

Total No. of Questions : 10]

SEAT No. :

P2844

[4958]-1018

[Total No. of Pages : 4

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.3 or 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]

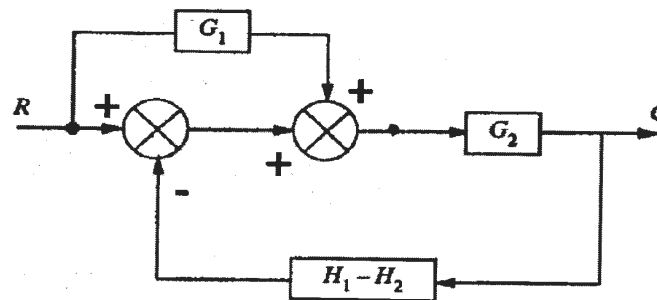


Figure 1

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

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**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  $M = \text{mass} = 1\text{kg}$ ,  $k = \text{stiffness} = 2\text{ N/m}$  and  $d = \text{damping} = 0.5\text{ Ns/m}$ . Also,  $F = \text{force input in N}$  and  $y = \text{displacement output in m}$ . [10]

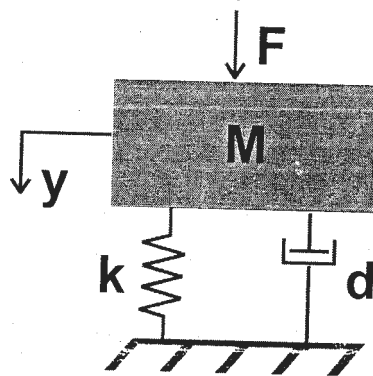


Figure 2

For this system:

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

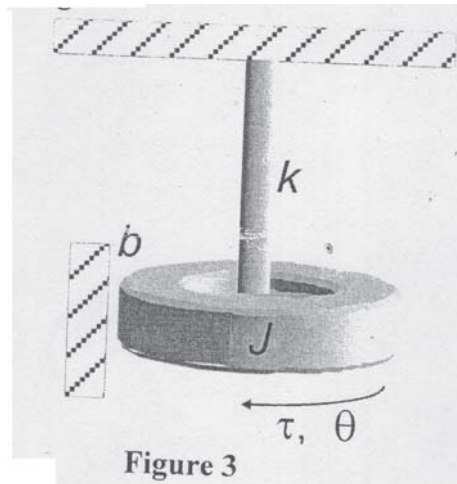
ii) Identify the location of the Poles and Zeros and

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  $\theta$  and input  $\tau$  for the single dof rotational system shown in Figure 3. [10]



- b) Define the following terms: [6]
- Steady State Error
  - Gain Margin
  - Phase Margin
  - Rise Time
  - Damping Frequency
  - % 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]

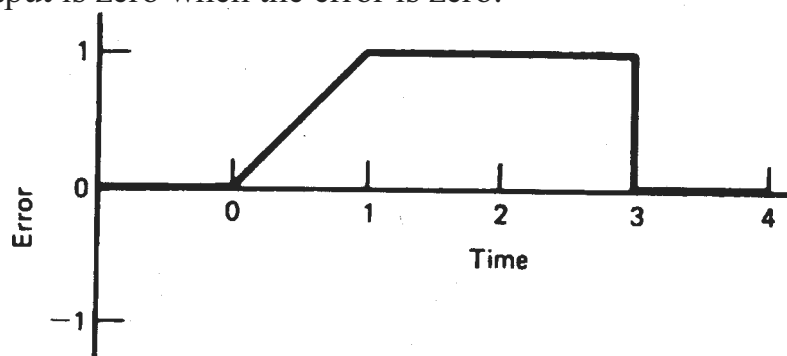


Figure 4

- 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]

