

Total No. of Questions : 8]

SEAT No. :

P3976

[Total No. of Pages : 3

[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 $+160^\circ$. 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]

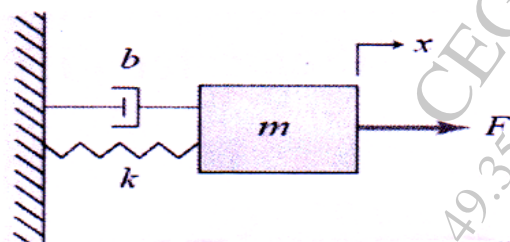
b) Give four normally open switches (P1, P2, S1 & S2). with DC motor(M), write PLC program to satisfy the following objectives: [10]

- When P1(Push Button) is pushed the cycle shall start. The cycle remain countinue untill P2 (stop Button) is pushed
- When S1 is pushed & S2 is not pushed then motor is ON clockwise direction
- When S2 is pushed & S1 is not pushed then, motor is on in counter clockwise direction
- When 2 pushed program stops.

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

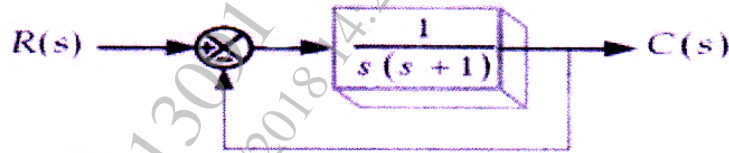
b) For the mechanical system shown in fig. Assume $M(\text{mass}) = 1\text{kg}$, $K(\text{stiffness}) = 2\text{N/m}$ & $b(\text{damping}) = 0.5\text{Ns/m}$. The displacement x of the mass m is measured from equilibrium position. In this system the external force $f(t)$ is input & x is the output. Determine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

- Transfer function
- Identify location of poles & zeros.



OR

- Q6)** a) Explain two steps of Routh Hurwitz criterion in detail. [8]
- b) Determine the value of Delay time (T_d), Rise Time (T_r), Peak time (T_p), settling time (T_s) & Peak overshoot (M_p) 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 an error time graph. Sketch the PD controller o/p w.r.t. time. Assume $K_p = 5$, $K_d = 0.5$ & $P_o = 30\%$ (i.e. controller o/p when error is zero.) [10]

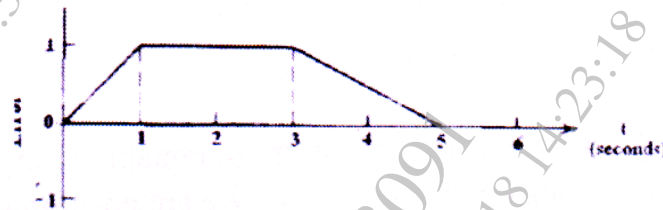


Figure 3

OR

- Q8)** a) Using a suitable block diagram 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 $K_i = -0.15\%$ controller output per second per percentage error. If the speed jumps to 13.5 rpm, calculate the controller output after 2 sec. for constant ep. [8]

