

Enrollment No.....



Faculty of Engineering
End Sem (Even) Examination May-2019
EE3CO14-EX3CO14 Electric Drives
Programme: B.Tech. Branch/Specialisation: EE/EX

Duration: 3 Hrs.**Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

- Q.1 i. The selection of electric drive for a particular application involves of **1**
 (a) Speed control (b) Starting Torque
 (c) Environment conditions (d) All of these
- ii. In a multi-quadrant operation, quadrant I operation provides **1**
 (a) Forward motoring (b) Reverse motoring
 (c) Forward braking (d) Reverse braking
- iii. The value of firing angle (α), at which a converter acts as a line **1**
 commutative inverter
 (a) $\alpha < 90^\circ$ (b) $\alpha > 90^\circ$ (c) $\alpha = 0^\circ$ (d) $\alpha = 180^\circ$
- iv. For constant torque operation for a separately excited DC motor, **1**
 which is kept constant
 (a) Armature Voltage (b) Flux
 (c) Both (a) and (b) (d) None of these
- v. A chopper is DC equivalent to a **1**
 (a) Transformer (b) Cycloconverter
 (c) Dual converter (d) None of these
- vi. The control strategies used in DC chopper is **1**
 (a) Time ratio control (b) Current limit control
 (c) Both (a) and (b) (d) None of these
- vii. In voltage/frequency (V/f) control, with change in slip, the maximum **1**
 torque is
 (a) Variable (b) Constant
 (c) Both (a) and (b) (d) None of these

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- viii. The speed control method for squirrel cage induction motor is **1**
 (a) Stator voltage and supply frequency
 (b) Rotor resistance control
 (c) Slip power recovery control
 (d) All of these
- ix. Number of thyristors required in a load commutated inverter based synchronous motor drive are **1**
 (a) 3 (b) 6 (c) 12 (d) 24
- x. The disadvantage of Load commutation is **1**
 (a) Harmonic torques
 (b) Loss of efficiency due to losses
 (c) The speeds from 0 to 10% of base speed are not possible
 (d) The speed control range is limited to 0 - 10% of base speed
- Q.2 i. Derive and explain fundamental torque equation. **3**
 ii. Draw and explain the complete block diagram of electric drive. **7**
 OR iii. Derive and explain the steady state stability criteria of electric drive. **7**
- Q.3 i. Explain the importance of freewheeling diodes in converters with example. **3**
 ii. Explain the continuous current operation of 1- Φ fully controlled converter for separately excited DC motor control with suitable circuit diagram, equations and waveforms. **7**
 OR iii. A separately excited DC motor running at 1200 rpm is operated from a 1- Φ , half (semi) controlled bridge with input voltage of $V_{in} = 320\sin(310t)$, back emf = 100 V, $R_a = 5 \Omega$. SCRs are fired at $\alpha = 45^\circ$, for every half cycle. Calculate **7**
 (a) The armature current (b) Motor torque.
- Q.4 i. Explain dynamic braking in case of DC motor with diagram. **3**
 ii. Discuss the operation of second quadrant chopper with suitable diagram, equations and waveforms for DC motor. **7**
 OR iii. A separately excited DC motor is controlled by an ideal step down chopper, with source voltage of 230 V, having $R_a = 1.5 \Omega$, $L_a = 1\text{mH}$, with constant load torque requiring an average armature current

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- $I_a = 15$ Amp, with motor back emf = 0.05 V/rpm. Obtain the range of
 (a) Speed control (b) Duty cycle.
- Q.5 i. Write three advantage and three disadvantages of stator voltage control method. **3**
 ii. Explain variable frequency control of induction motor with suitable circuit diagram, characteristics and equations. **7**
 OR iii. A 3- Φ , 400 V, 50 Hz, 6-pole, star-connected induction motor parameters (referred to stator) are $R_1 = R_2 = 0.15 \Omega$, $X_1 = X_2 = 0.8 \Omega$. Determine the initial braking torque if the motor is braked by plugging the full load. The slip is 0.04. **7**
- Q.6 Attempt any two:
 i. Explain the self control of synchronous motor by VSI with suitable diagram. **5**
 ii. Explain the load commutated CSI fed synchronous motor drive with suitable diagram. **5**
 iii. Explain the separate control of synchronous motor with suitable diagram. **5**

Marking Scheme
EE3CO14-EX3CO14 Electric Drives

Q.1	i.	The selection of electric drive for a particular application involves of	1
		(d) All of these	
	ii.	In a multi-quadrant operation, quadrant I operation provides	1
		(a) Forward motoring	
	iii.	The value of firing angle (α), at which a converter acts as a line commutative inverter	1
		(b) $\alpha > 90^\circ$	
	iv.	For constant torque operation for a separately excited DC motor, which is kept constant	1
		(b) Flux	
	v.	A chopper is DC equivalent to a	1
		(a) Transformer	
Q.2	vi.	The control strategies used in DC chopper is	1
		(c) Both (a) and (b)	
	vii.	In voltage/frequency (V/f) control, with change in slip, the maximum torque is	1
		(b) Constant	
	viii.	The speed control method for squirrel cage induction motor is	1
		(a) Stator voltage and supply frequency	
	ix.	Number of thyristors required in a load commutated inverter based synchronous motor drive are	1
		(c) 12	
	x.	The disadvantage of Load commutation is	1
		(c) The speeds from 0 to 10% of base speed are not possible	
Q.2	i.	Fundamental torque equation.	3
		Derivation	2 marks
		Explanation	1 mark
	ii.	Complete block diagram of electric drive.	7
		Diagram	2 marks
OR		Explanation 1 mark for each block (1 mark * 5)	5 marks
	iii.	Steady state stability criteria of electric drive.	7
		Derivation	3 marks
		Explanation	2 marks
		Final equation	2 marks

Q.3	i.	Importance of freewheeling diodes in converters	3
		Explanation	2 marks
		Example.	1 mark
	ii.	Continuous current operation of 1- Φ fully controlled converter	7
		Explanation	1 mark
OR		Circuit diagram	2 marks
		Equations	2 marks
		Waveforms	2 marks
	iii.	(a) The armature current	4 marks
		(b) Motor torque.	3 marks
Q.4	i.	Dynamic braking in case of DC motor with	3
		Diagram.	1 mark
		Explanation	2 marks
	ii.	Operation of second quadrant chopper	7
		Explanation	1 mark
OR		Diagram	2 marks
		Equations	2 marks
		Waveforms for DC motor.	2 marks
	iii.	Obtain the range of	7
		(a) Speed control	4 marks
Q.5		(b) Duty cycle.	3 marks
	i.	Three advantage of stator voltage control method.	1.5 marks
		Three disadvantages of stator voltage control method	1.5 marks
	ii.	Frequency control of induction motor	7
		Explanation	1 mark
OR		Circuit diagram	2 marks
		Characteristics	2 marks
		Equations	2 marks
	iii.	Determine the initial braking torque if the motor is braked by plugging the full load.	7
		Slip,	1 mark
		Speed	2 marks
		Initial current	2 marks

Initial braking torque 2 marks

Q.6

Attempt any two:

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|------|---|---------|----------|
| i. | Self control of synchronous motor by VSI | | 5 |
| | Diagram | 2 marks | |
| | Explanation | 3 marks | |
| ii. | Load commutated CSI fed synchronous motor drive | | 5 |
| | Diagram | 2 marks | |
| | Explanation | 3 marks | |
| iii. | Separate control of synchronous motor | | 5 |
| | Diagram | 2 marks | |
| | Explanation | 3 marks | |
