Total No. of Questions : 10]

SEAT No. :

P1696

[Total No. of Pages : 4

[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]**

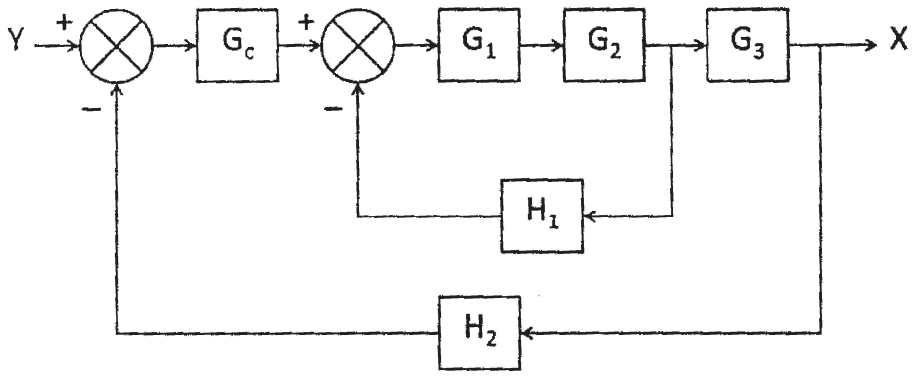

Figure 1

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

OR

P.T.O.

Q2) a) Reduce the block diagram in Figure 2 and determine the transfer function: C/R. **[8]**

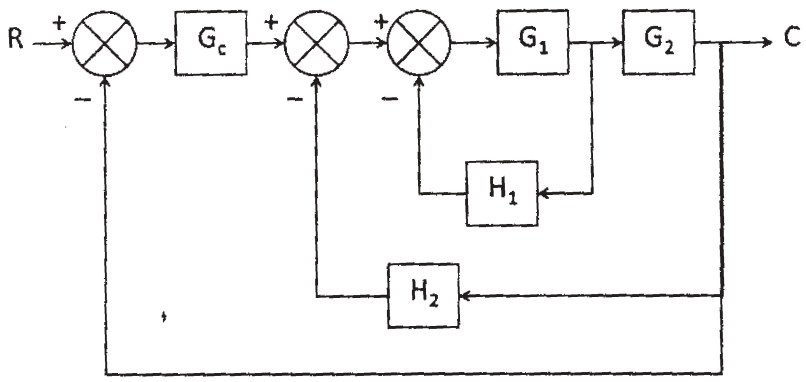

Figure 2

b) List any two reasons to justify the need for a signal conditioner in a mechatronic system. **[2]**

Q3) a) Draw a suitable block diagram and explain the working of a DAQ system. **[6]**

b) A LVDT is to be selected for measurement of displacement. Discuss, in brief, any four criterions for selection of the said sensor. **[4]**

OR

Q4) a) For a 4 bit ADC with a V_{ref} = 10 volts, find the digital equivalent of V_{in} = 6 volts. **[6]**

b) Draw a suitable diagram and explain the working of a strain gauge for force measurement. **[4]**

Q5) a) Using a suitable example discuss the working of the following in a PLC:

i) Latch ii) Counter **[8]**

b) Considering a suitable example explain the working of the SCADA system. **[8]**

OR

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* is 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 O*ff*.

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]**