

# Bachelor of Electrical Engineering Examination, 2018

( 4th Year, 1st Semester)

## ELECTRIC DRIVES

**Time:** Three Hours

**Full Marks:** 100

( 50 marks for each part)

Use a separate Answer-Script for each Part

### PART - I

Answer any three questions

Two marks are for neatness and well-organised answer

1.	a) Classify electric drives according to their method of speed control. State and discuss their main features.	5
	b) What factors are to be considered for the selection of electric drive? Discuss in brief.	5
	c) What do you mean by four quadrant operation of an electric drive? Explain. Why is it necessary? Discuss with an example.	6
2.	a) Classify motors used in drive system according to the required type of duties. Draw the load-time, loss-time and the temperature rise – time curves in the case of S5 and S6 type of duties.	8
	b) Find out an expression for Temperature Rise of an electric machine with Intermittent Short Time ratings.	8
3.	a) Draw and explain connection diagram of an automatic DC shunt motor starter using current sensing relay.	8
	b) Draw and explain connection diagram of an automatic starting arrangement for a slip ring induction motor using frequency sensing relay.	8
4.	a) Derive an expression for speed and current of a DC shunt motor during starting.	8
	b) Derive an expression for speed and current of a DC shunt motor during counter current braking. Also draw the variation of speed and current with time.	8
5.	a) Draw the time-speed curve for short run and derive an expression for maximum speed of an electric train.	8
	b) Co-efficient of adhesion is higher for electric train than for steam train. --- Explain.	2
	c) What are different types of current collector systems are used in electric traction? Discuss their advantages and disadvantages, if any.	6

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No. of Questions	PART II	Marks
Answer any Three Questions Two marks are for neat and systematic answers		
Q6. (a)	Explain with suitable diagrams that, "Armature voltage control method is called constant torque variable power mode whereas field control is called constant power variable torque mode" for the speed control of dc separately excited motor.	8
(b)	A 220V, 1500 rpm, 20A, separately excited dc motor with $r_a=1.2$ ohm is fed from a single phase fully controlled rectifier with supply voltage 240V, 50 Hz. Assuming continuous load current, compute: (i) Motor speed at $30^\circ$ firing angle at load torque of 6 N-m. (ii) Developed torque at firing angle $45^\circ$ with operating speed of 1200 rpm.	8
Q7. (a)	Explain briefly with block diagrams the speed control schemes of dc separately excited motor with speed feedback below rated speed.	8
(b)	Discuss with necessary circuit diagram how four quadrant operation is implemented for a dc separately excited motor with dual converter.	8
Q8. (a)	Explain with suitable block diagram the closed loop V/f speed control scheme of three phase induction motor taking speed feedback. Also draw and explain the nature of torque-speed curves under such operation.	8
(b)	Explain with suitable block diagrams, the speed control of induction motor based on slip compensation.	8
Q9.(a)	Enumerate the disadvantages of stator voltage control for induction motor speed control.	4
(b)	Explain the method of frequency control technique for the speed control of induction motor below and above rated speed.	6
(c)	Develop the mathematical model of separately excited dc motor in the context of speed control.	6

	(ii) Thermal protection of motors (iii) Protection against excessive regeneration in induction motor drives (iv) Protection of individual power electronic devices. (v) Open loop V/f control of induction motors. (vi) Speed control of dc separately excited motor above base speed.	
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