

M.E. ELECTRICAL ENGINEERING - FIRST YEAR - SECOND SEMESTER
(1st / 2nd Semester/Repeat/Supplementary/Annual/Bi-Annual)

SUBJECT: - ADVANCED ELECTRIC DRIVES

Time: Three hours

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
Q1.	Answer any Two Questions	
	a) Explain the necessity of field oriented speed control technique of induction motors for high performance drive systems. Also sketch the basic block diagrams along with different transformations required for the same.	7+8
	b) With the help of model equations, develop the block diagram of a direct rotor field oriented control scheme and explain the same.	10
Q2.	a) With the help of neat sketches, show the different speed and current sensing schemes for the induction motor drive system under field oriented control schemes.	10
Q3.	b) Explain the basics of direct torque control (DTC) scheme of a three-phase induction motor drive system with the help of space vector diagram of flux. From the basic principle, develop and explain the control block diagram for the same.	15
	a) A 415V, 6-pole 50 Hz, 3.2kW, 970 rpm star connected three phase induction motor is controlled with v/f technique. Assuming constant slip speed at different loads, calculate the applied voltage and frequency for the speed commands of (i) 100 rpm and (ii) 500 rpm and (iii) 1200 rpm at rated torque.	10
	b) Explain how the field orientation can be achieved knowing the stator voltage and current information in case of a stator flux oriented control scheme. Also show the closed loop block diagram for the scheme.	15

**M.E. ELECTRICAL ENGINEERING FIRST YEAR 2 ND SEMESTER
EXAMINATION, 2018**

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ADVANCED ELECTRIC DRIVES

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PART -II (50 marks)**

Answer any three Questions.

Two marks are reserved for neat and well organized answer.

1. a) In the context of motor drives, explain the regions of constant torque, constant hp and constant flux operation. 4
 (b) What is IaRa compensation in DC motor drive without speed feedback ? Sketch and explain the principle of closed loop speed control of a DC motor using IaRa compensation method. 6
 c) Sketch and explain the principle of closed loop speed control of DC motor for above and below the rated speed using dual feedback loops with speed and voltage and speed and current feedback. 6

2. a) Sketch and explain the principle of speed control of an induction motor, using slip compensation without speed feedback. 8
 b) Sketch and explain the principle of speed control of an induction motor in open loop mode. Explain why this method of speed control is not so accurate. 8

3. a) Sketch what are known as Stepped Wave and Sinusoidal Pulse Width Modulated (SPWM) voltage waveforms for an induction motor drive. Explain the main drawbacks of stepped wave inverter fed induction motor drive. Also explain the advantages of SPWM voltage waveform fed induction motor drive over Stepped Waveform fed drive. 10
 b) What are the main problems of Voltage Source Inverter (VSI) fed induction motor drive? 6

4. a) Derive the harmonic equivalent circuit of three phase induction motor from the equivalent circuit corresponding to fundamental component of supply voltage. Also derive the expression of slip of an induction motor for m^{th} harmonic component of supply voltage. 12
 b) Explain the effects of harmonics on induction motor torque, core losses and copper losses. 4

5. a) After deriving the expression of torque for a three phase induction motor, show that the torque is proportional to slip frequency. 12
 b) Show that the torque-speed curves of an induction motor are straight lines and parallel to each other under constant flux operation. 4