B.E DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Third Semester

MECHATRONICS ENGINEERING

U18MCI3202: Electrical Machines

COURSE OUTCOMES

CO1:   Describe the construction, principle of operation and performance of DC motors.

CO2:   Elucidate the construction, principle of operation and performance of Induction Machines

CO3:   Summarize the speed control methods of electrical machines

CO4:   Explain the construction, principle of operation and performance of special machines and Permanent magnet machines.

CO5:   Select suitable motor for simple applications

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	Define back emf in DC motors.	CO1	[K$_1$]
2.	What are the types of DC motors based on construction?	CO1	[K$_2$]
3.	State the working principle of a three-phase induction motor.	CO2	[K$_2$]
4.	What is the significance of slip in induction motors?	CO2	[K$_1$]
5.	Mention two methods of speed control for DC series motors.	CO3	[K$_2$]
6.	What is cogging and how does it affect the performance of an induction motor?	CO3	[K$_1$]
7.	State the working principle of a stepper motor.	CO4	[K$_2$]
8.	Differentiate between AC and DC servo motors.	CO4	[K$_2$]
9.	What factors influence the selection of a motor for industrial applications?	CO5	[K$_1$]
10.	Define fatigue in the context of motor performance.	CO5	[K$_1$]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11.   A conveyor belt system is used in an assembly line to transport heavy components. The system requires a DC shunt motor for operation. The following data is given:
Required speed: 1000 RPM, Load torque: 15 Nm, Supply voltage: 230V, Motor efficiency: 85%

a)   Calculate the power required to drive the system.   7   CO1   [K$_4$]

	b)	Describe how the speed of the DC motor can be controlled using armature and field control methods.	7	CO3	[K$_3$]
	c)	What are the advantages of using a DC shunt motor in this application?	2	CO5	[K$_1$]
12.		An industrial crane requires a three-phase induction motor to lift loads. The system specifications are Required lifting speed: 1 m/s, Load weight: 1000 kg, Pulley radius: 0.5 m, Slip: 3%			
	a)	Determine the torque developed by the motor to lift the load.	7	CO2	[K$_4$]
	b)	Explain the speed control of this induction motor using the voltage/frequency (V/f) control method.	7	CO4	[K$_3$]
	c)	How does the slip affect the motor performance in this application.	2	CO3	[K$_2$]
13.	a)	Explain the voltage control method for speed control of three-phase induction motors.	7	CO3	[K$_4$]
	b)	How does a servo mechanism differ from regular system in motors? Give examples of its applications.	7	CO5	[K$_3$]
	c)	Mention the key factors for selecting a motor for a lathe machine application.	2	CO1	[K$_2$]
14.	a)	Analyze the torque-slip characteristics of a three-phase induction motor and explain its significance in industrial applications.	7	CO1	[K$_4$]
	b)	Discuss the construction and operation of BLDC motors.	7	CO4	[K$_3$]
	c)	Define armature control and its impact on motor performance.	2	CO2	[K$_1$]
15.	a)	Explain the slip power recovery scheme used for speed control in induction motors.	7	CO2	[K$_4$]
	b)	Discuss the typical motor application requirements for a conveyor system in terms of current density and heat flow?	7	CO5	[K$_3$]
	c)	Describe the basic working principle of a stepper motor.	2	CO4	[K$_2$]
16.	a)	Describe the slip power recovery scheme method and its application in controlling the speed of induction motors.	7	CO2	[K$_4$]
	b)	How does the use of permanent magnets enhance the performance of PMDC motors?	7	CO3	[K$_2$]
	c)	Discuss the lubrication requirements in motor operation and its impact on motor life.	2	CO4	[K$_2$]

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