

T.E. (Mechanical/Mechanical-Sandwich)
MECHATRONICS
(2012 Course) (Semester-II) (302050)

Time : 2½ Hours]

[Max. Marks : 70

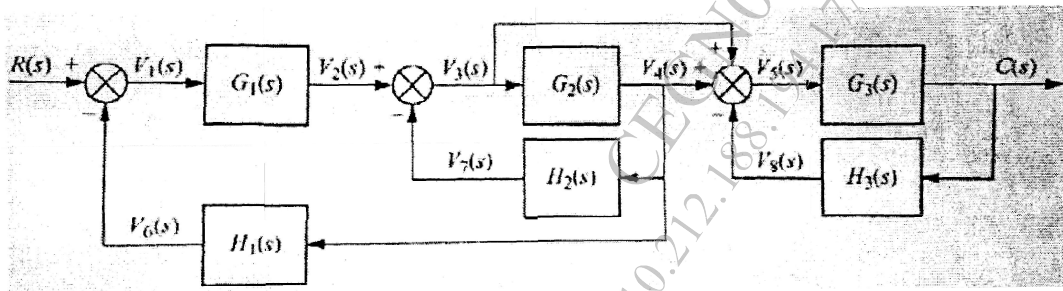
Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of electronic pocket calculator is allowed.
- 5) Assume suitable data, if necessary.

- Q1)** a) Explain the significance of static and dynamic characteristics of measuring instruments while selecting an instrument for a particular application. [6]
- b) A strain gauge and bridge circuit is used to measure the tension force in the steel bar. The steel bar has across section area of 50 mm^2 . The strain gauge has nominal resistance of 120Ω and gauge factor of 2. The bridge supply voltage is 10 Volts. When the bar is unloaded, the bridge is balanced so the output is 0 Newton. When force 'F' is applied to the bar, the bridge output voltage goes to 0.0005 Volts. Find the value of 'F' if the Young Modulus of the bar material is $2.1 \times 10^5 \text{ N/mm}^2$. [4]

OR

- Q2)** a) Explain with neat sketch the working principle of solenoid. [5]
- b) Rotary potentiometer is used for angle measurement. Potentiometer is supplied with 10 Volts and set up with 82° . The range of single turn of pot is 350° . Calculate the output voltage. [5]
- Q3)** a) Explain the role of sample and hold process in the conversion of analog signal into equivalent digital signal. [5]
- b) Find the overall transfer function for the following block diagram. [5]



OR

P.T.O.

- Q4) a)** Explain the advantages of closed loop control system for the open loop control system. **[5]**

- Q5) a)** Explain with suitable example the role of following in PLC. [8]

- b) A batch process - which involves filling a vat with a liquid, mixing the liquid, and draining the vat - is automated with a PLC. Following figure shows the hardware. The specific sequence of events is as follows: When the start button near the process is pushed: [8]

Draw the laddered diagram for the PLC program.

OR

Q6) a) Explain with suitable example the architecture of SCADA system. [8]

b) A process for washing parts requires the following sequence: [8]

i) Spray water and detergent for 2 min (Wash cycle).

ii) Rinse with water spray only for 1 min (Rinse cycle).

iii) Water off, air blow dry for 3 min (Drying cycle).

The sequence is started with a toggle switch. Draw the ladder diagram for this process.

Q7) a) Explain in brief the following terms: [8]

i) % Overshoot

ii) Damping factor

iii) Rise time

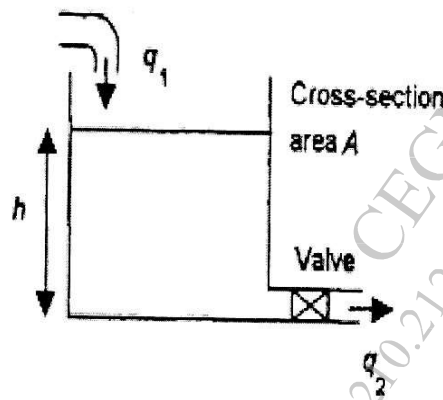
iv) Damping frequency

b) Develop a model for the temperature of a room containing a heater which supplies heat at the rate q_1 and the room loses heat at the rate q_2 . Make use of suitable notations and assumptions. [8]

OR

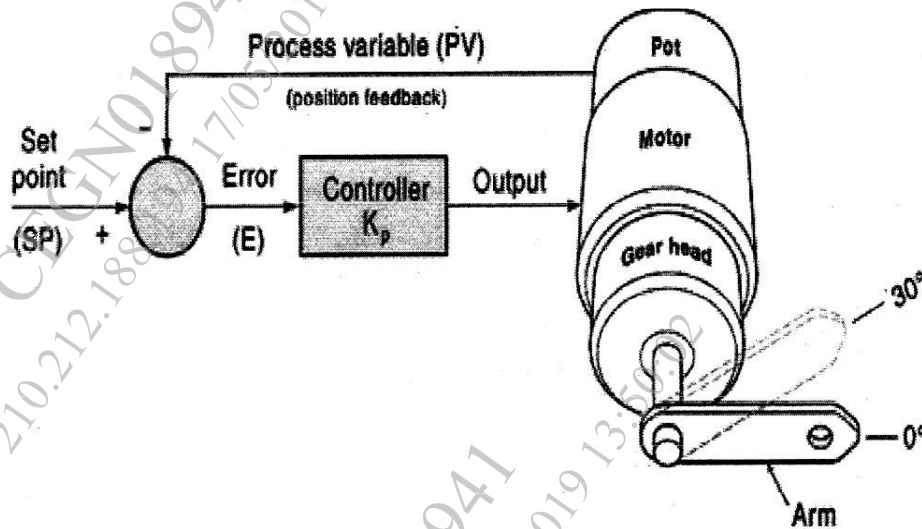
Q8) a) Explain the difference and need for time and frequency domain analysis. [8]

b) Develop a model for the hydraulic system shown in the following figure where there is a liquid entering a container at one rate q_1 and q_2 . Make use of suitable notations and assumptions. [8]



Q9) a) Narrate the advantages of PID controller over PI controller. Justify your answer with suitable example. [8]

b) A motor driven arm was originally at 0° and then was directed to move to a new position at 30° . The gain of the system is $K_P = 2 \text{ in.}\cdot\text{oz/deg}$. Describe how the controller responds to this situation. [10]



OR

Q10)a) Discuss the effect of each of P, I and D from PID controller on stability of the system. [8]

b) An integral controller is used to control the temperature of a system with a set point of 12°C within a range of $10\text{--}15^\circ\text{C}$. The controller output is 22% initially. The constant $K_I = -0.15\%$ controller output per second per percentage error. If the temperature jumps to 13.5°C , calculate the controller output after 2 second from the constant e_p . [10]

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