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)

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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