Total No. of Questions : 10]

P2844

SEAT No. :

[Total No. of Pages : 4

[4958]-1018

T.E.(Mechanical)

MECHATRONICS

(2012Course) (Semester-II)(302050)(End Sem.)

Time :2½Hours] ***[Max. Marks : 70***

Instructions to the candidates:

1) *Answer Q.1 or Q.2, Q.3or Q.4, Q.5 or Q. 6 , Q.7 or Q.8, Q.9 or Q.10 .*
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) Flow inside a pipe is to be measured using a flow sensor. For this,draw the setup and explain the principle of working of the said sensor. **[6]**

b) From the block diagram in Figure1, determine the transfer function: C/R. **[4]**

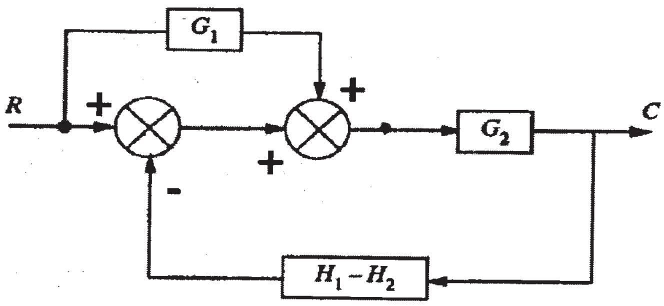

Figure 1

OR

Q2) a) List any six Static Characteristics along with their definition. **[6]**

b) Draw a suitable block diagram and list the key elements in a generic Mechatronics system. **[4]**

Q3) a) A 4-bit R-2R type DAC is supplied with 2.56 volts dc reference potential. Determine the full scale output potential and the Least significant Bit(LSB). **[8]**

b) List two distinct benefits of closed loop control system over open loop control system. **[2]**

OR

Q4) a) Draw suitable diagrams and explain the construction and working of a two stage current Amplifier **[8]**

b) List two distinct benefits of open loop control system over closed loop control system. **[2]**

Q5) a) Explain on Delayed, off Delayed Timers used in PLC programming with one application and corresponding ladder program. **[8]**

b) Write ladder logic for a simple traffic light controller for the following sequence of operations as below: **[8]**

Step 1: Turn Green ON for 35 seconds,

Step 2: Turn Yellow ON for 5 seconds,

Step 3: Turn Red ON for 40 seconds,

Step 4: Repeat the sequence i.e. Step 1-Step 2-Step 3.

OR

Q6) a) Draw a suitable ladder diagram and explain the application of counter in a PLC. **[8]**

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

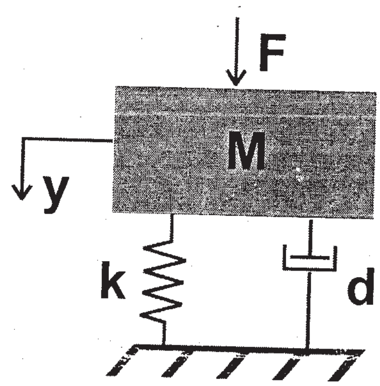

Figure 2

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) Consider a second -order unity feedback system with damping factor=0.6 and natural frequency = 5 rad/sec. Calculate the rise time, maximum overshoot and settling time when a unit-step input is applied to the system. **[6]**

OR

Q8) a) Derive the transfer function between output θ and input τ for the single dof rotational system shown in Figure 3. **[10]**

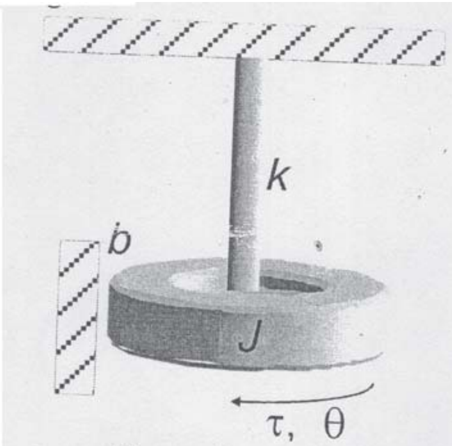

Figure 3

b) Define the following terms: **[6]**

i) Steady State Error

ii) Gain Margin

iii) Phase Margin

iv) Rise Time

v) Damping Frequency

vi) % Overshoot

Q9) a) Figure 4 shows an error time graph. Sketch the PID controller 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]**

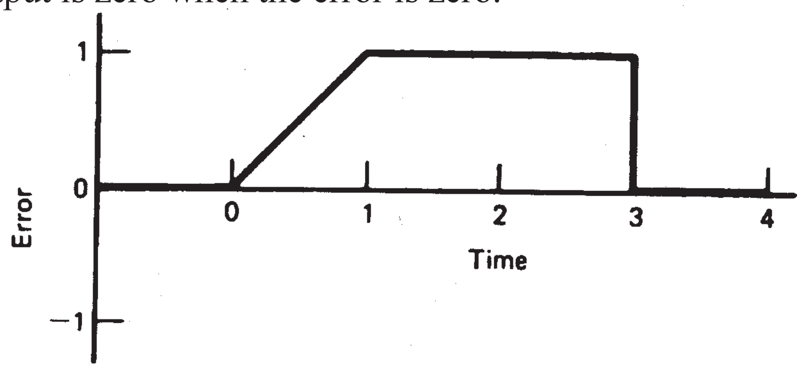

Figure 4

b) A second order system is under damped, inherently. Discuss the step by step procedure for manual tuning of a PID controller so that the behavior of the system becomes that of a critically damped one. **[8]**

OR

Q10) a) An integral controller is used for speed control with a setpoint of 12rpm within a range of 10 to 15 rpm. The controller output is 22% initially. The constant K_I= –0.15% controller output per second per percentage error. If the speed jumps to 13.5 rpm, calculate the controller output after 2 sec for a constant e_p. **[10]**

b) Derive the equation for the control signal, u, for the proportional Integral Derivative(PID) controller. Discuss, in detail, the advantages and disadvantages of adding Derivative term to the Proportional term. **[8]**

◄► ◄► ◄►