Total No. of Questions : 10]

SEAT No. :

P3618

[Total No. of Pages : 3

[4858] - 1023

T.E. (Mechanical) (S/W)

MECHATRONICS

(2012 Pattern) (Semester - I)

Time : 3 Hours] *[Max. Marks :70*

Instructions to the candidates:

1) *Answers 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) List and define any six static measurement characteristics. **[6]**

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

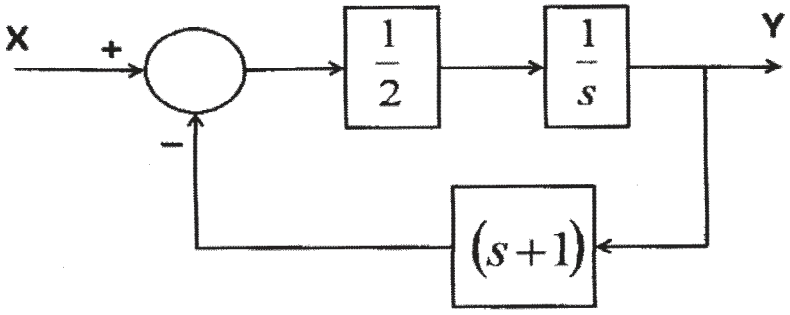

Figure 1

OR

Q2) a) Speed of a dc motor is to be measured using an optical encoder. Draw a suitable schematic and explain the working of the said sensor. **[6]**

b) Draw a suitable block diagram displaying the key elements of a generic mechatronic system and explain the significance of the actuator element. **[4]**

Q3) a) Draw a suitable flowchart and explain the working of a 4-bit R-2R DAC. **[8]**

b) Draw a block diagram of open loop control system and define its operating principle. **[2]**

OR

P.T.O.

Q4) a) Draw suitable diagrams and explain the significance of Sample and Hold Circuit and Aliasing in an Analog to Digital Convertor. **[8]**

b) Draw a block diagram of closed loop control system and define its operating principle. **[2]**

Q5) a) List and discuss 5 exclusive criterions for selection of a PLC. **[10]**

b) Draw ladder diagram 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) Give suitable examples and discuss the importance of Timer and Counter in a PLC. **[10]**

b) Draw a ladder diagram to satisfy following objectives **[8]**

i) START a counter C1 (count up) when SI (push-to-on switch) is pushed. Cl is set for 10 counts.

ii) When counter Cl saturates, the RED lamp goes ON.

iii) When RED lamp is ON and S2 (push-to-ON switch) is pushed, the Cl resets and RED lamp is OFF.

Q7) a) Determine the transfer function x(s)/F(s) for the system shown in figure below. **[10]**

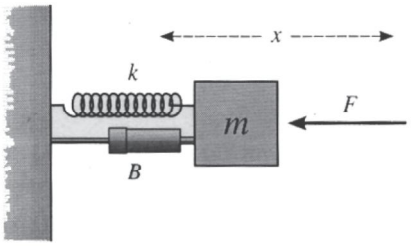

Figure 2

b) Determine the Poles and Zeros of the system whose transfer function, C(s)/R(s) is given below. In addition, comment on the stability of this system. **[6]**

$$\frac{C(s)}{R(s)} = \frac{2s+1}{s^3+3s^2+3s+1}$$

OR

Q8) a) Sketch approximate unit step response for following systems : **[10]**

System 1: Both the poles were collocated and on negative real axis.

System 2: Poles were a complex conjugate pair with negative real part.

System 3: Poles were an imaginary pair.

System 4: Both the poles were located at origin.

System 5: Poles were a complex conjugate pair with positive real part.

b) Consider a second-order unity feedback system with damping factor = 0.3 and natural frequency = 10 rad/sec. Calculate the rise time, maximum overshoot and settling time when a unit-step input is applied to the system. **[6]**

Q9) a) An integral controller is used for speed control with a setpoint of 12 rpm 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) Define Proportional control as well as Integral control with their mathematical equations. **[6]**

OR

Q10)a) Derive the equation for the control signal, u, for the Proportional Integral Derivative (PID) controller. Discuss, in detail, the advantages of adding the Integral as well as the Derivative term to the Proportional term. **[10]**

b) Discuss the step by step procedure for the manual tuning of a PID control. **[6]**

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