Total No. of Questions : 10]

SEAT No. :

P3575

[Total No. of Pages : 4

[5560]-519
TE (Mechanical) (Mechanical S/W)
MECHATRONICS
(2015 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 side indicate full marks.***
4) ***Assume Suitable data if necessary.***

Q1) a) Draw a suitable diagram and explain the working of the 2 bit R-2R type Digital to Analog converter. **[6]**

b) Discuss, in detail, any four criterion for accessing the measurement performance of a rotary Potentiometer. **[4]**

OR

Q2) a) A 4-bit DAC has a V_{ref} of 0-10 V. For a binary input of 1010, find the equivalent analog output voltage given by the DAC. **[6]**

b) Using a suitable diagram, explain the working of an optical type proximity sensor. **[4]**

Q3) a) Using a suitable diagram explain the application of Mechatronics in an automotive system. **[8]**

b) Discuss, in brief, the operating principle of the LVDT type position sensor. **[2]**

OR

Q4) a) Reduce the block diagram in Figure 1 and determine the transfer function: X/Y. **[8]**

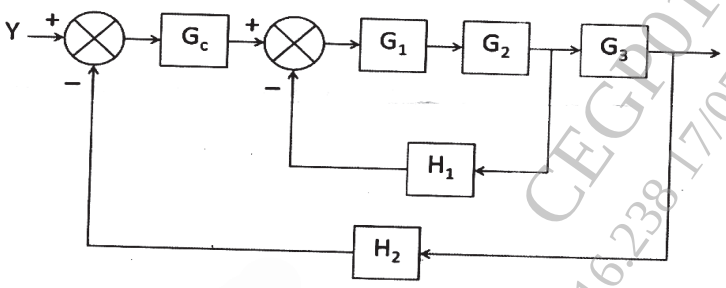

Figure 1

b) Discuss, in brief, the operating principle of the Thermocouple. **[2]**

P.T.O.

Q5) a) Given three push to on switches (P1, P2, and S), with two lamps (L1 and L2), write a PLC program to satisfy following objectives. **[10]**

i) When P1 (start switch) is pushed, L1 shall go On and cycle shall start. the cycle shall continue to remain On until P2 (stop switch) is pushed.

ii) When L1 is On then L2 is Off and vice a versa.

iii) When S switch is pushed for four times the program shall stop.

iv) When P2 (stop switch) is pushed, the program shall stop.

v) When program stops, L2 shall be On.

b) Draw a suitable diagram and discuss, in detail, the working of a PLC. **[6]**

OR

Q6) a) Consider a tank with inflow valve V1 and outflow valve V2 connected to the tank at top and bottom respectively. The level high (LH) and level low (LL) float switches are mounted at top and bottom to indicate the level. Develop a PLC ladder program to achieve the following objectives:**[10]**

i) When LL is OFF and LH is OFF, the V1 should be ON

ii) V1 shall continue to be ON till LH is ON

iii) When LL and LH is ON, V1 should be OFF and V2 should be ON

iv) V2 should continue to be ON till LL is OFF

b) Using suitable example, explain the working of the following in a PLC. **[6]**

i) Timer

ii) Counter

Q7) a) A mass spring damper system is mounted on an massless cart as shown in Figure 2. Derive the transfer function between output y and input u.**[10]**

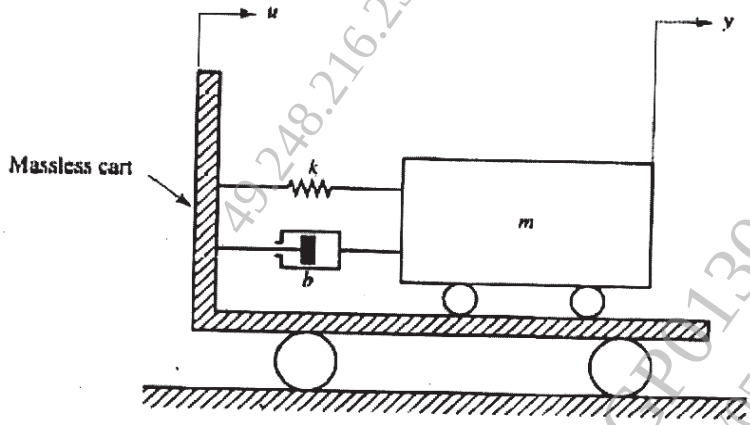

Figure 2

b) Using Routh Hurwitz criterion, determine the range of K that would confirm closed loop stability of system given by Eq. (2). **[6]**

$s^3 + 101.71s^2 + 171s + 6.63K = 0$

OR

Q8) a) For the system in Figure 3, assume m=mass=2 kg, k=stiffness=4 N/m and b=damping = 0.3 Ns/m. Also, F=Force input in N and x = displacement output in m. **[10]**

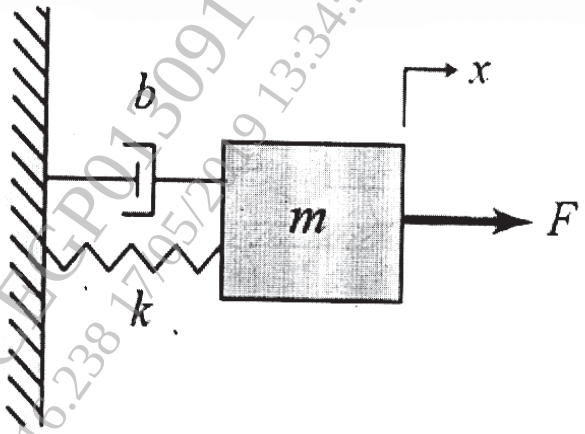

Figure 3

For this system:

i) Derive the transfer function: $x(s)/F(s)$,

ii) Identify the location of the Poles and Zeros and

iii) Comment on the absolute stability of the system.

b) Draw suitable sketch to depict the unit step response of a generic second order system when its: **[6]**

i) poles are negative, real and collocated

ii) poles are complex conjugate pair with negative real part

iii) poles are a imaginary pair with no real part

Q9) a) Figure 4 shows an error versus time graph. Sketch the PD controller (parallel form) output with respect to time. Assume Kp = 10%/s, K_D= 0.5 % /s and P_0 = 20%. **[10]**

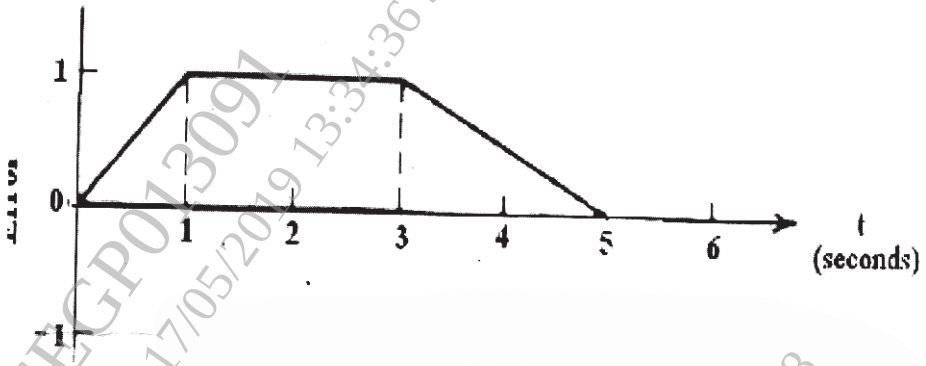

Figure 4

b) Discuss the significance of transient specifications with respect to assessment of performance of the PID controller. **[8]**

OR

Q10) a) Write the equation for their control signal and discuss, in detail, the advantages as well as the dis-advantages of the following terms in the PID control. **[10]**

i) Proportional

ii) Integral

iii) Derivative

b) Write the cost function of an LQR control algorithm, define as well as discuss the significance of all the terms mentioned in the cost function.**[8]**