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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