[5353]-519

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

MECHATRONICS

(2015 Pattern)

Time : 2½ Hours]   *[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.*

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) A potentiometer which is used to measure the rotational position of shaft has 850 turns of wire. The input range is from $-160°$ to $+160°$. The output range is from 0V to 12 V.   **[6]**

Determine

i) Sapn

ii) Sensitivity in volts per degree

iii) The average resolution in volts

b) Compare Open loop & closed Loop system.   **[7]**

c) What is Nyquist Theorem? Explain Sample & Hold Circuit.   **[7]**

OR

Q2) a) Using suitable sketch explain construction & working of stepper motor.**[6]**

b) Explain the control system used for following   **[7]**

i) Controlling the water height in tank

ii) Actuation of street lights at 6 p.m.

c) A 3 bit D/A converter is set for 0 to 10 V output range. Map all the possible digital input values to their corresponding analog output values.**[7]**

P.T.O.

Q3) a) Explain with block diagramme architecture of Programmable Logic Controller. **[8]**

b) A conveyor is run by switching on or off a motor. We are positioning parts on the conveyor with an optical detector. When the optical sensor goes on, we want to wait 1.5 seconds, and then stop the conveyor. After a delay of 2 seconds the conveyor will start again. We need to use a start and stop button - a light should be on when the system is active. **[10]**

OR

Q4) a) Discuss the selection criteria for PLC. Explain Timers & Counters. **[8]**

b) Give four normally open switches (P1, P2, Sl & S2). with DC motor(M), write PLC program to satisfy the following objectives: **[10]**

   i) When P1(Push Button) is pushed the cycle shall start. The cycle remain countinue untill P2 (stop Button) is pushed

   ii) When S1 is pushed & S2 is not pushed then motor is ON clockwise direction

   iii) When S2 is pushed & S1 is not pushed then, motor is on in counter clockwise direction

   iv) When 2 pushed program stops.

Q5) a) Using Suitable diagram explain transient response specification for second order system. **[8]**

b) For the mechanical system shown in fig. Assume M(mass) = 1kg, K(stiffness)=2N/m & b (damping) = 0.5Ns/m. The displacement x of the mass m is measured from equilibrium position. In this system the external force f(t) is input & x is the output. Determine **[8]**

   i) Transfer function

   ii) Identify location of poles & zeros.
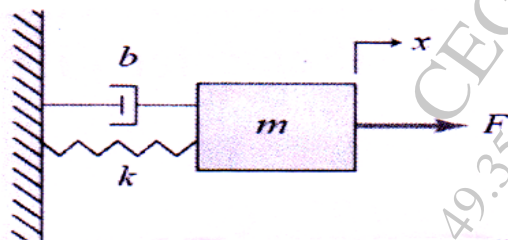
OR

Q6) a) Explain two steps of Routh Hurwetz criterion in detail. **[8]**

b) Determine the value of Delay time (Td),Rise Time (Tr),Peak time (Tp), settling time (Ts) & Peak overshoot (Mp) when control system shown in fig. is subjected to unit step input. **[8]**
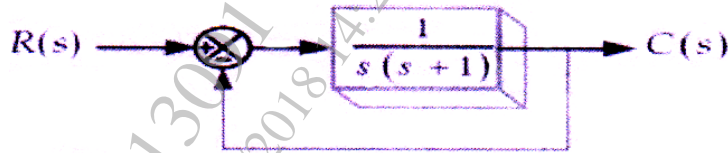
Q7) a) Compare P controller with D controller. **[6]**

b) Fig. shows as error time graph .Sketch the PD controller o/p w.r.t. time. Assume Kp = 5, Kd = 0.5 & Po = 30% (i.e. controller o/p when error is zero.) **[10]**
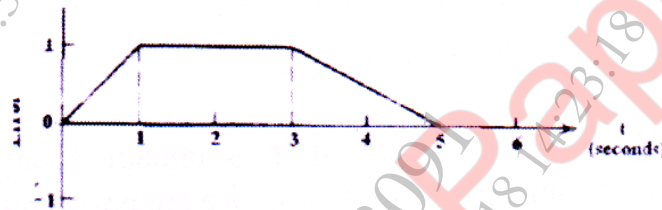

Figure 3

OR

Q8) a) Using a suitable block diagramme explain the working of PID control in parallel form. **[8]**

b) An Integral controller is used for speed control with a set point of 12rpm within a range of 10 to 15 rpm. The controller output is 22% initially. The constant Ki = –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 constant ep. **[8]**

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