SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

VII SEMESTER

1905706 – CONTROL OF ELECTRICAL DRIVES

Regulation – 2019

Academic Year 2022 – 23

Prepared by

Ms.S.Vanila, Assistant Professor (Sel.G)/EEE

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SUBJECT: 1905706– CONTROL OF ELECTRICAL DRIVES

SEM / YEAR: VII / IV

UNIT I - CONTROL OF DC DRIVES				
Losses in electrical drive system, Energy efficient operation of drives, block diagram/ transfer function of self, separately excited DC motors --closed loop control-speed control- current control - constant torque/power operation - P, PI and PID controllers–response comparison.				
PART – A				
Q.No	**Questions**	**BT Level**	**Competence**	**Course Outcome**
1.	Define electrical drive.	BLT 1	Remember	CO1
2.	Draw the basic block diagram of an electrical drive.	BLT 5	Evaluate	CO1
3.	Mention the functions of power modulator.	BLT 1	Remember	CO1
4.	List out the advantages of an electrical drive.	BLT 1	Remember	CO1
5.	Point out the different losses found in an electrical drive.	BLT 4	Analyse	CO1
6.	What are electrical transmission losses?	BLT 2	Understand	CO1
7.	Write the transfer function of separately excited DC motors	BLT 1	Remember	CO1
8.	Summarize the factors that depend on the energy saving of electrical drives?	BLT 2	Understand	CO1
9.	Illustrate the use of feedback loops employed in an electrical drive.	BLT 2	Understand	CO1
10.	List out the applications of closed loop torque control.	BLT 1	Remember	CO1
11.	Illustrate the use of inner current loop in closed loop speed control.	BLT 3	Apply	CO1
12.	Prepare the methods in which speed of a DC motor drive can be controlled.	BLT 3	Apply	CO1
13.	Show the speed torque characteristics of a series motor operating under field flux control.	BLT 3	Apply	CO1
14.	How flux is controlled in a separately excited dc motor?	BLT 5	Evaluate	CO1
15.	What are the methods to be followed when the supply is ac under armature voltage control?	BLT 4	Analyse	CO1
16.	Conclude the effect seen in DC motor without any controller.	BLT 6	Create	CO1
17.	Analyse the different kinds of industrial controllers available for the closed loop operation of electrical drives.	BLT 4	Analyse	CO1
18.	What is PI controller? List out its applications.	BLT 1	Remember	CO1
19.	State the difference between PI and IP controllers.	BLT 2	Understand	CO1
20.	Sketch the block diagram of PID controller of DC motor	BLT 6	Create	CO1

21.	What are the advantages and disadvantages of Group drive(Shaft drive)?	BLT 5	Evaluate	CO1
22.	Give an expression for the losses occurring in a machine	BLT 4	Analyse	CO1
23.	Indicate the importance of power rating & heating of electric drives.	BLT 3	Apply	CO1
24.	Define heating time constant & cooling time constant	BLT 3	Apply	CO1
	PART – B			
1.	Draw the schematic representation and equivalent circuit of a DC machine and derive the expression for induced emf and electromagnetic torque. (13)	BLT 2	Understand	CO1
2.	Bring out the significance of back emf and formulate the voltage and torque equations of a DC drive. (13)	BLT 2	Understand	CO1
3.	Elucidate on the losses found in electrical drive systems. (13)	BLT 1	Remember	CO1
4.	(i)List out the measures to be adopted for energy conservation of electrical drives. (6) (ii)Examine the use of efficient motors for the conservation of electrical drives. (7)	BLT 1	Remember	CO1
5.	Write short notes on (i)Replacement of resistance controllers. (5) (ii)Replacement of eddy current couplings. (4) (iii)Replacement of ward leonard drives. (4)	BLT 1	Remember	CO1
6.	Account on the energy efficient operation of electrical drives. (13)	BLT 4	Analyse	CO1
7.	Derive the transfer function of a separately excited DC motor load converter system. (13)	BLT 4	Analyse	CO1
8.	Discuss the various closed loop configurations which finds application in electrical drives. (13)	BLT 3	Apply	CO1
9.	Describe the various speed control methods available for DC motor. (13)	BLT 2	Understand	CO1
10.	Compare and contrast the responses of P,PI,PID controllers. (13)	BLT 4	Analyse	CO1
11.	Explain Ward leonard drive in detail. (13)	BLT 1	Remember	CO1
12.	Bring out the transfer function of armature-controlled DC motor. (13)	BLT 6	Create	CO1
13.	A 220 V, 500 A, 600 rpm separately excited motor has armature and field resistance of 0.02and 10 ohm respectively. The load torque is given by the expression T_L = 2000–2N, N-m, where N is the speed in rpm. Speeds below the rated are obtained by armature voltage control and depends above the rated are obtained by field control. i)Calculate motor terminal voltage and armature current when the speed is 450 rpm. ii)ii) Calculate field winding voltage and armature current when the speed is 750 rpm. Assume the rated field voltage is the same as the rated armature voltage (13)	BLT 5	Evaluate	CO1

14.	Brief on the comparison of different controlling schemes for speed control of DC motor. (13)	BLT 3	Apply	CO1
15.	Draw the typical temperature rise-time curve and derive the equation for temperature rise in an electric drive.**(13)**	BLT 3	Apply	CO1
16.	Explain the factors governing the selection of motors. **.(13)**	BLT 2	Understand	CO1
17.	Draw the diagram and Derive the transfer function of a self-excited DC motor load converter system. **.(13)**	BLT 1	Remember	CO1
PART – C				
1.	"In pump drives fluid flow control is required"- Elaborate it by explaining the use of variable speed drives for the conservation of energy in electrical drives. (15)	BLT 6	Create	CO1
2.	A 2 pole separately excited dc motor has the ratings of 220 V, 100 A and 750 rpm. Resistance of the armature is 0.1 ohm. The motor has two field coils which are normally connected in parallel. It is used to drive a load whose torque is expressed as T_L=500-0.3N, N-m where N is the motor speed in rpm. Speeds below and above the rated are obtained by armature voltage control and by connecting the two field windings in series respectively. (i)Calculate the motor armature current and speed when the armature voltage is reduced to 110V. (7) (ii)Calculate the motor speed and current when field coils are connected in series. (8)	BLT 5	Evaluate	CO1
3.	A permanent magnet dc motor has the following specifications. Maximum speed = 500 rad/sec Maximum armature current = 2.0 A Voltage constant (Ke) = 0.06 V-s/rad Torque constant (KT) = 0.06 N-m/A Friction torque = 0.012 N-m Armature resistance = 1.2 ohms Armature inductance = 0.020 H Armature inertia = 6.2x10-4 N-m-s^2/rad Armature viscous friction = 1x10^{-4} N-m-s/rad a) Determine the voltage/velocity and voltage/position transfer functions for this motor. (7) b) Determine the voltage/velocity and voltage/position transfer functions for the motor neglecting the electrical time constant. (8)	BLT 5	Evaluate	CO1
4.	A 250 V, shunt motor with armature resistance of 0.6 ohm runs at 600 rpm on full load and takes an armature current 25 A.If resistance of 1.0 ohm is placed in the armature circuit, find the speed at (i)Full load torque. (7) (ii)Half full-load torque. (8)	BLT 6	Create	CO1
5.	Create the flowchart for the computation of DC motor response. and explain in detail about it (15)	BLT 6	Create	CO1

UNIT II - CONTROL OF INDUCTION MOTOR DRIVE
VSI and CSI fed induction motor drives-principles of V/f control-closed loop variable frequency PWM inverter with dynamic braking- static Scherbius drives- power factor considerations– modified

Kramer drives-principle of vector control- implementation-block diagram, Design of closed loop operation of V/f control of Induction motor drive systems.				
PART – A				
Q.No	**Questions**	**BT Level**	**Competence**	**Course Outcome**
1.	Mention the application of AC drives.	BLT 1	Remember	CO2
2.	What are the advantages and disadvantages of AC drives	BLT 1	Remember	CO2
3.	What are the features of variable frequency control ?	BLT 1	Remember	CO2
4.	How is the speed controlled in an induction motor?	BLT 2	Understand	CO2
5.	Sketch the torque speed curves of v/f control.	BLT 5	Evaluate	CO2
6.	Define Voltage Source Inverter.	BLT 1	Remember	CO2
7.	How does the induction motor behave when it operates as a stepped wave inverter?	BLT 2	Understand	CO2
8.	List out the drawbacks of VSI inverter fed drive.	BLT 1	Remember	CO2
9.	What is dynamic braking?	BLT 2	Understand	CO2
10.	Summarize the general features of an induction motor drive operated on a CSI fed inverter.	BLT 2	Understand	CO2
11.	Prepare the various schemes of VSI fed induction motor drives.	BLT 3	Apply	CO2
12.	Generalize the schemes employed for CSI fed induction motor drives.	BLT 3	Apply	CO2
13.	Illustrate the importance of PWM inverter in closed loop operation of an induction motor.	BLT 3	Apply	CO2
14.	Write the different types of braking employed for induction motor.	BLT 4	Analyse	CO2
15.	What is slip power recovery scheme?	BLT 6	Create	CO2
16.	Why the static Scherbius drive has a poor power factor?	BLT 5	Evaluate	CO2
17.	Anlyse the features of static scherbius drive.	BLT 4	Analyse	CO2
18.	Why modified Kramers drive is used?	BLT 4	Analyse	CO2
19.	Examine the principle of operation of vector control of induction motor drive.	BLT 1	Remember	CO2
20.	Draw the block diagram of closed loop control of IM drives.	BLT 6	Create	CO2
21.	What are the possible methods of speed control available by using inverters?	BLT 1	Remember	CO2
22.	Compare static Kramer and scherbius system.	BLT 5	Evaluate	CO2
23.	What is meant by stator frequency control?	BLT 3	Apply	CO2
24.	What are the different means of controlling induction motor?	BLT 4	Analyse	CO2
PART – B				
1.	Account on voltage source inverter fed induction motor drives along with its limitations. (13)	BLT 1	Remember	CO2

2.	Explain CSI fed induction motor drive with its regenerative mode and multiquadrant operation. (13)	BLT 2	Understand	CO2
3.	(i)List out the drawbacks of stepped wave inverter fed drive. (7) (ii)Explain the four quadrant operation of VSI fed induction motor drive. (6)	BLT 1	Remember	CO2
4.	Write in detail about closed loop control of VSI and CSI fed induction motor drives. (13)	BLT 1	Remember	CO2
5.	A three phase star connected, 50Hz, 4pole induction motor has the following parameters in ohms per phase referred to the stator.R_s=R_r'=0.034 and X_s=X_r'=0.18.If the rated slip is 4%, then determine the motor speed for rated torque and f=25Hz.The motor I controlled with a constant V/f ratio. (13)	BLT 5	Evaluate	CO2
6.	Draw the speed torque and speed current characteristics for fixed V/f ratio of an induction motor by explaining the operation of V/f control. (13)	BLT 4	Analyse	CO2
7.	(i)Write notes on dynamic breaking of VSI controlled induction motor drive. (7) (ii)How are induction motor controlled using cycloconverter? (6)	BLT 2	Understand	CO2
8.	With help of block diagram, explain the closed loop operation of slipped control PWM inverter drive with dynamic breaking. (13)	BLT 1	Remember	CO2
9.	(i)Compare VSI and CSI drives. (7) (ii)Brief about modified Kramer drives. (6)	BLT 4	Analyse	CO2
10.	What is slip power recovery scheme and describe Scherbius static drive in detail? (13)	BLT 2	Understand	CO2
11.	(i)List out the drives which operate under low power factor. (4) (ii)Mention the properties of a good power factor. (4) (iii)At 50Hz the synchronous speed and full load speed are 1500 rpm and 1370 rpm respectively. Calculate the approximate value speed for a frequency of 30Hzand 80% full load torque for inverter fed induction motor drive. (5)	BLT 3	Apply	CO2
12.	A 440V,50Hz,970rpm,6pole,Y connected,3phase wound rotor induction motor has the following parameters referred to the stator: R_s=0.1ohm,R_r'=0.08ohm,X_s=0.3ohm,X_r'=0.4ohm. The stator to rotor turns ratio is 2.Motor speed is controlled by static Scherbius drive .Drive is designed for a speed range of 25% below the synchronos speed.Maximum value of firing angle is 165^o.Calculate (i)Transformer turns ratio. (4) (ii)Torque for a speed of 780rpm and $\alpha=140^o$. (4) (iii)Firing angle for half the rated motor torque and speed of 800rpm.DC link inductor has a resisitance of 0.01ohm. (5)	BLT 6	Create	CO2
13.	Implement closed loop control of V/f control employed for induction motor. (13)	BLT 3	Apply	CO2
14.	Develop an algorithm for vector control of induction motor drive. (13)	BLT 4	Analyse	CO2

15.	Explain the different methods of speed control used in three phase induction motors.(13)	BLT 3	Remember	CO2
16.	Explain the Kramer system and Scherbius system.(13)	BLT 2	Understand	CO2
17.	Draw the power circuit arrangement of three phase variable frequency inverter for the speed control of three phase induction motor and explain its working.(13)	BLT 5	Evaluate	CO2
PART – C				
1.	Summarize the various schemes employed for VSI and CSI drives. (15)	BLT 5	Evaluate	CO2
2.	A star connected squirrel cage induction motor has following ratings and parameters: 400V, 50Hz, 4pole, 1370rpm, R_s=2ohm, R_r'=3ohm, X_s=X_r'=3.5ohm,X_m=55ohm.It is controlled by a CSI at a constant flux.Calculate (i)motor torque,speed and stator current for 30Hz and rated slip speed. (7) (ii)Inverter frequency and stator current for rated motor torque and motor speed of 1200rpm. (8)	BLT 5	Evaluate	CO2
3.	A star connected squirrel cage induction motor has following ratings and parameters.400V, 50Hz, 4pole, 1370rpm, R_s=2ohm, R_r'=3ohm, X_s=X_r'=3.5ohm.Motor is controlled by a voltage source at constant V/f ratio. Inverter allows frequency variation from 15 to 50Hz. (i)Obtain a plot between the breakdown torque and frequency. (7) (ii)Calculate starting torque and current of this drive as a ratio of their values when motor is started at rated voltage and frequency. (8)	BLT 6	Create	CO2
4.	Explain the operating principle of vector-controlled induction motor drives. (15)	BLT 6	Create	CO2
5.	Describe the operation of dynamic braking of three phase squirrel cage in duction motor.(15)	BLT 6	Create	CO2

UNIT III - CONTROL OF SYNCHRONOUS MOTOR DRIVES

Open loop VSI fed drive and its characteristics–Self control–Torque control –Torque angle control – Power factor control–Brushless excitation systems—Field oriented control – Design of closed loop operation of Self control of Synchronous motor drive systems.

PART – A

Q.No	Questions	BT Level	Competence	Course Outcome
1.	List out the characteristics features of synchronous motor drive.	BLT 1	Remember	CO3
2.	Write the classifications of SM drive	BLT 2	Understand	CO3
3.	What are the modes of adjustable frequency control employed for IM?	BLT 1	Remember	CO3
4.	Analyse the characteristics of VSI fed SM drive.	BLT 4	Analyse	CO3
5.	When does a synchronous motor is said to be self controlled?	BLT 4	Analyse	CO3
6.	Examine the features of self-synchronous motor drives.	BLT 5	Evaluate	CO3

7.	Prepare the different control strategies available for synchronous motor drives.	BLT 5	Evaluate	CO3
8.	Analyse the reason behind the development of vector control of SM drives.	BLT 4	Analyse	CO3
9.	Write the expression for stator currents and rotor reference frames obtained from vector-controlled SM drives.	BLT 1	Remember	CO3
10.	Investigate the key results obtained from field-oriented control of SM drives.	BLT 3	Apply	CO3
11.	Discuss how the solution for torque angle reference is obtained analytically.	BLT 2	Understand	CO3
12.	What are the additional control strategies available for PMSM drives?	BLT 2	Understand	CO3
13.	Draw the performance characteristics of constant torque angle control.	BLT 6	Create	CO3
14.	Sketch the phasor diagram of constant torque angle control of SM drive.	BLT 6	Create	CO3
15.	Examine on UPF control of SM drive.	BLT 3	Apply	CO3
16.	What are the three possible combinations of VSI fed SM drives.	BLT 3	Apply	CO3
17.	What are brushless excitation systems? List out its benefits.	BLT 1	Remember	CO3
18.	Point out the disadvantages of VSI fed SM drive.	BLT 2	Understand	CO3
19.	Give the advantages and applications of closed loop operation of SM drive.	BLT 1	Remember	CO3
20.	Mention the applications of synchronous motor drives.	BLT 1	Remember	CO3
21	Which machine is said to be self-controlled?	BLT 5	Evaluate	CO3
22	How are the stator and rotor of the synchronous motor supplied?	BLT 4	Analyse	CO3
23	List out the commonly used synchronous motors in industry	BLT 3	Apply	CO3
24	Mention the two modes employed in variable frequency control.	BLT 2	Understand	CO3
	PART – B			
1.	Write a detailed answer on the classification of synchronous motor. (13)	BLT 2	Understand	CO3
2.	Explain the three different combinations which provide variable voltage frequency supply to a synchronous motor. (13)	BLT 2	Understand	CO3
3.	Write notes on (i)Open loop volts/Hertz control. (7) (ii)Control characteristics of open loop volts /Hertz control. (6)	BLT 1	Remember	CO3
4.	Account on the self-control operation of synchronous motor drives with its features. (13)	BLT 2	Understand	CO3
5.	Depict the principle operation of separate and self-control mode of synchronous motor. (13)	BLT 1	Remember	CO3

6.	Analyse the derivation of vector control of synchronous motor. (13)	BLT 4	Analyse	CO3
7.	Compute the constant torque angle control of PMSM drive. (13)	BLT 4	Analyse	CO3
8.	Draw the maximum torque versus speed envelope for the machine considered using a constant torque angle control. The inverter current is restricted to a maximum of 2p.u. and the voltage is limited to 1p.u. (13)	BLT 6	Create	CO3
9.	Derive the torque angle by enforcing unity power factor control. (13)	BLT 3	Apply	CO3
10.	(i)Implement the automatic closed loop adjustment of power factor of synchronous motor. (7) (ii)Draw the mutual flux linkages versus stator current magnitude for the UPF control strategy. (6)	BLT 3	Apply	CO3
11.	With a schematic diagram, explain about the brushless excitation system of SM drives. (13)	BLT 1	Remember	CO3
12.	Generalize the operation of closed loop control of synchronous motor drives. (13)	BLT 5	Evaluate	CO3
13.	What are the different control strategies available for SM drives? (13)	BLT 1	Remember	CO3
14.	Explain the torque-controlled drive system of SM drives. (13)	BLT 4	Analyse	CO3
15	Explain the construction and working of permanent magnet synchronous motor.(13)	BLT 3	Apply	CO3
16	Explain the closed loop control scheme of adjustable speed synchronous motor drive.(13)	BLT 5	Evaluate	CO3
17	Explain variable frequency control of synchronous motor drive in detail.(13)	BLT 1	Remember	CO3
	PART – C			
1.	How does self control operation takes place in a SM drive by employing load commutated thyristor inverter? (15)	BLT 6	Create	CO3
2.	"Field oriented control meet the challenges of oscillating flux and torque responses of SM drive"-Discuss. (15)	BLT 6	Create	CO3
3.	A synchronous motor is controlled by a load commutated inverter which in turn is fed from a line commutated converter. Source voltage is 6.6kV,50Hz,load commutated inverter operates at a constant firing angle α_1 at 120^o and when rectifying α_1 $=0^o$ dc line inductor resistance R_d=0.4ohm.Drive operates in self control mode with a constant V/f ratio. Motor has the details 8MW,3phase ,6600V,6 pole,50Hz,P.F=1,stator connected X_s=2.6 ohm, R_s=0.Determine source side firing angle for the Motor operation at the rated and 500rpm, what will be the power developed by motor. (15)	BLT 5	Evaluate	CO3

4.	A synchronous motor is controlled by a load commutated inverter which in turn is fed from a line commutated converter. Source voltage is 6.6kV,50Hz,load commutated inverter operates at a constant firing angle α_1 at 120^o and when rectifying α_1 $=0^o$ dc line inductor resistance R_d=0.4ohm.Drive operates in self control mode with a constant V/f ratio. Motor has the details 8MW,3phase ,6600V,6 pole,50Hz,P.F=1,stator connected X_s=2.6 ohm, R_s=0.Determine source side firing angle for Regenerative breaking operation at 750rpm and rated motor current also determine power supplied to the source. (15)	BLT 5	Evaluate	CO3
5.	Explain the Closed Loop control operation of synchronous motor drives.(15)	BLT 5	Evaluate	CO3

UNIT IV - CONTROL OF SRM AND BLDC MOTOR DRIVES

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine -Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlled Brushless dc motor drive.

PART – A

Q.No	Questions	BT Level	Competence	Course Outcome
1.	Define output equation of SRM	BLT 1	Remember	CO4
2.	Sketch the graph of flux linkage Vs Stator current of SRM	BLT 6	Create	CO4
3.	Mention the factors involved in selection of main dimensions.	BLT 1	Remember	CO4
4.	Explain about thermal considerations of SRM	BLT 4	Analyse	CO4
5.	Write the expression for Rise time T_r	BLT 2	Understand	CO4
6.	How do you verify the design of SRM?	BLT 4	Analyse	CO4
7.	What are the primary selection criteria for stator and rotor pole arcs?	BLT 1	Remember	CO4
8.	How are torque distributed in torque controlled SRM?	BLT 2	Understand	CO4
9.	List out the types of SRM.	BLT 1	Remember	CO4
10.	Where does an SRM finds its application?	BLT 3	Apply	CO4
11.	Point out the expression for transfer function of current and speed controller of BLDC machine	BLT 3	Apply	CO4
12.	Illustrate on the speed feedback of BLDC machine	BLT 3	Apply	CO4
13.	Generalize few applications of BLDC machine	BLT 6	Create	CO4
14.	List out the types of Brushless DC motors	BLT 1	Remember	CO4

15.	What is the principle behind the operation of BLDC motors?	BLT 1	Remember	CO4
16.	Examine the usage of MOSFET devices in sensorless mode of operation	BLT 4	Analyse	CO4
17.	Mention any four methods to estimate the commutation signals	BLT 5	Evaluate	CO4
18.	Prepare the merits and demerits of Brushless DC machines	BLT 5	Evaluate	CO4
19.	Distinguish Sinusoidal and Trapezoidal BLDC machines	BLT 2	Understand	CO4
20.	Write the difference between SRM and BLDC machine	BLT 2	Understand	CO4
21.	What is Switched reluctance motor drives?	BLT 5	Evaluate	CO4
22.	State modes of operation of Switched reluctance motor drives	BLT 2	Understand	CO4
23.	Define voltage pulse width modulation control.	BLT 4	Analyse	CO4
24.	Point out the different power controllers used for the control of switched reluctance motor	BLT 3	Apply	CO4
	PART – B			
1.	Explain the construction and working principle of SRM. 13)	BLT 1	Remember	CO4
2.	Write in detail about 4-phase SRM drive with a neat diagram. (13)	BLT 1	Remember	CO4
3.	Derive the output equation of SRM and draw the necessary graphs. (13)	BLT 3	Apply	CO4
4.	(i)Mention the factors in which the number of phases is chosen for SRM. (7) (ii)How do you select the number of poles for SRM? (6)	BLT 4	Analyse	CO4
5.	Analyze on torque control of SRM and methods to control it. (13)	BLT 3	Apply	CO4
6.	(i)Derive the voltage and torque equation of SRM. (7) (ii)Derive the small signal model of SRM. (6)	BLT 4	Analyse	CO4
7.	Design the current controller for SRM. (13)	BLT 6	Create	CO4
8.	(i)Write a note on flux controllers of SRM. (7) (ii)Mention the design factors of a SRM drive. (6)	BLT 2	Understand	CO4
9.	Write the constructional details and working principle of BLDC machine. (13)	BLT 1	Remember	CO4
10.	Examine the current sensing method of PMBLDC drive. 13)	BLT 1	Remember	CO4
11.	How will you achieve position estimation through sensor less control of PMBLDC drive? (13)	BLT 2	Understand	CO4
12.	Differentiate sinusoidal and trapezoidal type brushless DC motor. (13)	BLT 5	Evaluate	CO4
13.	Elucidate brushless DC motor drive fed from current regulated VSI. (13)	BLT 5	Evaluate	CO4

14.	Investigate on the current controlled operation of BLDC drive. (13)	BLT 2	Understand	CO4
15.	Explain the Switched reluctance motor drives with modes of operation and closed loop speed control.(13)	BLT 2	Understand	CO4
16.	Write a note on power controllers used for BLDC motor and explain the each blocks associated in it.(13)	BLT 4	Analyse	CO4
17.	(i)Explain the torque-speed characteristics of switched reluctance motors (7) (ii)Derive the expressions for voltage and torque of switched reluctance machines. (6)	BLT 3	Apply	CO4
PART – C				
1.	Design a low cost one quadrant SRM analog controller with a minimum number of parts and discuss the scheme and implementation details of 6/4 SRM . (15)	BLT 5	Evaluate	CO4
2.	List out the special applications of BLDC motor in detail. (15)	BLT 6	Create	CO4
3.	Explain the sensor less operation of BLDC drive. (15)	BLT 6	Create	CO4
4.	Validate the design technique using the linearized model, is considering a 5-Hp SRM for the current and speed controller designs. The specifications of the 5Hp SRM drive are listed below. (15) **Motor and System Parameters** Command signal levels: ±10 V Dc link voltage: 400 V Max. current: 15 A PWM chopping frequency: 8 kHz Phase resistance: 0.931 Ω Power: 5 hp Rated current: 10 A (1 p.u.) Rated speed: 2500 rpm Rotor friction constant: 0.001 N · m/rad/sec Rotor inertia: 0.006 kg–m^2 Speed feedback gain: 0.0383 V/rad/sec Speed feedback time constant: 0.1 sec	BLT 5	Evaluate	CO4
5.	Explain the current controlled BLDC motor drive with a suitable schematic diagram.(15)	BLT 6	Create	CO4
UNIT V - DIGITAL CONTROL OF DC DRIVE				
Phase Locked Loop and micro-computer control of DC drives–Program flow chart for constant constant torque and constant horse power operations Speed detection and current sensing circuits and feedback elements.				
PART – A				
Q.No	**Questions**	**BT Level**	**Competence**	**Course Outcome**

1.	What is PLL? Where it is used?	BLT 1	Remember	CO5
2.	How PLL is used to control the speed of DC drive?	BLT 2	Understand	CO5
3.	Draw the basic block diagram of PLL control of DC drive.	BLT 6	Create	CO5
4.	Mention the advantages of PLL.	BLT 1	Remember	CO5
5.	Define microcomputer.	BLT 1	Remember	CO5
6.	List the applications of microcomputer in electrical drives.	BLT 3	Apply	CO5
7.	Generalize the advantages of microcomputer.	BLT 5	Evaluate	CO5
8.	Why speed detection is necessary?	BLT 2	Understand	CO5
9.	Analyse the different controllers employed for industrial control.	BLT 4	Analyse	CO5
10.	Define torque in connection with Dc motor.	BLT 1	Remember	CO5
11.	Illustrate the significance of horsepower.	BLT 3	Apply	CO5
12.	Examine the principle of operation of PLL.	BLT 5	Evaluate	CO5
13.	Interpret the application of PLL in communication systems.	BLT 2	Understand	CO5
14.	Sketch the block diagram of DC motor with feedback element.	BLT 6	Create	CO5
15.	List any four applications of PLL in DC drives.	BLT 1	Remember	CO5
16.	List any four applications of microcomputer used in DC drives.	BLT 1	Remember	CO5
17.	Difference between PLL and microcomputer.	BLT 2	Understand	CO5
18.	Why digital control is necessary?	BLT 3	Apply	CO5
19.	What are the basic blocks seen in speed control of DC motor using PLL?	BLT 4	Analyse	CO5
20.	How voltage controlled oscillator is related to PLL-Justify.	BLT 2	Remember	CO5
21.	Highlight the factors to be considered for converter selection	BLT 4	Analyse	CO5
22.	How current and speed controllers are implemented in drives?	BLT 5	Evaluate	CO5
23.	What are the advantages of closed loop speed control drives?	BLT 3	Apply	CO5
24.	What is the role of current controller in the closed loop control of DC drives?	BLT 2	Remember	CO5
PART – B				
1.	Discuss the operation of PLL based DC drive with a block diagram. (13)	BLT 1	Remember	CO5

2.	What are the functions of microcomputer in power electronic systems? (13)	BLT 2	Understand	CO5
3.	Account on microcomputer control of DC drives. (13)	BLT 1	Remember	CO5
4.	Design a microcomputer based DC motor controlled by thyristor using PIOD controller system. (13)	BLT 3	Apply	CO5
5.	Draw the control system block diagram of a DC motor and explain its microprocessor control. 13)	BLT 2	Understand	CO5
6.	Examine phase locked loop technique to control the speed of DC motor. 13)	BLT 4	Analyse	CO5
7.	What is the principle of phase locked loop control of dc drives? Also list the advantages of phase locked loop control of dc drives. (13)	BLT 1	Remember	CO5
8.	Draw the block diagram and explain the operation of a phase locked loop control system. (13)	BLT 4	Analyse	CO5
9.	(i) Explain the principle of microcomputer control of dc drives. (6) (ii)List the advantages of microcomputer control of dc drives. (7)	BLT 1	Remember	CO5
10.	Draw and explain the block schematic of a 4-quadrant microcomputer-controlled dc drive system. Also draw and explain the suitable flow chart for the same scheme. (13)	BLT 6	Create	CO5
11.	How is speed detection achieved using digital DC drives? 13)	BLT 3	Apply	CO5
12.	Analyze and interpret on current sensing circuits of DC drives. (13)	BLT 4	Analyse	CO5
13.	Write a note on DC motor control sensor feedback circuits.(13)	BLT 2	Understand	CO5
14.	Illustrate how PLL, microcomputer proved to be successful for digital control of drives. (13)	BLT 5	Evaluate	CO5
15.	Using suitable block diagram explain the following control (i)Current limit control (5) (ii)Closed loop torque control (4) (iii)Closed loop speed control. (4)	BLT 5	Evaluate	CO5
16.	Describe the current controller design using (i)P controller (6) (ii)PI controller for a separately excited dc motor drive systems. (7)	BLT 3	Apply	CO5
17.	List the factors involved in converter selection and equations involved in controller characteristics. (13)	BLT 2	Understand	CO5
PART – C				
1.	Design a microprocessor-based motor controller. (15)	BLT 5	Evaluate	CO5
2.	Design a PLL based speed controller for DC motor. (15)	BLT 5	Evaluate	CO5

3.	Generalize on constant torque operation of C DC drives. (15)	BLT 6	Create	CO5
4.	What are the new trends in digital control of DC drive? (15)	BLT 6	Create	CO5
5.	Design a current controller for small capacity constant speed drive (15)	BLT 6	Create	CO5

Course Outcomes:

Cos	**Course Outcome**
CO1	Ability to understand the DC drive control.
CO2	Ability to study and analyze the Induction motor drive control.
CO3	Ability to study and understand the Synchronous motor drive control.
CO4	Ability study and analyze the SRM and BLDC motor drive control.
CO5	Ability to analyze and design the Digital control for drives.