



Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



I SEMESTER M.TECH (MECHATRONICS ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: SENSORS AND ACTUATORS IN INDUSTRIAL AUTOMATION [MTE 501]

Time: 3 Hours

MAX.MARKS: 50

Instructions to Candidates:

Answer **ANY FIVE FULL** the questions.

- ✤ Missing data may be suitably assumed.
- 1A. Describe the constructional and working details of 3 Ø squirrel cage and 3 Ø wound induction motors with appropriate diagrams. Mention some of the application areas of the motors.
- 1B. Define motor power rating. A slip ring induction motor is used to drive a 40 kW compressor. Outline the factors that have to be kept in mind for selecting the power rating of the driving motor. Estimate the approximate power absorbed by the motor if its efficiency is around 80%.
- 1C. A double acting cylinder is used to press together glued components. Upon operation of a START press button, the clamping cylinder slowly advances. Once the fully extended position is reached, the cylinder is to remain for a time of 6 seconds and then retract to the initial position. The retracting speed should be adjustable. Develop a pneumatic circuit for the above application.

List all the components that you have used for developing the pneumatic drive.

- 2A. A typical rotary printing press usually has several printing stations mechanically coupled by a long drive shaft. Design a suitable scheme for its closed loop speed control.
- 2B. Components are to be stamped using stamping machine. A double acting cylinder is used to stamp the workpiece after START push button is pressed. The cylinder is to retract after sufficient stamping time of 2 seconds is reached. This automatic cycle should stop after 5 cycles. Start button should reset the counter. Develop an electropneumatic circuit for the above. The operation can start again once the cylinder has completely retracted.

- 2C. A DC motor is to be selected for driving a load having a high torque of short duration followed by a long no load period. Suggest the most suitable DC motor for this application and justify your choice. Describe a scheme of speed control for a DC motor when the supply available is AC.
- **3A.** Explain Hall effect. State and explain the various areas of application of Hall effect **3** sensors.
- 3B. Develop a pneumatic circuit for the sequence given below using the cascade method.
 4 The operation can start on the pressing of a START button.
 A+B+B-C+C-A-
- 3C. Mention some of the distinctive features of stepper motors. Explain how a switched3 reluctance motor differs from a permanent magnet stepper motor.
- 4A. Discuss a suitable method of speed control that can be employed for the use of 3phase induction motors in intermittent load applications.
 Explain with diagram, any one type of squirrel cage motor specially designed for intermittent load applications.
- 4B. Describe the working principle of a thermocouple and suggest its merits for measurement of temperature, when compared with RTD and thermistors. Explain one method of industrial cold junction compensation of thermocouples.
- 4C. Discuss the function of a relief valve and an unloading valve in hydraulics. Explain 3 the operation achieved in the hydraulic circuit below for a typical punch press application:



5A. Identify and explain the working of a non-intrusive type of flow measuring 4 instrument. State and explain a method which can be used to measure the flowrate of saturated steam.

- **5B.** Design the regenerative circuit used for rapid extension of a double acting hydraulic **3** actuator.
- 5C. A certain pressing application requires the workpiece to be acted upon by a large force. However due to space constraint it is not possible to accommodate the double acting cylinder of the required volume. What could be the possible solution for this problem? Justify your solution.
- **6A.** Compare and contrast between a conventional DC motor and a brushless DC motor **3** on the following grounds:
 - i) Construction and working
 - ii) Performance
 - iii) Applications
- **6B.** Justify the following statement: "A BLDC motor drive draws similarity with a closed loop synchronous drive."
- 6C. Explain why synchronous motors are not self-starting. Elaborate on two methods of starting a synchronous motor. Illustrate with appropriate reasons, few applications of the same.

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