4. Motors preferred for rolling nice drive are
   a) DC motor b) AC slip ring motor with speed control c)any of these d)none of these
5. A motor is less than full load power rating can be used if the load is -------------
   a) Continuous duty b) short time duty c) intermittent periodic duty d) none of these
6. To get speed higher than base speed of dc shunt motor -------------------------
   a) Armature resistance control is used c) field resistance control
   b) Armature voltage control d) none of these
7. In case of conductors the duty in which the main contacts remain closed, for a period bearing a definite relation to the no-load periods, is known as ---------------------
   a) Standard duty b) intermittent duty c)temporary duty d)uninterrupted duty
8. In overhead travelling cranes,----------------------
   a) Continuous duty motors are used
   b) Slow speed motors are preferred
   c) Short time rated motors are preferred
   d) None of these
9. Light duty cranes are generally used in----------------------
   a) Automobile workshop b) pumping stations c) power houses d) all of these
10. Heavy duty cranes are used in ------------------------------

a) Heavy engineering workshops c)steel plants
b) Ore handling plants d) all of these

11. The number of sets used in pole changing type squirrel cage motors, for derricks and winches, is --------------------
    a) 2 b) 3 c) 4 d)6
12. A pole changing type squirrel cage motors used in derricks has four, eight and twenty four poles. In this , medium speed is used for----------------
    a) Lifting b) hoisting c) lowering d) landing the load
13. Belt conveyors offer-------------------
    a) Zero starting torque b) low starting torque c) medium starting torque d) high starting torque
14. Torque is proportional to-------------------
    a)I_a b)E C)W d) E_b
15. speed is propotional to------------
    a)I_a b)T C)W d) E_b
16. To make a dc machine operate in reverse motoring,-------------
    a)E and I should be negative
    b) E should be positive and I should be negative
    c) E should be negative and I should be positive
    d) E should be and I should be positive

17. power supply will be fed back to supply lines during ---------------- braking
a) regenerative b)rheostatic c) revese current d) mechanical

18. power will be dissipated as heat during -------------------- braking.
a) regenerative b)rheostatic c) revese current d) mechanical

19. either armature or field terminals of a dc motor are reversed in-------------- braking
a) regenerative b)rheostatic c) revese current d) mechanical

20. for applications of high starting torque , motor preferred is ----------------------
a) dc shunt b) dc series c) dc compound d) none of these

21. which motor is not supposed to start without load.
a) dc shunt b) dc series c) dc compound d) none of these

23. SCR commutation is the process of ----------------------
a) opening the SCR b) closing the SCR c)replacing the SCR d) calibrating the SCR

25. what is mean by dynamic braking?
a) power dissipated in resistance b) power fed back to the source c) reverse the supply terminal d) all

26. a free-wheeling diode is connected across the R-L load because--------------
a) it prevent infinite voltage across switch which breaks current
b)it rectifies current
c) it prevents current in opposite direction
d)none of these

27. power electronic equipments have very high efficiency because------------------
a) the device always operate in active region
b)the device never operate in active region
c) devices achieve inverse region at high speed and stay at the two states on or off
d) cooling is very efficient
28. in simultaneous control of dual converter , both the rectifiers are controlled together in order to avoid---------a)AC circulating current between rectifiers
b) DC circulating current between rectifiers
c)leakage current between rectifiers
d) none of these
29. in a non- simultaneous control of dual converter ------------------------
a) one rectifier is controlled at a time
b) two rectifiers are controlled at a time
c)both rectifiers in the circuit one by one
d) none of these
30. what are the control strategies in in a dc chopper
a) time ratio control b)current limit control c) both a& b d) none of these
31. what is mean by dual converter
a)fourth quadrant operaton is possible
b)first quadrant operation is possible
c) second quadrant operation is possible
d)third quadrant operation is possible
32. what is mean by plugging?
a) supply terminals are reverse b) supply terminals are disconnected c)power flows from load to source d)all
33. what is mean by regenerative braking?
a) supply terminals are reverse b)power flows from load to source
c) power flows from source to load d) all of these
34. what are braking methods used in dc motor?
a)plugging b) dynamic braking c)regenerative braking d) all of these
35. what are the three types of electric braking
a) plugging b) dynamic braking c) regenerative d) all of these
36. dual converter operates in ---------------- quadrant
a)first and second b) fourth c) second and third d) third and fourth
37. dc-dc converter chopper has -------------------
a)only step-down dc voltage b) only step-up dc voltage c)a or b d)none of these

Unit-III: (Title)

CONTROL OF DC MOTORS BY CHOPPERS

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1Mention different types of control strategies for choppers.
2Define time ratio control.
3Define current limit control.
4Classify the choppers based on voltage level.
5Classify the choppers based on quadrant operations.
6Define constant frequency control.
7Define variable frequency control.
8Draw the circuit of Type-A Chopper drive.
9What is dynamic braking in Choppers?
10Draw the circuit of four quadrant chopper drive.
11What are the control strategies in choppers?
12In which chopper drive regenerative braking occurs?
13What is duty ratio?

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1Deduce the mathematical expression for minimum and maximum currents for a class A chopper operated DC motor with back emf.
2Discuss with the suitable diagrams I quadrant and II quadrant choppers.
3Distinguish between class A and class B choppers with suitable examples of speed control of motors
4List the advantages offered by DC chopper drives over line commutated converter controlled DC drives.
5Explain the operation of the two quadrant chopper fed DC drive system
6Draw the diagram of regenerative chopper fed separately excited DC motor drive
7Describe the working of a single quadrant chopper fed DC series motor drive
8Explain the different types of control strategies of DC chopper.
9Explain the operation of four quadrant DC chopper drive
10Explain regenerative braking and dynamic braking of separately excited
11Describe the operation of type –B chopper with neat circuit and waveforms
12Describe the operation of type –C chopper with neat circuit and waveforms
13Describe the operation of type –D chopper with neat circuit and waveforms

Fill in the Blanks: (Minimum 10 to 15 with Answers)
Choose the Best:

1. In dc choppers, if Ton is the on period and f is the chopping frequency, then output voltage in terms of input voltage Vs is given by
   (a) Vs. Ton l f (b) Vs .f / Ton
   (c) V / f. Ton (d) Vs. f. Ton
2. In dc choppers, the waveforms for input and output voltages are respectively
   (a) discontinuous, continuous (b) both continuous
   (c) both discontinuous (d) continuous, discontinuous
3. In PWM method of controlling the average output voltage in a chopper, the on time is (varied / kept constant) but the chopping frequency is (varied / kept constant).
4. In FM method of controlling the average output voltage in a chopper, chopping period is (varied / kept constant) but on time is (varied / kept constant) or off time is (varied / kept constant).
5. For type-A chopper, Vs is the source voltage, R is the load resistance and is the duty cycle. The average output voltage and current for this chopper are respectively
   (a) αVs, α. (Vs / R) (b) (1-α) V¬s, (1- α) Vs / R
   (c) Vs / Vα, V s / αR (d) Vs / (1 -α, Vs /(1 - α) R
6. A chopper has Vs as the source voltage, R as the load resistance and as the duty cycle. For this chopper, RMS value of output voltage is
   (a) αVs (b) (α) 1/2.Vs
   (c) Vs/ (α) ½ (d) (1-α) 1/2 Vs
7. For a chopper, Vs is the source voltage, R is the load resistance and a is the duty' cycle. RMS and average values of thyristor currents for this chopper are
   - (a)α.Vs / R, (√α)Vs / R (b) (√α).Vs / R , (√α) .Vs / R
   (c) (√α) Vs / R, αVs / R (d) (1-α) 1/2.Vs / R, (1-α) 1/2Vs / R.
8. In dc choppers, per unit ripple is maximum when duty cycle a is
   (a) 0.2 (b) 0.5
   (c) 0.7 (d) 0.9.
9. A voltage-commutated chopper has the following parameters:
   Vs = 200 V, Load circuit parameter: 1Ω, 2 mH, 50 V
   Commutation circuit parameters, L = 25 μH, C = 50μF
   Ton = 500 μs, T = 2000 μs
   For a constant load current of 100 A, the effective on period and peak current through the main thyristor are respectively
   (a) 1000 μs, 200 A (b) 700 μs, 382.8 A
   (c) 700 μs, 282.8 A (d) 1000 μs, 382.8 A.
10. For the voltage-commutated chopper of Prob. 10, the turn-off times for main and auxiliary thyristors are, respectively,
   (a) 120 μs, 60 μs (b) 100 μs, 0.5 μs
   (c) 120 μs, 55 μs (d) 100 μs, 55.54μs.

11. A load commutated chopper, fed from 200 V dc source, has a constant load current of 50 A. For a duty cycle of 0.4 and a chopping frequency of 2 kHz, the value of commutating capacitor and the turn-off time for one thyristor pair are respectively
(a) 25 μF, 50 μs (b) 50 μF, 50 μs
(c) 25 μF, 25 μs (d) 50 μF, 25 μs

12. A dc battery is charged from a constant dc source of 200 V through a chopper. The dc battery is to be charged from its internal emf of 90 to 120 V. The battery has internal resistance of 1 Ω. For a constant charging current of 10 A, the range of duty cycle is ……….. to…….......

13. For type-A chopper; Vs, R, Io and a are respectively the dc source voltage, load resistance, constant load current and duty cycle. For this chopper, average and RMS values of freewheeling diode currents are
(a) α Io, (√α) Io (b) (1 - α) Io, (1-α) 1/2 Io
(c) α Vs / R, (√α) Vs / R (d) (1 - α) Io, (√α) Io

14. A step-up chopper has Vs as the source voltage and a as the duty cycle. The output voltage for this chopper is given by
(a)Vs (1+ α) (b) Vs / (l - α)
(c) Vs (1 - α) (d) Vs / (l + α).

15. A dc chopper is fed from 100 V dc. Its load voltage consists of rectangular pulses of duration 1 m sec in an overall cycle time of 3 m sec. The average output voltage and ripple factor for this chopper are respectively
(a) 25 V, 1 (b) 50 V, 1 (c) 33.33 V, (√2) (d) 33.33 V, 1

16. When a series LC circuit is connected to a dc supply of V volts through a thyristor, then the peak current through thyristor is
(a) V. √ LC (b) V / √CL
(c) V. √(C / L) (d) V. √ (L / C)

17. In dc choppers, if T is the chopping period, then output voltage can be controlled by PWM by varying
(a) T keeping Ton constant (b) Ton keeping T constant
(c) Toff keeping T constant (d) T keeping Toff constant.

18. In dc choppers, for chopping period T, the output voltage can be controlled by FM by varying
(a) T keeping Ton constant (b) T keeping Toff constant
(c) Ton keeping T constant (d) Toff keeping T constant

19. for high frequency choppers, the device that is preferred is-------------
a)thyristor b)TRIAC c)transistor d)GTO

20. In the third quadrant of operation of a chopper power is--------------------
Positive b)negative c) botha a&b d)none of these

21. in a chopper control circuits, transistor choppers are preferred over thyristor because these can be operated at-----
a)very high frequency b) very low frequency c)medium frequency d)supply frequency

22. what are the types of control strategies in a dc chopper
a)time ratio control b)current limit control c)both a&b
23. regenerative breaking of a dc motor may be achieved by
a)phase controlled converter b)inverter c) cyclo converter d)none of these
24. whtat is advantage of closed loop control scheme?
a) accurate speed control b)high amount of loss c)low efficiency d)all of these
25. a chopper is a -------- speed on/off semiconductor switch
a)low b)high c)both a&b d) none of these
26. the control function of chopper can be performed by using -------------
a)TRC b)CLC c)both A&B d)none of these

Unit-IV: (Title)

CONTROL OF INDUCTION MOTORS

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)
1What are advantages of induction motor?
2What are the applications of slip ring induction motor?
3Define rotor current frequency
4Draw the equivalent circuit of an induction motor
5What are the advantages of variable frequency control?
6What are the disadvantages of variable frequency control?
7What are the limitations of v/f control?
8What is constant torque mode operation?
9What are the different types of rotor resistances control in induction motor
10Draw the speed torque characteristics of rotor resistances control
11Draw the speed torque characteristics of induction motor

12What are the applications of variable frequency drives?
13What are the types of slip power recovery system
14What are the advantages of Kramer system
15What are the advantages of static scherbius drive

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1Why stator voltage control is an inefficient method of induction motor speed control

2Constant torque loads are not suitable for AC voltage controller fed induction motor drive. Why?

3Using 3-phase solid state AC voltage controllers explain clearly how it is possible to achievef4-quadrant operation of 3-phase induction motors

4Draw a closed loop block diagram for the above speed control technique. Mention the merits of the above method of speed control

5Explain the mechanical characteristics of a three phase induction motor with stator frequency control.

6Explain in detail the speed control scheme for a three phase induction motor using PWM inverter.

7Sketch the mechanical characteristics of a there phase induction motor with V/f method

8Draw the speed-torque characteristics of a rotor resistance controlled induction motor and explain the effect of rotor resistance variation

9Draw and explain closed loop operation for a static Kramer controlled drive

10Draw and explain static scherbius drive

11What happens to the performance of AC motor if the stator voltage control technique is adopted with frequency being constant

Fill in the Blanks: (Minimum 10 to 15 with Answers)
Choose the Best:

1. A single-phase voltage controller feeds an induction motor
   (a) In both the loads, fundamental and harmonics are useful
   (b) In A only fundamental and in B only harmonics are useful
   (c) In A only fundamental and in B harmonics as, well as fundamental are useful (d) In A only harmonics and in B only fundamental are useful.

2. A load resistance of 10 Ω is fed through a I-phase voltage controller from a voltage source of 200 sin 314 t. For a firing angle delay of 90°, the power delivered to load in kW, is

(a) 0.5 (b) 0.75
(c) 1 (d) 2

3. A single-phase voltage controller is employed for controlling the power flow from 260 V, 50 Hz source into a load consisting of R = 5 Ω and wL = 12 Ω. The value of maximum RMS load current and the firing angle are respectively
(a) 20 A, 0° (b) 260/10.91A, 0°
(c) 20 A, 90° (d) 260/10.91 A, 90°

4. A "load, consisting of R = 10 Ω and wL = 10 Ω, is being fed from 230 V, 50 Hz source through a I-phase voltage controller. For a firing angle delay of 30°, the RMS value of load current would be
(a) 23 A (b) 23/√2 A
(c) > 23/√2 A (d) < 23/√2 A

5. In a single-phase voltage controller with RL load, ac output power can be controlled if
(a) firing angle α > (load phase angle) and conduction angle Ø = Π
(b) α > Ø and Ø < Π
(c) α << Ø and Ø = Π
(d) α < Ø and Ø > Π

6. A single-phase voltage controller feeds power to a resistance of 10 .0. The source voltage is 200 V rms. For a firing angle of 90°, the RMS value of thyristor current in amperes is
(a) 20 (b) 15
(c) 10 (d) 5

7.A single-phase voltage controller is connected to a load of resistance 10.0 and a supply of 200 sin 314t volts. For a firing angle of 90°, the average thyristor current in amperes is
(a) 10 (b) 10 / Π
(c) 5√2 / Π (d) 5√2

8. A single-phase voltage controller, using two SCRs in anti parallel, is found to be operating as a controlled rectifier. This is because
(a) load is R and pulse gating is used
(b) load is R and high-frequency carrier gating is used
(c) load is RL and pulse gating is used
(d) load is RL and continuous gating is used

9. A single-phase ac voltage controller (or regulator) fed from 50 Hz system supplies a load having resistance and inductance of2.0 .0 and 6.36 mH respectively. The control range of firing angle for this regulator is
(a) 0° < α< 180° (b) 45° < α < 180°
(c) 90° < α < 180° (d) 0° < α< 45°

10. If, for a single-phase half-bridge inverter, the amplitude of output voltage is Vs and the output power is P, then their corresponding values for a single-phase full-bridge inverter are
(a) Vs, P (c) 2 Vs, 2P
(b) V/2, 2P (d) 2 Vs, P

11. In voltage source inverters
(a) load voltage waveform Vo depends on load impedance Z, whereas load current waveform io does not depend on Z
(b) Both Vo and io depend on Z
(c) Vo does not depend on Z whereas io depends on Z
(d) both Vo and io do not depend upon Z

12. A single-phase full bridge inverter can operate in load-commutation mode in case load consists of

(a) RL (b) RLC over damped
(c) RLC under damped (d) RLC critically damped

13. A single-phase bridge inverter delivers power to a series connected RLC load with R = 2 Ω, ωL = 8 Q. For this inverter-load combination, load commutation is possible in case the magnitude of l/ωC in ohms is .
(a) 10 (b) 8 (c) 6 (d) zero

14. For a 3-phase bridge inverter in 180° conduction mode, Fig. A-33, the sequence of SCR conduction in the first two steps, beginning with the initiation of thyristor 1, is
(a) 6, 1,2 and 2,3, 1 (b) 2,3, 1 and 3, 4, 5
(c) 3, 4, 5, and 5, 6, 1 (d) 5, 6, 1 and 6, 1, 2

15.For a 3-phase bridge inverter in 120° conduction mode, Fig. A-33, the sequence of SCR conduction in the first two steps, beginning with the initiation of thyristor 1, is
(a) 6, 1 and 1, 2 (b) 1,2 and 2,3
(c) 1, 6 and 5, 6 (d) 1, 3 and 3, 4

16.In single-pulse modulation of PWM inverters, third harmonic can be eliminated if pulse width is equal to
(a) 300 (b) 600
(c) 1200 (d) 150°

17.In single-pulse modulation of PWM inverters, fifth harmonic can be eliminated if pulse width is equal to
(a) 300 (b) 720
(c) 36° (d) 108°

18. In single-pulse modulation of PWM inverters, the pulse width is 120°. For an input voltage of 220 V dc, the RMS value of output voltage is
(a) 179.63 V (b) 254.04 V
(c) 127.02 V (d) 185.04 V

19. In single-pulse modulation used in PWM inverters, Vs is the input de voltage. For eliminating third harmonic, the magnitude of RMS value of fundamental component of output voltage and pulse width are respectively
(a) 2√2 Vs/π, 120° (b) 4 Vs/π, 60°

(c) 2√2 Vs/π, 60° (d) 4 Vs/π, 120°

20. In multiple-pulse modulation used in PWM inverters, the amplitudes of reference square wave and triangular carrier wave are respectively 1 V and 2 V. For generating 5 pulses per half cycle, the pulse width should be
(a) 36° (b) 24° (c) 18° (d) 12°

21. In multiple-pulse modulation used in PWM inverters, the amplitude and frequency for triangular carrier and square reference signals are respectively 4 V, 6 kHz and 1 V, 1 kHz. The numbers of pulses per half cycle and pulse width are respectively
(a) 6, 90° (b) 3, 45°
(c) 4, 60° (d) 3, 40°

22. In sinusoidal-pulse modulation used in PWM inverters, amplitude and frequency for triangular carrier and sinusoidal reference signals are respectively 5 V, 1 kHz and 1 V, 50 Hz. If zeros of the triangular carrier and reference sinusoid coincide, then the modulation index and order of significant harmonics are respectively
(a) 0.2,9 and 11 (b) 0.4,9 and 11
(c) 0.2, 17 and 19 (d) 0.2, 19 and 21

23. Which of the following statement/statements is/are correct in connection with in-verters:
    (a) VSI and CSI both require feedback diodes
    (b) Only CSI requires feedback diodes
    (c) GTOs can be used in CSI
    (d) Only VSI requires feedback diodes

24. In a CSI, if frequency of output voltage is f Hz, then frequency of voltage input to CSI is
    (a) f (b) 2f
    (c) f/2 (d) 3f

25. In sinusoidal-pulse modulation used in PWM inverters, amplitude and frequency of triangular carrier and sinusoidal reference signals are respectively 5 V, 1 kHz and 1 V, 50 Hz. If peak of the triangular carrier coincides with the zero of the reference sinusoid, then the modulation index and order of significant harmonics are
    (a) 0.2,9 and 11 (b) 0.4,9 and 11
    (c) 0.2, 17 and 19 (d) 0.2, 19 and 21

26. In sinusoidal PWM, there are 'm' cycles of the triangular carrier wave in the half cycle of reference sinusoidal signal. If zero of the reference sinusoid coincides with zero/peak of the triangular carrier wave, then number of pulses generated in each half cycle is respectively
    (a) (m - 1)/m (b) (m - 1)/(m - 1)
    (c) m/m (d) m/(m - 1)

27. In an inverter with fundamental output frequency of 50 Hz, if third harmonic is eliminated, then frequencies of other components in the output voltage wave, in Hz, would be
    (a) 250, 350, 450, high frequencies (b) 50, 250, 350, 450
    (c) 50,250,350,550 (d) 50, 100, 200, 250

28. A single-phase CSI has capacitor C as the load. For a constant source current, the voltage across the capacitor is
    (a) square wave (b) triangular wave
    (c) step function - (d) pulsed wave

29. A single-phase full bridge VSI has inductor L as the load. For a constant source voltage, the current through the inductor is
    (a) square wave (b) triangular wave
    (c) sine wave (d) pulsed wave

30. centrifugal pumps are usually driven by
a) DC shunt motor b)DC series motor c)squirrel cage IM d)any of these

31. belted slip-ring IM is almost invariably used for
a) centrifugal blower b)jaw crushers c)water pumps d)screw pumps

32. in jaw crusher a motor has to often start against
a)low load b) medium load c) normal load d)heavy load

33. which of the following motor is preferred for synthetic fiber mills
a)series motor b)IM c)shunt motor d) synchronous motor

34. by using voltage controller ----------- can be varied
a)supply frequency b)supply voltage c)current d) none of these

35. speed control of AC drives can be achieved by varying
a)voltage b)current c)frequency d) all of these

36. what are different methods of braking applied to an IM
a) regenerative and dynamic breaking b)plugging c) both a& b d)all of these

37. in which of the application ac devices used
a)fans b) biowers c) mill run-out tables d)all of these

38. what is mean by plugging?

a) phase sequency of supply is reversed b) disconnecting source
c) stored energy dissipated in resistance d) all of these
39. which of the following is preferred for automatic drives?
a) synchronous motors b) ward leonard controlled dc motor c) squirrel cage IM d) any of these
40. in a motor circuit , staic frequency changers are used for
a) power factor improvement b)improved cooling c)reversal of direction d) speed regulation.

Unit-V: (Title)

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1Write torque equation of synchronous motor
2What are the different methods for variable frequency control in synchronous motor
3What are the advantages of voltage source inverter
4What are the advantages of current source inverter
5What are the possible methods to provide variable voltage variable frequency to synchronous motor fed from VSI
6What is square wave inverter
7What is PWM inverter
8What is chopper with square wave inverter
9Define torque angle
10What is the advantage of constant margin angle control
11What are the factors effecting speed of synchronous motor?
12What are the advantages of cyclo converter drives?
13What are the applications of cyclo converter drives?

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1Why stator voltage control is an inefficient method of induction motor speed control
2Constant torque loads are not suitable for AC voltage controller fed induction motor drive. Why?
3Using 3-phase solid state AC voltage controllers explain clearly how it is possible to achievef4-quadrant operation of 3-phase induction motors
4Draw a closed loop block diagram for the above speed control technique. Mention the merits of the above method of speed control
5Explain the mechanical characteristics of a three phase induction motor with stator frequency control.

6Explain in detail the speed control scheme for a three phase induction motor using PWM inverter.
7Sketch the mechanical characteristics of a there phase induction motor with V/f method
8Draw the speed-torque characteristics of a rotor resistance controlled induction motor and explain the effect of rotor resistance variation
9Draw and explain closed loop operation for a static Kramer controlled drive
10Draw and explain static scherbius drive
11What happens to the performance of AC motor if the stator voltage control technique is adopted with frequency being constant

Fill in the Blanks: (Minimum 10 to 15 with Answers)
Choose the Best:

1. If, for a single-phase half-bridge inverter, the amplitude of output voltage is *Vs* and the output power is *P*, then their corresponding values for a single-phase full-bridge inverter are
   (a) Vs, P (c) 2 Vs, 2P
   (b) V/2, 2P (d) 2 Vs, P

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   (a) load voltage waveform Vo depends on load impedance Z, whereas load current waveform io does not depend on Z
   (b) Both V_o and i_o depend on Z
   (c) V_o does not depend on Z whereas i_o depends on Z
   (d) both V_o and i_o do not depend upon Z

3. A single-phase full bridge inverter can operate in load-commutation mode in case load consists of
   (a) RL (b) RLC over damped
   (c) RLC under damped (d) RLC critically damped

4. A single-phase bridge inverter delivers power to a series connected *RLC* load with *R* = 2 Ω, ωL = 8 Q. For this inverter-load combination, load commutation is possible in case the magnitude of l/ωC in ohms is
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5. For a 3-phase bridge inverter in 180° conduction mode, Fig. A-33, the sequence of SCR conduction in the first two steps, beginning with the initiation of thyristor 1, is
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   (c) 3, 4, 5, and 5, 6, 1 (d) 5, 6, 1 and 6, 1, 2

6. For a 3-phase bridge inverter in 120° conduction mode, Fig. A-33, the sequence of SCR conduction in the first two steps, beginning with the initiation of thyristor 1, is
   (a) 6, 1 and 1, 2 (b) 1,2 and 2,3
   (c) 1, 6 and 5, 6 (d) 1, 3 and 3, 4

7. In single-pulse modulation of PWM inverters, third harmonic can be eliminated if pulse width is equal to
   (a) 30^0 (b) 60^0
   (c) 120^0 (d) 150°

8. In single-pulse modulation of PWM inverters, fifth harmonic can be eliminated if pulse width is equal to
   (a) 30^0 (b) 72^0
   (c) 36° (d) 108°

9. In single-pulse modulation of PWM inverters, the pulse width is 120°. For an input voltage of 220 V dc, the RMS value of output voltage is

(a) 179.63 V (b) 254.04 V
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(c) $\frac{2\sqrt{2}}{\Pi} V_s$, 60° (d) $\frac{4 V_s}{\Pi}$, 120°

11. In multiple-pulse modulation used in PWM inverters, the amplitudes of reference square wave and triangular carrier wave are respectively 1 V and 2 V. For generating 5 pulses per half cycle, the pulse width should be

(a) 36° (b) 24° (c) 18° (d) 12°

12. In multiple-pulse modulation used in PWM inverters, the amplitude and frequency for triangular carrier and square reference signals are respectively 4 V, 6 kHz and 1 V, 1 kHz. The numbers of pulses per half cycle and pulse width are respectively

(a) 6, 90° (b) 3, 45°
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(c) m/m (d) m/(m - 1)

18. In an inverter with fundamental output frequency of 50 Hz, if third harmonic is eliminated, then frequencies of other components in the output voltage wave, in Hz, would be

(a) 250, 350, 450, high frequencies *(b)* 50, 250, 350, 450
(c) 50,250,350,550 *(d)* 50, 100, 200, 250

19. A single-phase CSI has capacitor C as the load. For a constant source current, the voltage across the capacitor is

(a) square wave (b) triangular wave
(c) step function - (d) pulsed wave

20. A single-phase full bridge VSI has inductor *L* as the load. For a constant source voltage, the current through the inductor is

*(*a) square wave (b) triangular wave
(c) sine wave (d) pulsed wave

21. A cyclo converter is a

(a) frequency changer (fc) from higher to lower frequency with one-state conversion
(b) fc from higher to lower frequency with two-stage conversion
(c) fc from lower to high frequency with one-state conversion
(d) either (a) or (c).

22. The cyclo converters (CCs) require natural or forced commutation as under:

(a) natural commutation in both step-up and step-down CCs
(b) forced commutation in both step-up and step-down CCs
(c) forced commutation in step-up CCs
(d) forced commutation in step-down CCs.

23. For converting 3-phase supply at one frequency to single-phase supply at a lower frequency, the basic principle is to_______(vary/keep) the firing angle __________ (constant/gradually).

24. Three-phase to three-phase cyclo converters employing 18 SCRs and 36 SCRs have the same voltage and current ratings for their component thyristors. The ratio of VA rating of 26-SCR devices to that of 18-SCR devices is

(a) 2 (b) 1 (c) 2 (d) 4.

27. Three-phase to 3-phase cyclo converters employing 18 SCRs and 36 SCRs have the same voltage and current ratings for their component thyristors. The ratio of power handled by 36-SCR devices to that handled by 18-SCR devices is

(a) 2 (b) 1 (c) 2 (d) 4.

28. The number of thyristors required for single-phase to single-phase cyclo converter of the mid-point type and for three phase-to three-phase 3-pulse type cyclo converters are respectively -.

(a) 4, 6 (b) 8, 18 (c) 4, 18 (d) 4, 36.

29. A 3-phase to single-phase conversion device employs a 6-pulse bridge cyclo converter. For an input voltage of 200 V per phase, the fundamental rms value of output voltage is

(a) 600/Π V (b) 300√3/Π V (c) 300/Π V (d) 600√3/Π V.

30. speed control of an induction motor is possible from the following

a) rotor side b) stator side c)both a&b d)none of these

31. synchronous speed is directly proportional to

a) no.of poles b) actual speed c) supply frequency d) voltage

32. the speed controlling methods for IM of both slip-ring and squirrel cage types are

a) stator voltage control b) variable frequency control c) slip energy recovery control d) both a&b

33. the voltage induced in the rotor of IM E_2 is proportional to the product of slip frequency and--------
a)f b) E2 c)v_1 d)none
34. if flux increases beyond its rated value, ----------- effects arise in te IM.
a)constant current b) constant voltage c)increase current d) incrase voltage
35. if frequency = 50Hz and poles =4 , the synchronous speed for 3-phase IM is
a)1500rpm b)1000rpm c)2000rpm d)1200rpm
36. by using PWM inverter ------------------------------- of output can be changed.
a)voltage b)frequency c)both a&b d)none of these
37. ---------------------of IM will attain synchronous speed
a)stator b)rotor c)stator magnetic field d)none of these