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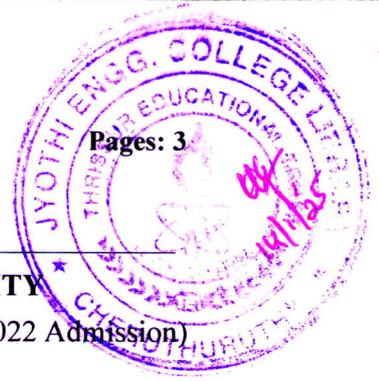
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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech (Hons.) Degree Examination December 2024 (2022 Admission)



Course Code: MRT 393

Course Name: DRIVES AND CONTROL SYSTEM FOR AUTOMATION

Max. Marks: 100

Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks)

Marks

- 1 What is the difference between synchronous and asynchronous motors? (3)
- 2 What are the advantages and limitations of using a microprocessor for motor control? (3)
- 3 Justify the selection of a brushless DC motor over a brushed DC motor for a high-speed application. Explain the reasoning behind your choice. (3)
- 4 Compare and contrast the characteristics of regenerative braking and rheostatic braking in DC motors. (3)
- 5 Compare and contrast the dynamic response of ball screws and rack and pinion systems. Consider factors like backlash, stiffness, and speed limitations. (3)
- 6 Define the terms "on-delay" and "off-delay" in the context of PLC timer instructions. Provide a practical example of each. (3)
- 7 Explain various data comparison instructions. (3)
- 8 What are the various methods of PLC programming? Explain briefly (3)
- 9 Compare and contrast GPIB, HART, and OLE protocols in terms of their data transmission capabilities, application areas, and limitations. (3)
- 10 What are the key considerations for selecting a communication protocol for industrial automation? Discuss factors like bandwidth, reliability, and compatibility. (3)

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

- 11 a) A 3-phase induction motor has a rated speed of 1440 rpm. Calculate the synchronous speed and slip. (7)

- b) Compare and contrast the torque-speed characteristics of DC motors, induction motors, and stepper motors. (7)
- 12 a) Explain the concept of flux vector control and its advantages over V/F control. (7)
- b) A motor is operated at a duty cycle of 50%. Calculate the on-time and off-time if the total cycle time is 100 ms. (7)

Module -2

- 13 a) A Permanent Magnet Synchronous Motor (PMSM) is used in a robotic arm. Explain the control strategies employed to achieve precise position control of the arm. Include a discussion on the challenges and limitations. (7)
- b) Analyze the heating effects in a stepper motor. How can these effects be mitigated to ensure reliable operation and prevent overheating? (7)
- 14 a) Compare and contrast the torque-speed characteristics of AC servomotors and stepper motors. Discuss their suitability for different applications based on these characteristics. (7)
- b) Analyze the advantages and disadvantages of using electric drives in electric vehicles compared to traditional internal combustion engines. Consider factors like efficiency, environmental impact, and infrastructure requirements. (7)

Module -3

- 15 a) Design a linear motion system for a robotic arm using a ball screw and a stepper motor. Consider factors like payload, speed requirements, and accuracy. Calculate the required ball screw lead and motor step angle. (7)
- b) Design a PLC program to control a traffic light system using a combination of timers and counters. The program should ensure proper sequencing of the traffic light signals and handle pedestrian crossings. (7)
- 16 a) Design a PLC program to control a conveyor system with multiple stations. The program should include features like start/stop control, emergency stop, and sensor-based control to detect and handle jams. (7)
- b) Analyze the selection criteria for a belt drive system in a power transmission application. Consider factors like speed, power, center distance, and environmental conditions. (7)

Module -4

- 17 a) Explain the concept of data handling in a PLC system. Discuss different data types. (7)
- b) What is the role of Human-Machine Interfaces (HMIs) in industrial automation? (7)
- 18 a) Analyze the importance of PID control in industrial automation applications (7)
- b) How do fieldbus systems facilitate communication and data exchange between PLCs and other devices in a networked environment? (7)

Module -5

- 19 a) Design a communication network for a small-scale manufacturing plant using a combination of fieldbus protocols. Justify your choice of protocols and explain how the network would be configured to ensure data integrity and reliability. (7)
- b) A SCADA system is used to monitor and control a water treatment plant. Explain the security measures that need to be implemented to protect the SCADA system from cyberattacks and ensure data integrity. (7)
- 20 a) Design a SCADA system for a remote monitoring application, such as a weather station or a pipeline monitoring system. Explain the hardware and software components required, and discuss the challenges associated with remote monitoring. (7)
- b) Analyze the role of OPC (OLE for Process Control) in industrial automation. Explain how OPC facilitates data exchange between different software applications and devices in a heterogeneous environment. (7)
