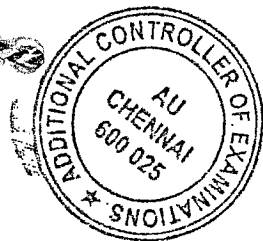


Dr. K. Kalha



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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)
END SEMESTER EXAMINATIONS – DECEMBER 2024
B.E (Full Time) - ELECTRICAL AND ELECTRONICS ENGINEERING
Semester VII
EE5701 – ELECTRICAL DRIVES
(Regulation 2019)

Max. Marks: 100

Time: 3hrs

CO 1	Understand the basic requirements of motor selection for different load profiles.
CO 2	Analyse the steady state behavior and stability aspects of drive systems.
CO 3	Simulate the DC drive using converter and chopper control.
CO 4	Simulate the AC drive
CO 5	Design the controller for electrical drives

BL – Bloom's Taxonomy Levels
 (L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analyzing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	What is the dynamic equation of motor load system?	2	CO1	L1
2	Draw the torque and temperature rise characteristics w.r.t time for continuous duty and short time duty	2	CO1	L1
3	Explain how regenerative braking is achieved using chopper circuit for dc drive.	2	CO3	L2
4	For a semi converter fed separately excited dc motor draw the load voltage and load current waveform for discontinuous current conduction.	2	CO3	L2
5	Draw the rotor structures of permanent magnet synchronous motor for inset, interior and surface mounted types.	2	CO3	L1
6	What is the advantage of leading powerfactor operation for synchronous motor drive.	2	CO4	L3
7	Explain why V/f must be maintained constant in variable frequency operation of drive for constant torque mode of operation.	2	CO4	L3
8	Explain derating of the induction motor using stator voltage control	2	CO4	L1
9	Explain what happens when closed loop control is implemented without current feedback	2	CO5	L4
10	Explain how current can be sensed using Hall sensor	2	CO5	L3

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11 (a)	Derive the overload capacity for short time duty of a motor	6	CO2	L3
(i)				
(ii)	Explain the different methods of speed control of DC motor with modes to obtain (i) $N > N_r$ and (ii) $N < N_r$ with N-T characteristics.	7		
OR				

11 (b)(i)	What is steady state stability of a drive? Derive the condition of steady state stability of a drive.	7	CO2	L5
(ii)	What are the electrical factors taken into account for selecting a motor for a drive?	6		
12 (a) (i)	For a single phase fully controlled converter fed dc drive drive an expression for critical speed for $\alpha > \gamma$ where γ is the angle when $E=v$.	7	CO3	L5
(ii)	Explain speed control of chopper fed separately excited DC motor. Derive an expression of ω -T in terms of δ . Draw the ω -T characteristics for different δ .	6		
OR				
12 (b)	A 200 V, 875 rpm ,150 A separately excited dc motor has an armature resistance of 0.06 ohm. It is fed from a 1 phase fully controlled rectifier with an ac source voltage of 220 V, 50 Hz . Assuming a continuous conduction calculate i) firing angle for rated motor torque and 750 rpm ii) firing angle for rated motor torque and (-500) rpm iii) motor speed for $\alpha=160$ and rated torque	13	CO3	L5
13 (a) (i)	Derive the torque equation of induction motor drive for the field weakening mode and prove that the breakdown torque is inversely proportional to the square of the stator frequency. Draw the s-T characteristics for the above control.	6	CO4	L4
(ii)	A 3 kW, 440 V, 50 Hz, 4 pole, 1370 rpm, delta connected squirrel-cage induction motor has following parameters referred to the stator: $R_s = 2 \Omega$, $R'_r = 5 \Omega$, $X_s = X'_r = 5 \Omega$, $X_m = 90 \Omega$. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate motor speed and torque for a stator voltage of 350 V.	7		
OR				
13 (b) (i)	Explain stator voltage control of induction motor drive with s-T characteristics. Explain why this method is best suited for pump drives.	7	CO4	L4
(ii)	Prove that the rotor current is maximum when motor runs at a slip $s=1/3$ for pump drive. Derive an expression for ratio of maximum current to full load current. For a speed of 1350 rpm calculate the ratio of maximum to full load current.	6		
14 (a) (i)	Explain constant torque and constant HP mode of operation for stator frequency control of synchronous motor with speed torque characteristics .Derive the torque equation.	7	CO4	L4
(ii)	Explain V/f control of a synchronous motor in true synchronous mode with the help of a block diagram. What are the disadvantages of this method of speed control?	6		
OR				
14 (b)	What is meant by margin angle ? Explain the self controlled synchronous motor drive with constant margin angle control. Prove that damper windings can be avoided by this control strategy	13	CO4	L4

15 (a) (i)	Explain with block diagram the closed loop control of separately excited dc motor with current limiting and inner current control.	8	CO5	L4
(ii)	Compare the time constants of speed controller and current controller used in closed loop speed control of dc drive. Explain why it has to be chosen that way.	5		
OR				
15 (b)	Derive the transfer function $w(s)/w^*(s)$ for 3 phase full converter fed separately excited dc motor having PI controller for both speed and current controller.	13	CO5	L4

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16. (i)	Explain how speed and armature current are varied for a separately excited dc motor by i) doubling flux with armature voltage and load torque remaining constant. ii) halving the armature voltage and field current with load torque remaining constant iii) by halving armature voltage with the flux remaining constant and T_L proportional to speed squared.	6	CO1	L5
(ii)	A 230 V, 500 rpm, 90 A separately excited dc motor has armature resistance of 0.2 ohm and 12 mH respectively. The motor is controlled by class C chopper operating with source voltage of 230 V and frequency of 400 Hz. a) Calculate the motor speed for a motoring operation at $\delta=0.5$ and half the rated torque b) What will be the motor speed when regenerating at $\delta=0.5$ and the rated torque	9		

