Total No. of Questions : 10]

SEAT No. :

P1701

[Total No. of Pages : 4

[5460]-519

T.E. (Mechanical/Mechanical Sandwich)

MECHATRONICS

(2015 Pattern) (Semester - II)

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) Write six exclusive points of comparison between serial and parallel communication. **[6]**

b) List and define any four static characteristics for accessing the measurement performance of a capacitive proximity sensor. **[4]**

OR

Q2) a) A 4-bit DAC has a V_{ref} of 0-12V. For a binary input of 1100, find the equivalent analog output voltage given by the DAC. **[6]**

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

Q3) a) Using a suitable diagram explain the application of Mechatronics in an industrial shop floor. **[8]**

b) Discuss, in brief, the operating principle of the strain gauge type force sensor. **[2]**

OR

P.T.O.

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

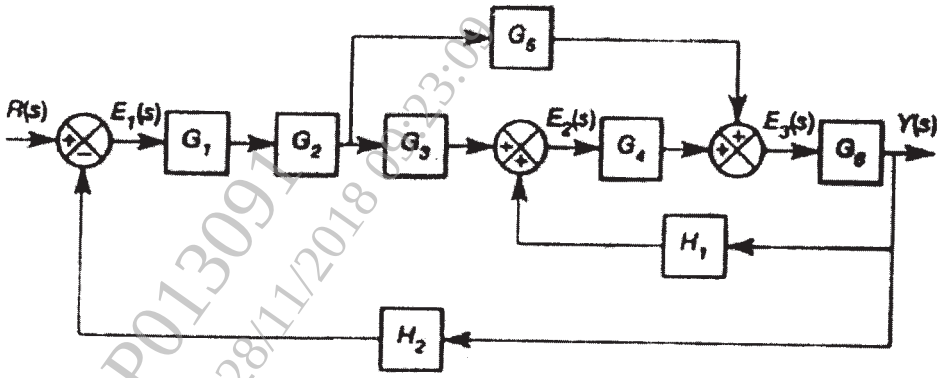

Figure 1

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

Q5) a) A traffic light controller is supposed to execute following sequence of operations. **[10]**

Draw a ladder diagram for implementation of the said sequence.

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.

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

i) Latching
ii) Counter

OR

Q6) a) A solenoid valve is used to control both the extension as well as the retraction stroke of a double-acting cylinder. Draw a ladder diagram to execute the following operation: **[10]**

i) The solenoid valve should extend the piston of the cylinder.
ii) Once extended, the piston should be held in that position for 5 seconds.
iii) After the 5 second hold is complete, the piston should retract
iv) After complete retraction of the piston, the operation should stop.

b) List and discuss, in brief, any six specifications of a PLC. **[6]**

Q7) a) For the translational mechanical system in Figure 2, determine the transfer function between output Z and input u. Also, determine the location of poles from the transfer function. **[10]**

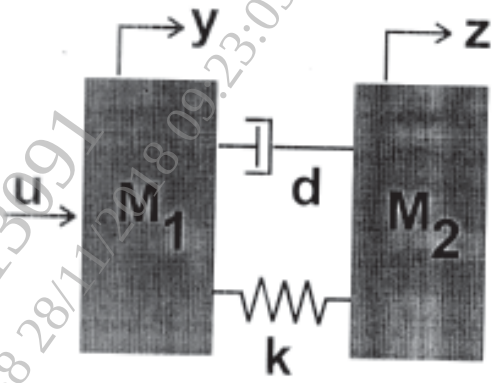

Figure 2

b) Using Routh Hurwitz criterion, determine the range of K that would confirm closed loop stability of system given by Eq. (1). **[6]**

$$s^4 + 3s^3 + 3s^2 + 2s + k = 0 \qquad (1)$$

OR

Q8) a) For the system in Figure 3, assume m = mass = 2 kg, k = stiffness = 4 N/m and c = damping = 0.3 Ns/m. Also, f(t) = force input in N and y(t) = displacement output in m. **[10]**

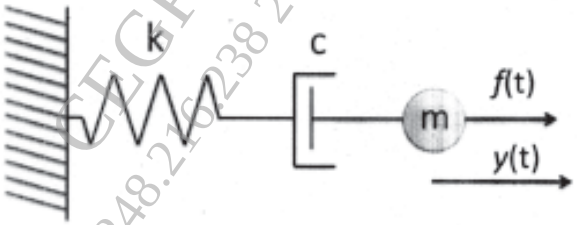

Figure 3

For this system:

i) Derive the transfer function: $y(s)/f(s)$.

ii) Identify the location of the Poles and Zeros and

iii) Comment on the absolute stability of the system.

b) Define the following terms and discuss, in detail, their significance with respect to closed loop stability of a system. **[6]**

i) Gain Margin

ii) Phase Margin

Q9) a) A proportional controller is used to control temperature within 50°C to 130°C with a set point of 73.5°C. The set point is maintained with 50% controller output. The offset error is corresponding to load change which causes 55% controller output. If the proportional gain is 2 find the % controller output if the temperature is 61°C. **[10]**

b) The open loop response of a second order system is slow and oscillatory. Discuss, in detail, the step by step procedure for manual tuning of a PID controller so that closed loop response of this second order system resembles that of a critically damped system, which is capable of accurately tracking a reference unit step input. **[8]**

OR

Q10) a) Using a suitable block diagram explain the working of PID control in Parallel form. Also, list two industrial applications where in such control could be used. **[10]**

b) Discuss the significance of the terms Q and R in an LQR type control. Also, discuss, in brief, the advantages and disadvantages of the LQR type control. **[8]**

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