



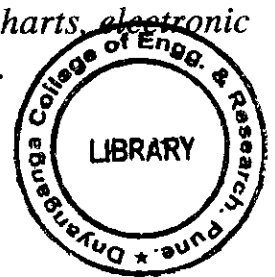
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T.E. (Mechanical Engineering) (Sem. – II) Examination, 2011
MECHATRONICS
(New) (2008 Course)

Time : 3 Hours

Max. Marks : 100

- Instructions :**
- 1) Answer any three questions from each Section.
 - 2) Answers to the two Sections should be written in separate books.
 - 3) Neat diagrams must be drawn wherever necessary.
 - 4) Black figures to the right indicate full marks.
 - 5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
 - 6) Assume suitable data, if necessary.



SECTION – I

1. a) How Microbalance Machine works used which is for measurement of weight in Jewellery shop, explain its working with suitable diagram ? 8
- b) Classify thermocouples used for measurement of temperature. 4
- c) Explain one of the following : 4
 - 1) Bridge Circuit in measurement
 - 2) Basic Divider Circuits.

OR

2. a) A strain gauge and bridge circuit are used to measure the tension force in a bar of steel that has a cross-sectional area of 13 cm^2 . The strain gauge has a nominal resistance of 120Ω and a GF of 2. The bridge is supplied with 10 V. When the bar is unloaded, the bridge is balanced so the output is 0 V. Then force is applied to the bar, and the bridge voltage goes to 0.0005 V. Find the force on the bar. (Youngs modulus $2 \times 10^5 \text{ N/mm}^2$ for steel). 6
- b) What is meant by Temperature Compensation in Strain Gauges and how it is done ? 6
- c) Explain different static characteristics parameters used in measurement techniques. 4

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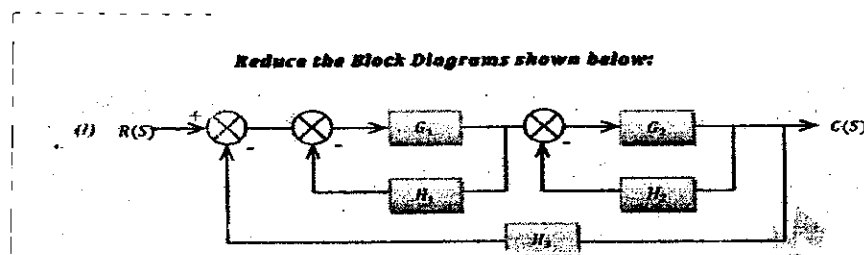
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3. a) Compare an LVDT with a potentiometer as a position sensor. What are advantages and disadvantages of using an LVDT? 6
- b) A potentiometer with a total range of 350° is supplied with a voltage of 8 Vdc. The voltage at the wiper is 3.7 Vdc. What is the present angle of the pot? 5
- c) Describe proximity sensor with application. 5

OR

4. a) How does a bimetallic temperature sensor work? 5
- b) A 350° wire-wound potentiometer has 300 turns and a total resistance of $1\text{ k}\Omega$. What is the resolution in ohms? In degrees? 6
- c) How variable reluctance sensor works? Explain with example. 5
5. a) What is meant by Nyquist Frequency? 4
- b) Carry out block diagram reduction for following system. 8



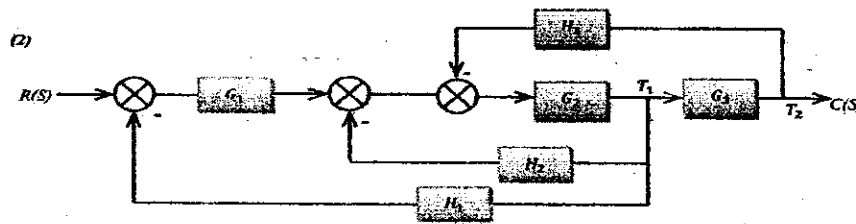
- c) A microprocessor-based control system runs at a clock speed of 1 MHz. The system uses an 8-bit ADC with a $100\text{-}\mu\text{s}$ conversion time. The program loop that processes the analog-to-digital input requires 55 instructions with an average execution time of 4 clocks/instruction. If analog-to-digital conversion is not overlapped with processing, what is the maximum sample rate? What is the highest frequency that this system can monitor? 6

OR

6. a) Write down the limitations of a sample and hold circuit used for ADC. 6
- b) Write a note on DAC (Digital to Analog Conversion) and how it is done? 4

c) Carry out block diagram reduction for following system.

8



SECTION – II

7. a) Explain following terms with respect to control system.

4

- 1) Feed Back and Feed Forward Control System.
- 2) Regulator System.

b) In a certain system, an electric heating element was found to increase the temperature of a piece of metal 10° for each ampere of current. The metal expands 0.001 in /deg and pushes on a load sensor which outputs 1 V/0.005 in. of compression.

6

- a) Find the transfer functions of the three components and draw the block diagram.
- b) Calculate the overall transfer function of this system.

c) What is the difference between a process control system and a servomechanism?

6

OR

8. a) Explain following terms :

4

- 1) Process Variable.
- 2) Process Error.

b) Give an example of the following :

6

- a) Feed forward control system.
- b) Feedback control system.
- c) Regulator control system.

c) Explain control systems used for following (as open-or closed-loop control.)

6

- a) Controlling the water height in a toilet tank
- b) Actuation of street lights at 6 P.M.
- c) Stopping a clothes dryer when the clothes are dry.

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9. a) Explain working of PID control system and why this controller is mostly used in industry. 6
- b) What problem is solved and what new problem is created with the addition of integral feedback? 4
- c) Explain why a proportional control system lifting a weight can never reduce the steady-state error to zero. 6

OR

10. a) Explain how the addition of integral feedback in a proportional control system eliminates steady-state error. 4
- b) What is the difference between analog and digital control system? Explain with appropriate example. 6
- c) A position control system has a gain K_P of 2 in oz/deg and works against a constant friction torque of 6 in oz. What is the size of the dead band? 6
11. a) Explain application of PLC system for following case studies. 6
- 1) Bottle Filling Machine.
- 2) Elevator.
- b) Construct the ladder logic diagrams for (a) the NAND gate and (b) the NOR gate. Also develop a truth table for both logics. 12

OR

12. a) In a certain bank, each of three bank officers has a unique key to the vault. The bank rules require that two out of the three officers be present when the vault is opened. Draw the ladder diagram for a relay logic circuit that will unlatch the door and turn on the light when two of the three keys are inserted. 12
- b) List the steps the PLC takes to execute the ladder diagram program. 6