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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree (S, FE) Examination May 2023 (2019 Scheme)

Course Code: EET413

Course Name: ELECTRIC DRIVES

Max. Marks: 100 **Duration: 3 Hours**

Graph sheets to be provided if necessary.

PART A

Answer all questions, each carries 3 marks. Marks

1	What are the advantages of an electric drive?	(3)
2	Draw the Torque – Speed characteristics of the following loads (i) Centrifugal pump (ii) Paper mills	(3)
3	Which are the methods of speed control suitable for getting speeds higher than base speed and lower than base speed, in a dc motor? Explain.	(3)
4	A 220V,1500 rpm, 50A separately excited motor with armature resistance of 0.5Ω is fed from a 3-phase semi controlled rectifier. The available ac source has a line voltage of 440V, 50 Hz. Determine the value of firing angle, when the motor is running at 1200 rpm and rated torque.	(3)
5	With detailed analysis, explain how the chopper helps to control a separately excited DC motor drive in motoring mode.	(3)
6	Using a block diagram, explain the closed loop speed control of DC motors.	(3)
7	A 3-phase, 460V, 60Hz, 4-pole, 1750rpm, star-connected induction motor has the following parameters: Rs=0.66Ω, Rr'=0.38Ω, Xs=1.14Ω, Xr'=1.71Ω. The motor is fed from a voltage source inverter with a constant voltage-to-frequency ratio. Calculate maximum torque T_{max} and the corresponding speed for 30Hz frequency.	(3)
8	What are the advantages of static rotor resistance control over conventional rotor resistance control?	(3)
9	When a synchronous motor is operating in true synchronous mode, frequency must be varied in steps. Why?	(3)
10	Explain Park transformation with necessary equations.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	a)	Explain the four quadrant operation of a motor driving a hoist load.	(8)
	b)	Derive the dynamic torque equation of a motor load system and hence explain the different components of load torque.	(6)

OR

12	a)	Derive the mathematical condition to obtain the steady state stability of an electric drive.	(6)

b) A motor is driving two loads one coupled directly to its shaft and the other through a transmission system converting rotational motion to linear motion. Let the mass, velocity and force of load with translational motion be M_1, v_1 and F_1 respectively and the moment of inertia and load torque of directly coupled load be J_0 and T_{l0} respectively. Obtain the expression for equivalent moment of inertia and equivalent torque referred to motor shaft. (8)

Module II

13 a) A 230V, 1500 rpm, 20A separately excited DC motor has an armature resistance of 0.6Ω. It is fed from a 3-phase full converter connected to an ac source voltage of 400V, 50Hz through a delta–star transformer. The motor terminal voltage is rated when the converter firing angle is zero. Determine the thyristor firing angle for the converter when 1) the motor is running at rated torque and 1000 rpm and 2) the motor is running at - 900 rpm and half the rated torque. (8)

b) Explain the working of a single-phase semi-converter fed separately excited DC drive in Continuous conduction mode. (6)

OR

14 a) Explain the working of a Dual converter fed separately excited DC motor in circulating current mode. (8)

b) A 200V, 875rpm, 150A separately excited DC motor has an armature resistance of 0.06Ω. It is fed from a 1-phase fully-controlled rectifier with an ac source voltage of 220V, 50Hz. Assuming continuous conduction, calculate i) firing angle for rated motor torque and -500rpm ii) motor speed for α=160° and rated torque. (6)

Module III

15 a) A 230V, 960 rpm, 200A 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 operations. The source has a voltage of 230V. Assuming continuous conduction, (6)
i)Calculate duty ratio of chopper for motoring operation at rated torque and 350 rpm
ii)Calculate duty ratio of chopper for braking operation at rated torque and 350 rpm

b) Explain the operation of four quadrant chopper fed DC drives. (8)

OR

16 a) Explain the chopper control of DC series motor. (7)

b) With a circuit diagram explain the working of a class C chopper showing the two quadrants of operation. (7)

Module IV

17 a) What is the principle of slip power recovery schemes used in Induction motors? Explain the static slip power recovery scheme using Scherbius drive for speed control of Slip Ring Induction motor. (8)

b) A 3-phase 400V, 6-pole 50Hz Δ connected wound rotor induction motor has rotor resistance of 0.2Ω and leakage reactance of 1Ω/phase referred to stator. When driving a fan load, it runs at full load at 4% slip. What resistance must be inserted in rotor circuit (6) to obtain a speed of 850rpm? Neglect stator impedance and magnetizing branch. Stator to rotor turns ratio is 2.2.

OR

18	a)	A 3-phase 400V, 50Hz, 4-pole, 1370rpm Δ-connected induction motor has the following parameters Rs=2Ω, Rr'=5Ω, Xs=Xr'=5Ω, Xm=80Ω. Motor speed is controlled by stator voltage control. While driving a fan load, it runs at rated speed at rated voltage. Calculate motor terminal voltage, current and torque at 1200 rpm.	(7)
	b)	Using a block diagram explain the closed loop speed control of Induction motor using Static Rotor Resistance control	(7)

Module V

19	a)	Explain the working of self-controlled synchronous motor drive employing load-commutated thyristor inverter.	(8)
	b)	Explain the principle and advantages of Field Oriented Control	(6)

OR

20	a)	Explain the true synchronous mode of operation of Synchronous Motor Drives	(6)
	b)	Using a block diagram explain the Direct Vector control of Induction motor drives	(8)

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