Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EE308

Course Name: ELECTRIC DRIVES (EE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1		Draw the block diagram of a closed loop speed control of an electric drive.	(5)
2		Derive the speed torque characteristics of DC separately excited motor. Draw its speed torque characteristics for variable armature resistance.	(5)
3		Draw the circuit diagram of a class-C chopper fed DC motor. Draw its V/I characteristics.	(5)
4		Draw and explain the speed torque characteristics of a variable stator voltage controlled induction motor. Why stator voltage control is not suitable for speed control of induction motor with constant load torque.	(5)
5		What are the different methods for obtaining variable output voltage from an inverter? Explain.	(5)
6		What is field oriented control of induction motor? Why it is superior to other types of speed control?	(5)
7		Explain power and torque capability curves of a synchronous motor drive. In variable frequency control of synchronous motor drive, why V/f ratio is maintained constant upto base speed and voltage constant above base speed.	(5)
8		Draw the bock diagram of microprocessor based control of permanent magnet synchronous motor drive	(5)

PART B

Answer any two full questions, each carries10 marks.

9	a)	Differentiate between passive and active load torques. Give examples of each.	(3)
	b)	A motor when operating in quadrant I and II has the characteristic T = 400 – 0.4N Nm, where N is the speed in rpm. The load which is coupled to the motor is an active load with the characteristic, $T_l = \pm 200$ Nm. Calculate the motor speeds for motoring and braking operation in the forward direction. When the drive is operating in quadrant III and IV, motor has the characteristic, T = - 400 - 0.4N Nm. What will be the equilibrium speed in quadrant III?	(7)
10	a)	State and explain how armature current and speed of a dc separately excited motor will be affected by halving armature voltage and field current with load torque remaining constant.	(3)
	b)	Explain the speed control of separately excited DC motor using combined armature voltage and flux control method. Draw and explain the torque and power capability curves.	(7)
11	a)	Draw and explain the speed torque curves of a fan load and traction load	(4)

b) A 220 V, 1500 rpm, 50 A separately excited motor with armature resistance of 0.5 Ω is fed from a three-phase fully controlled rectifier. Available ac source has a line voltage of 440 V, 50 Hz. A star-delta connected transformer is used to feed the armature so that motor terminal voltage equals rated voltage when the converter firing angle is zero. (6)

Determine the value of firing angle when: (a) motor is running at 1200 rpm and rated torque and (b) when motor is running at -800 rpm and twice the rated torque.

PART C

Answer any two full questions, each carries10 marks.

12 a) What are the different types of braking in DC motors? Why plugging is not popular. How the dynamic braking can be implemented by using a chopper (5)

b) A 220 V, 900 rpm, 100 A separately excited DC motor has an armature resistance of 0.05 Ohm. It is braked by plugging from an initial speed of 1000 rpm. Calculate (i) Resistance to be placed in the armature circuit to limit braking current to 1.5 times the full load torque. (ii) Braking torque and (iii) Torque when the speed has fallen to zero. (5)

13 A separately excited DC motor fed from a converter can be worked as generator when the firing angle is increased towards 90^0 and by reversing the armature terminal mechanically. Draw the circuit diagram. Can you realize the same by using a dual converter and without using a mechanical switch? Draw the circuit diagram for the implementation and explain its working. (10)

14 What is slip power recovery scheme? Describe static Scherbius drive and show that the slip at which it operates is given by $S = -(a_T/a)\cos\alpha$, where 'a' and 'a_T' pertain to per phase turns ratio for induction motor and transformer respectively. Why it is always suggested to use a transformer in line side converter for static Scherbius drive? (10)

PART D

Answer any two full questions, each carries 10 marks.

15 a) When a synchronous motor is operating in true synchronous mode, frequency must be varied in steps. Why? (5)

b) Why square wave inverter fed induction motor drives are not popular? (5)

16 a) Explain the frame transformation from three phase to synchronous reference frame. What is its significance in induction motor drive? (5)

b) Explain the difference between the VSI fed induction motor drive and CSI fed induction motor drive. (5)

17 A 5 MW, 3 phase, 11 kV, Y connected , 6 pole, 50 Hz, 0,9 leading power factor synchronous motor has Xs = 9 Ω and Rs = 0 Ω. Rated field current is 50 A. Machine is controlled by variable frequency control at constant V/f ratio upto the base speed and at constant voltage, above rated speed. Determine (i) Torque and field current for the rated armature current, 750 rpm and 0.8 leading power factor and (ii) Armature current and power factor for half the rated motor torque, 1500 rpm and rated field current. (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: EE308

Course Name: Electric Drives

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries5 marks. Marks

1 What is an Electric Drive? Explain the function of each blocks with the help of a neat block diagram. (5)

2 Explain the armature voltage control and field weakening mode control of DC separately excited motor drive system. (5)

3 With a chopper circuit and waveforms explain the regenerative braking of a DC motor drive. (5)

4 Explain the speed control method of induction motor with stator voltage and also state the disadvantages of this method. (5)

5 Compare CSI fed IM drive with VSI fed IM drive (5)

6 Explain the Park's transformation. (5)

7 With a block diagram explain the variable frequency control of SM drive in self-control mode. (5)

8 Explain the V/F control characteristics in torque-speed plane of a SM drive (5)

PART B

Answer any two full questions, each carries10 marks.

9 a) What are the different components of a load torque? Explain each component in detail. (5)

b) Derive the mathematical condition to obtain the steady state stability of equilibrium point. (5)

10 With a neat sketch, explain the motoring and braking operation of three phase fully controlled rectifier control of separately excited DC motor. (10)

11 A 200 V, 875 rpm, 150 A separately excited dc motor has an armature resistance of 0.06Ω. It is fed from a single phase fully controlled rectifier with an ac voltage of 220 V,50Hz. Assuming continuous conduction, calculate (10)

(i) Firing angle for rated motor torque and 750 rpm

(ii) Firing angle for rated motor torque and -500 rpm

(iii) Motor speed for firing angle $\alpha=160^{o}$ and rated torque

PART C

Answer any two full questions, each carries10 marks.

12 Explain the operation of four quadrant chopper fed separately excited DC motor drive with necessary diagrams. (10)

13 Explain the closed loop static rotor resistance control method for the speed control of a slip ring induction motor. What are the disadvantages of this method? (10)

14 Explain the static Kramer scheme for the speed control of a slip ring IM. Explain the firing angle control of thyristor bridge with constant motor field. (10)

PART D

Answer any two full questions, each carries 10 marks.

15 a) With a neat circuit and waveform explain a thyristor based CSI fed IM drive. (5)

b) Explain how CSI fed IM drive can be used for regenerative braking and multiquadrant operation. (5)

16 a) Explain in detail about the classification of PM synchronous motor? (5)

b) Explain the field oriented control (FOC) of an AC motor with a block diagram (5)

17 With a block diagram explain the Micro controller based PMSM drive. (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: EE308

Course Name: Electric Drives

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries5 marks. Marks

1		What are the functions of power modulator in an electric drive?	(5)
2		A single phase fully controlled converter is used to control a DC separately excited motor of 200V, 900rpm,100A with armature resistance of 0.06Ω. AC source voltage is 210V, 50Hz. Determine firing angle for rated motor torque and 700rpm.	(5)
3		With detailed analysis explain how chopper helps to control a separately excited DC motor drive in motoring mode	(5)
4		How speed of the induction motor can be controlled using stator frequency control.	(5)
5		Differentiate VSI fed induction motor drive with CSI fed induction motor drive	(5)
6		Explain field orientation control of induction motors.	(5)
7		Explain in detail about the different types of PM synchronous motor?	(5)
8		Explain how speed control can be done in a set of multiple synchronous motors	(5)

PART B

Answer any two full questions, each carries10 marks.

9	a)	Illustrate four quadrant operation of drive considering hoist as an example	(6)
	b)	Draw the Torque – Speed characteristics of the following loads (i) Centrifugal pump (ii) Traction load	(4)
10	a)	With the help of block diagram explain in detail about the closed loop speed control of DC motor	(5)
	b)	Draw the armature voltage and armature current waveforms of 3 phase semi-converter-fed DC motor drive for $\alpha=60^{o}$.	(5)
11	a)	Give one application of dual converter for speed control of DC motor.	(5)
	b)	A 220V, 1500rpm, 50A separately exited motor with armature resistance of 0.5Ω is fed from a circulating current mode dual converter with a source voltage	(5)

of 165V (line). Determine converter firing angle for the following operating points.

(i) Motoring operation at rated motor torque and 1000rpm

(ii) Braking operation at rated motor torque and 1000rpm.

PART C

Answer any two full questions, each carries10 marks.

12 List different types of cycloconverters. Explain single phase step down cycloconverter with circuit diagram and waveforms. (10)

13 a) Describe dynamic braking operation of chopper fed separately excited DC motor drive. Draw speed-torque curves in motoring and braking mode (5)

b) Describe speed control of induction motors using three phase ac voltage controller. (5)

14 What are the slip power recovery control schemes of induction motors. Explain how static Kramer drive is used to control the speed of induction motors. (10)

PART D

Answer any two full questions, each carries 10 marks.

15 Discuss the operation of CSI fed induction motor drive. Explain its regenerative braking and multi-quadrant operation. (10)

16 a) Give the concept of basic transformation in reference frame theory applied to induction motors. (5)

b) Explain in detail about self-control mode of operation of synchronous motor (5)

17 With block diagram, explain the operation of microcontroller based permanent magnet synchronous motor drives. (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth semester B.Tech degree examinations (S), September 2020

Course Code: EE308

Course Name: Electric Drives

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1		How are the load torques classified? Give an example for each type of load torque.	(5)
2		Derive the speed-torque (ω-T) equation of a separately excited DC motor. Plot the ω-T characteristics of the motor.	(5)
3		Compare and contrast Class-C and Class-D choppers.	(5)
4		List and explain the merits of constant V/f control of Induction Motor.	(5)
5		Explain the differences between the switching devices used for Voltage Source Inverter and Current Source Inverter.	(5)
6		Write the transformation matrix which converts phasor in three-phase system to an orthogonal, stationary reference frame.	(5)
7		List down the salient features of "True Synchronous Mode" of operation of a synchronous motor.	(5)
8		Draw a neat labelled block schematic diagram of microcontroller based Permanent Magnet Synchronous Motor (PMSM) drive.	(5)

PART B

Answer any two full questions, each carries 10 marks.

9	a)	A motor-drive system has the following specifications: Polar moment of inertia of motor-load system referred to the shaft, J = 5 kg-m^2 Motor torque $T_m = 50 – 0.1N$, and Load Torque, $T_L = 0.025N$ where, "N" is the speed of the motor in rpm. Calculate the start-up time of the drive.	(5)
	b)	Draw and explain the closed loop speed control scheme widely used in electric drives.	(5)

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10 a) With neat circuit diagrams and waveforms explain the operation of single phase fully controlled rectifier fed separately excited dc motor. (5)

b) A 220 V, 1500 rpm, 10 A separately excited motor has an armature resistance of 2Ω. The motor is driven from a single-phase fully-controlled rectifier operating in continuous conduction mode. The input is rated at 230V, 50Hz. Calculate firing angle of the controlled rectifier if the motor runs at 600 rpm developing rated torque. (5)

11 a) Explain the four-quadrant operation of a motor driving a passive load torque. (5)

b) A 200 V, 20 A, 800 rpm, separately excited DC motor has an armature resistance of 0.5□. The motor drives a load whose torque-speed equation is $T_L = 5 + 0.05N$, where "N" is the speed of the motor in rpm. The motor is driven from a single-phase fully controlled rectifier, operating in continuous conduction mode, from an ac source rated at 230V, 50Hz. Find the firing angle of the converter if the motor is operating at 500 rpm. (5)

PART C

Answer any two full questions, each carries 10 marks

12 a) With the help of a neat labelled circuit diagram, explain the operation of any one cycloconverter based drive system. (5)

b) Derive the condition for maximum torque of an induction motor. Also derive the value of the maximum torque the machine can develop. (5)

13 a) A 230 V, 90 A, 500 rpm separately excited DC motor has an armature resistance of 0.15 Ω. The motor is controlled by a class-C chopper operating with a source voltage of 230 V and a frequency of 400 Hz. Calculate the motor speed for a braking operation at a duty ratio of 0.4 and half the rated torque. (5)

b) With necessary diagram, briefly explain the rotor-resistance controlled drive. Draw the Torque – Speed (T-ω) characteristics for different resistances. (5)

14 a) A 230 V, 200 A, 960 rpm separately excited DC motor has an armature resistance of 0.02 Ω. The motor is fed from a class-C chopper. The DC input voltage to the chopper is 220 V. Braking method employed is dynamic braking using brake-chopper. The value of the braking resistor used is 2.5Ω. Find the duty ratio of the brake-chopper if the speed is 700 rpm and braking torque is twice the rated torque of the motor. (5)

b) With the aid of a neat labelled circuit diagram, explain the operation of any one slip-power-recovery scheme induction motor drive. (5)

PART D

Answer any two full questions, each carries 10 marks

15 a) With the help of a neat, labelled circuit diagram, explain the concept of current-source-inverter (CSI) fed induction motor drive. (5)

b) A 500kW, three-phase, 3.3kV, 4-pole, 0.8 *pf* lag, star connected synchronous motor has following parameters: (5)

Synchronous reactance $X_s = 15\Omega$; Rotor Resistance $R_s = 0\Omega$.

Calculate the per phase excitation voltage in polar form.

16 a) With the help of a neat, labelled circuit diagram, explain the concept of current-source-inverter (CSI) fed induction motor drive. (5)

b) Explain the reason which facilitates the use of thyristor switches for load commutated inverters to drive synchronous motors. What is the condition to be satisfied for the thyristor based load commutated inverter to work? (5)

17 a) Explain Park's Transformation with reference to space vectors. Write down the transformation matrices. (5)

b) With the help of a neat labelled diagram, explain the working principle, salient features and the advantages of Self Controlled Mode of operation of a Synchronous motor. (5)

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