

**Code : 102607**

**B.Tech 6th Semester Exam., 2022**

( New Course )

**MECHATRONICS SYSTEMS**

Time : 3 hours

Full Marks : 70

**Instructions**

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Answer any seven of the following questions in short : 2×7=14

- (a) Illustrate how capacitive sensor works when area changes.
- (b) Differentiate between stepper motor and servo motor.
- (c) What is embedded system?
- (d) Explain the working of piezoelectric sensors.
- (e) What is shape memory alloy?
- (f) What is microfabrication?

- 1) Explain how a PLC can be used to handle an analogue input.
- 2) State and explain the selection criteria for PLC. Also draw and explain the block diagram architecture of PLC.

2) A platinum resistance temperature detector has a resistance of 100 V at 0 °C, 138.50 V at 100 °C and 175.83 V at 200 °C. What will be the non-linearity error at 100 °C if the detector is assumed to have a linear relationship between 0 °C and 200 °C?

(b) With the help of a case study, explain the application of micromechatronics systems in medical technology. 8

(a) State and compare the advantages, process capabilities and limitations of the various microfabrication techniques used in micromechatronics systems. 6

(b) With a neat sketch, explain the working principle of lithography. 8

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- (b) What is the main advantage of using a gray code instead of straight binary code in an encoder? Give a table corresponding to a gray code for a 4-bit absolute encoder. What is the corresponding code pattern on the encoder disk? 8
5. (a) Define the terms 'gain margin' and 'phase margin', and discuss their significance with respect to closed-loop stability of a system. 6
- (b) Draw the symbols for (i) a pressure-relief valve, (ii) a 2/2 valve which has actuators of a push-button and a spring, (iii) a 4/2 valve, (iv) a directional valve. 8
6. (a) A force of 400 N is required to open a process control valve. What area of diaphragm will be needed with a diaphragm actuator to open the valve with a control gauge pressure of 70 kPa? 6
- (b) A hydraulic cylinder is to be used to move a workpiece in a manufacturing operation through a distance of 50 mm in 10 s. A force of 10 kN is required to move the workpiece. Determine the required working pressure and hydraulic liquid flow rate if a cylinder with a piston diameter of 100 mm is available. 8

- (g) What is PLC?
- (h) List the name of four smart materials.
- (i) List the different programming methods of PLC.
- (j) What is lithography?
2. (a) What is mechanical system? 3
- (b) Write the steps involved in modelling of mechatronics systems. 5
- (c) State the steps that might be present in the sequential control of a dishwasher. 6
3. (a) Explain the need of mechatronics in mechanical industries using suitable example. 6
- (b) You are offered a choice of an incremental shaft encoder or an absolute shaft encoder for the measurement of an angular displacement. What is the principal difference between the results that can be obtained by these two methods? Justify your observation with suitable example. 8
4. (a) State and differentiate between the static and dynamic characteristics of a transducer. 6