

[5058]- 318

T.E. (Mechanical)
MECHATRONICS

(2012 Course) (End Semester) (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 side indicate full marks.
- 4) Assume suitable data if necessary.

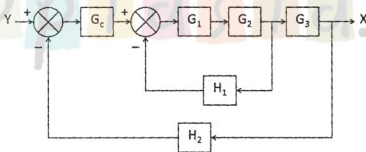
Q1) a) From the block diagram in Figure 1, determine the transfer function : X/Y . [8]

Figure 1

- b) Write two distinct points of comparison between Potentiometer and Digital Encoder. [2]

OR

P.T.O.

Q6) a) A circuit involves four NO type switches, P1, P2, S1 and S2, and a DC motor (M). Draw a ladder diagram such that the said circuit satisfies following objectives: **[10]**

- i) When P1 is pushed the circuit shall turn *On* and shall continue to remain *On* until P2 is pushed.
 - ii) When S1 is pushed and S2 is not pushed then Motor is *On* in clockwise direction.
 - iii) When S2 is pushed and S1 is not pushed then Motor is *On* in anti-clockwise direction.
 - iv) When P2 is pushed the circuit turns *Off*.
- b) Draw a suitable block diagram and explain the architecture of a PLC. **[6]**

Q7) a)
$$\frac{C(s)}{R(s)} = \frac{0.5s + 2}{s^2 + 0.5s + 2}$$

From the transfer function, of a second order system, presented by Eq. (1), determine: **[10]**

- i) Location of Pole
- ii) Location of Zero
- iii) Damping Factor ζ

Also, for the transfer function in Eq. (1), comment on:

- i) Absolute stability of the system.
 - ii) Unit step response of the system.
- b) Discuss the advantages and the dis-advantages of the frequency domain analysis in comparison to the domain analysis. **[6]**

OR

Q8) a) Draw suitable sketch and explain “Time Domain Specifications and Analysis”. [10]

b) Determine the approximate Rise Time, 2% Settling Time and % Overshoot of a second-order system driven using a unit step input. Assume the system to have a damping factor = 0.75 and natural frequency = 5 rad/sec. [6]

Q9) a) The equation of error is $e = 0.5t + 0.03t^2$. With $K_p = 5$, $K_D = 0.5$ and $p(0) = 50\%$, sketch the graph of the controller output vs time for a Proportional plus Derivative controller (in series form) from $t = 0$ to $t = 2$ sec. [10]

b) Write the equation for the control signal for Integral action. Also, discuss the advantages as well as the disadvantages of adding Integral action to the Proportional action. [8]

OR

Q10) a) Derive the transfer function of the Proportional Integral Derivative (PID) controller in parallel form. Also, discuss, in detail, the advantages and disadvantages of adding Derivative term to the Proportional term. [12]

b) W.R.T parallel form, discuss the advantages offered by the Series Form of PID control. [6]

