Total No. of Questions : 10] SEAT No. :

P3918 [Total No. of Pages : 4

[4758] - 518
T.E. (Mechanical) (Semester - II)
MECHATRONICS
(2012 Pattern)

Time : 3 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) Using a suitable diagram, explain the construction as well as the working of a digital optical encoder. **[6]**

b) From the block diagram in Figure 1, determine the transfer function: Y/X. **[4]**

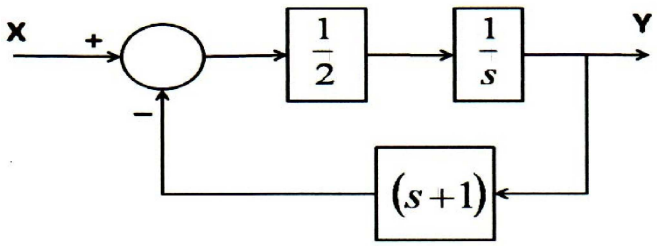

Figure 1

OR

Q2) a) A potentiometer, used to measure the angular position of a motor, has 750 turns of wire. The input range is from -150^0 to $+150^0$. The output range is from 0 to 10 Volts. Determine: **[6]**

i) The sensitivity

ii) The average resolution

b) Using a suitable block diagram, explain the application of a closed loop control system in temperature control in a house hold refrigerator. **[4]**

P.T.O.

Q3) a) Draw suitable diagrams and explain the construction, working and performance characteristics of a Current Amplifier. **[8]**

b) Define "Transfer Function" and discuss its importance in the context of control of a Machatronic system. **[2]**

OR

Q4) a) Draw the flowchart and explain the working of the SAR type Analog to Digital converter. **[8]**

b) List two important advantages of a closed loop control system. **[2]**

Q5) a) Given four normally open switches (P1, P2, S1 and S2), with DC motor (M) write a PLC program to satisfy following objectives: **[10]**

i) When P1 (Start Button) is pushed the Cycle shall start. The cycle shall continue to remain *On* until P2 (Stop Button) is pushed.

ii) When S1 is pushed and S2 is not pushed then Motor is ON clockwise direction.

iii) When S2 is pushed and S1 is not pushed then Motor is ON in counter clockwise direction.

iv) When P2 is pushed the program stops.

b) Draw a suitable block diagram and explain the architecture of the SCADA system. **[6]**

OR

Q6) a) Using a suitable schematic list the components in a PLC as well as explain the significance of each of the components. **[8]**

b) List the criterion for the selection of a PLC and explain any three criterions in details. **[8]**

Q7) a) For the system in Figure 2, assume M=mass=1kg, k=stiffness=2 N/m and d=damping=0.5 Ns/m. Also, F=force input in N and y=displacement output in m. **[10]**

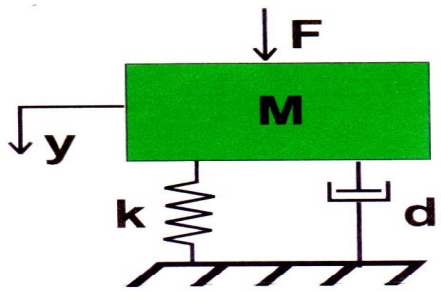

Figure 2

For this system:

i) Determine the transfer function: y(s)/F(s),

ii) Identify the location of the Poles and Zeros and

iii) Comment on the stability of the system.

b) Using the values of the natural frequency=ω_n=1.414 and the damping factor =ξ=0.177, estimate the values for percentage overshoot & 2% settling time. **[6]**

OR

Q8) a) Using four distinct points, compare, in detail, between Time Domain and Frequency Domain techniques for analysis of a system. **[8]**

b) Draw suitable sketch to depict the unit step response of a second order system when: **[8]**

i) System poles are negative and real

ii) System poles are complex conjugate pair with negative real part

iii) System poles are positive and real

iv) System poles are a imaginary pair with no real part

Q9) a) Figure 3 shows an error time graph. Sketch the PID controller (series form) output w.r.t. time. Assume K_P=10, K_I = 2, K_D= 0.5 and P_O=0 i.e the controller output is zero when the error is zero. **[10]**

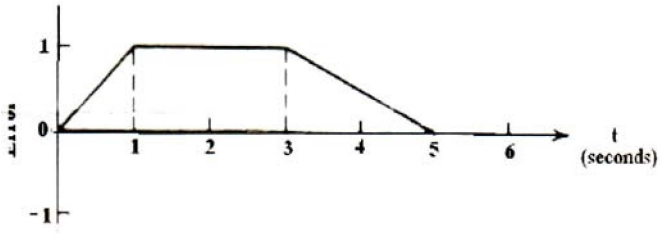

Figure 3

b) Derive the equation for the control signal, u, for the Proportional plus Derivative (PD) controller in parallel form. Discuss, in detail, the advantages and disadvantages of adding a Derivative term to the Proportional term. **[8]**

OR

Q10 a) Draw a suitable block diagram and derive the transfer function of the Proportional Integral Derivative (PID) controller in series form. Also, discuss the significance of the Integral and the Derivate term in the PID controller. **[10]**

b) Discuss the role of transient specifications W.R.T the performance of the PID controller. **[8]**