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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S4 (PT) (S, FE) Examination January 2024 (2015 Scheme)

Course Code: EE308

Course Name: Electric Drives

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries5 marks. Marks

1	The steady state stability of a drive depends on the relative characteristics of the motor and load, not just on motor characteristics. Justify this statement.	(5)
2	Explain constant torque and constant power operation of a separately excited DC Motor with relevant graphs.	(5)
3	Explain the dynamic braking in separately excited DC Motor. Derive the equation for the effective value of braking resistance.	(5)
4	Explain stator-frequency control as speed control method of induction motor. Draw the speed torque characteristics for various stator frequencies.	(5)
5	Compare and contrast Voltage Source Inverter fed Induction motor drive and Current Source Inverter fed Induction motor drive.	(5)
6	What is field oriented control? List the advantages of field oriented control.	(5)
7	List down the merits of a Permanent Magnet Synchronous Motor over conventional Synchronous Motor.	(5)
8	Draw the block diagram of Microcontroller based PMSM drives	(5)

PART B

Answer any two full questions, each carries10 marks.

9	a)	A drive has following parameters: J=10 kg-m^2 , Motor Torque, T_m = 100 - 0.1N, N-m, passive load torque T_L = 0.05N, N-m, where N is the speed in rpm. Initially the drive is operating in steady-state. Now speed has to be reversed for which, the motor characteristics is changed to T_m = -100 - 0.1N, N-m. Calculate the time of reversal.	(5)
	b)	A motor operating with suitable control system develops a motor-torque given by	(5)

$T_m = 10\omega + 5$, where ω is the angular velocity expressed in in rad/s. The load torque is given by $T_L = 0.1\omega^2 + 8$. Find the equilibrium speeds of the machine. Will the drive be stable at the calculated operating points ?

10 a) Explain four-quadrant operation of a motor driving an elevator (hoist) load. (5)

b) A 220 V, 1500 rpm, 10 A separately excited dc motor has an armature resistance of $R_a = 2\ \Omega$. It is fed from a single phase fully-controlled rectifier with an AC source voltage of 230V, 50 Hz. Conduction can be assumed to be continuous. Calculate the firing angle for half the rated motor torque and 500 rpm. (5)

11 a) Derive the condition for steady-state stability of a Motor-Load system. (5)

b) A 200 V, 875 rpm, 15 A separately excited dc motor has an armature resistance of $R_a = 2\ \Omega$. It is fed from a single phase fully controlled rectifier with an AC source voltage of 220V, 50 Hz. Conduction can be assumed to be continuous. Calculate the Motor speed for firing angle of 60° and rated torque. (5)

PART C

Answer any two full questions, each carries10 marks.

12 a) A 230V, 960 rpm, 200 A separately excited DC Motor has an armature resistance of 0.02 Ω. The motor is fed from a chopper which provides both motoring and braking operation. The DC input voltage to the chopper is rated at 250V. Assume continuous conduction. Calculate the duty ratio of the chopper for braking operation at rated torque and motor speed of 350 rpm. (5)

b) What is slip power recovery and how it can be achieved? List the merits and demerits of slip-power recovery drives. (5)

13 a) A 230V, 960 rpm, 200 A separately excited DC Motor has an armature resistance of 0.02 Ω. The motor is fed from a chopper which provides both motoring and braking operation. The DC input voltage to the chopper is rated at 250V. Assume continuous conduction. Assume continuous conduction. Calculate the duty ratio of the chopper for motoring operation at rated torque and motor speed of 650 rpm (5)

b) Explain speed control of an Induction motor using stator terminal voltage control (5)

method. What are the drawbacks? Which type of loads are suited to be driven using this method?

14 a) With the help of a neat circuit diagram, explain the working of any cyclo-converter fed motor drive. (5)

b) Explain the merits of static rotor-resistance controlled induction motor drive. (5)

PART D

Answer any two full questions, each carries 10 marks.

15 a) Dead-time (blanking time) is required for the switches of each inverter leg in a voltage-source inverter. However, there is no need of dead-time in switches of each leg of current-source-inverter. Justify the statement. (5)

b) Explain the working principle of "Self-Controlled" Mode of operation of a synchronous motor. List down the salient features of this mode. (5)

16 a) Explain Park's and Clarke's Transformation with reference to space-vectors. (5)

b) Explain the working principle of "True-Synchronous" Mode of operation of a synchronous motor. List down the salient features of this mode. (5)

17 a) Compare and contrast the switching devices used in Voltage Source Converters and Current Source Converters. (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)

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