

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November-December 2017

B. Tech in Electrical Engineering, Semester III

Roll No.....

Course Code: EE701 Electrical Drive and Control

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	In a 3 - phase induction motor the maximum torque (a) is proportional to rotor resistance r_2 (b) does not depend on r_2 (c) is proportional to $1/r_2$ (d) is proportional to r_2^2	
ii.	To save the energy during braking (a) dynamic braking is used (b) plugging is used (c) regenerative braking is used (d) mechanical braking is used	
iii.	In a dc shunt motor the terminal voltage is halved while the torque is kept constant. The resulting approximate variation in speed ω and armature current I_a will be (a) Both ω and I_a are doubled. (b) ω is constant and I_a is doubled. (c) ω is doubled while I_a is halved. (d) ω is constant but I_a is halved.	
iv.	A ceiling fan uses (a) split-phase motor (b) capacitor start and capacitor run motor (c) universal motor (d) capacitor start motor	
v.	A dc shunt generator has a speed of 800 rpm when delivering 20 A to the load at the terminal voltage of 220V. If the same machine is run as a motor it takes a line current of 20A from 220V supply. The speed of the machine as a motor will be (a) 800 rpm (b) more than 800 rpm (c) less than 800 rpm (d) both higher or lower than 800 rpm.	
vi	A d.c. shunt motor runs at no load speed of 1140 r.p.m. At full load, armature reaction weakens the main flux by 5% whereas the armature circuit voltage drops by 10%. The motor full load speed in r.p.m. is (a) 1080 (b) 1203 (c) 1000 (d) 1200	
vii	Ward Leonard method of speed control achieves speed change by (a) varying field flux (b) varying armature voltage (c) varying armature resistance (d) all of the above	
viii	The power modulator which is used to convert fixed DC voltage to variable DC voltage. (a) controlled rectifier (b) un-controlled rectifier	

	(c) chopper	(d) AC voltage controller	
ix	A separately excited dc motor is driving a centrifugal pump whose torque proportional to square of the speed. The armature current is 16 amp and at a speed of 400 rpm. The armature current at a speed of 200 rpm is (a) 4 amp (b) 8 amp (c) 16 amp (d) 32 amp		
x	A balanced three-phase, 50 Hz voltage is applied to a 3 phase, 4 pole, induction motor. When the motor is delivering rated output, the slip is found to be 0.05. The speed of the rotor structure is (a) 1500 r.p.m. (b) 1425 r.p.m (c) 25 r.p.m. (d) 75 r.p.m.		
Q.2	Short answer type questions (4 questions @ 2.5 marks)		10
i.	Why the starter is necessary for starting 3-phase induction motor? Name the different starting methods for 3-phase induction motors.		
ii.	under what condition, the slip in an induction motor is: (i) Negative (ii) Greater than one		
iii.	Why is the armature control method not suitable to control the speed above the base speed? What are the ways of speed control in dc motors?		
iv.	Which type of motor most suitable for high starting torque? Explain.		
Q.3A	Which are the factors that affect the power rating and size of electrical drives? Explain.		05
Q.3B	What are the applications of an electric drive? Discuss type of mechanical load.		05
Q.4A	How following speed transition are carried out in DC motor: (i) Increase in the speed in same direction. (ii) Decrease in speed. (iii) Speed reversal.		05
Q.4B	A 220 volt dc series motor run at 1000 rpm (clockwise) and take an armature current of 100 amp when driving a load with a constant torque. Resistance of armature and field winding are 0.05 ohm each. Find the magnitude and direction of motor speed and armature current if the motor terminal voltage is reversed and the number of turns in field winding is reduced to 80%. Assume linear magnetic circuit.		05
Q.5A	Design 1-phase fully controlled converter fed separately excited dc motor for different firing angle delay in both rectification and inversion mode of operation.		05

Q.5B	A 200 volt, 875 rpm, 150 amp separately excited dc motor has an armature resistance of 0.05 ohm. It is fed from a single phase fully controlled rectifier with an AC source voltage of 220 V, 50 Hz. Calculate	05
	i. Firing angle for rated motor torque and 400 rpm. ii. Firing angle for rated motor torque and (-400) rpm.	
Q.6A	Design first quadrant chopper control of separately excited dc motor for continuous conduction.	05
Q.6B	A separately excited dc motor is running at no load with weak field. Now field current is increased. State and explain various operation (braking, motoring) the motor will have before it settle at a new steady state speed.	05
	OR	
Q.6B	A 220 volt, 24 amp, 100 rpm, separately excited motor has an armature resistance of 2 ohm. Motor is controlled by a chopper with frequency of 500 Hz and source voltage of 230 volt. Calculate the delay ratio for 1.2 time rated torque and 500 rpm.	05
Q.7A	Why the pole changing method is not suitable for speed control of slip ring induction motor. Discuss the methods are used to speed control from stator side and rotor side.	05
Q.7B	Design voltage source inverter fed induction motor drive circuit when it supplied from DC supply or AC supply. Why pulse width modulation VSI is preferred than stepped wave VSI? Explain.	05
	OR	
Q.7B	A Y-connected squirrel cage induction motor has following rating and parameters:	05
	400 volt, 50 Hz, 4-pole, 1370 rpm, $R_1 = 2 \text{ ohm}$, $R_2' = 3 \text{ ohm}$ $X_1 = 3.5 \text{ ohm}$, $X_2 = 3.5 \text{ ohm}$ Motor is controlled by a voltage source inverter at constant V/f ratio. Inverter allows frequency variation from 10 to 50 Hz. i. Obtain a plot between the breakdown torque and frequency. ii. Calculate the starting torque and current of this drive as a ratio of their values when motor is started at rated voltage and frequency.	

- Q.8A Why the multi-quadrant operation is necessary for a drive? Explain speed torque conventions for multi-quadrant operation of drive with suitable example. 10
- Q.9A Explain the different types of braking used for an induction motor drive. Design equivalent circuit for the DC dynamic braking of an induction motor and explain why it is necessary to account for the saturation in the magnetic circuit. 10
- Q.9B A 220 V, 1500 rpm 50 A separately excited DC motor with armature resistance of 0.5Ω , is fed from 3-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 converter firing is zero. 10
- Calculate transformer turns ratio.
 - Determine the value of firing angle
 - Motor is running at 1200 rpm and rated torque.
 - When motor is running at -800 rpm and twice the rated torque.

OR

- Q.9B A motor drive two loads. One has rotational load. It is coupled to the motor through a reduction gear with $a = 0.1$ and efficiency of 90%. The load has a moment of inertia of 10 kg-m^2 and a torque of 10 N-m. Other load has a translational motion and consists of 1000 kg weight to be lifted up at a uniform speed of 1.5 m/s. Coupling between this load and the motor has an efficiency of 85%. Motor has an inertia of 0.2 kg-m^2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred to motor shaft and power developed by the motor. 10