(OLD COURSE)   **QP Code : 4248**

[1]

[03 Hrs]   [Total Marks 100]

N.B.:

(1) **Question No.1 is compulsory**
(2) Attempt any **four** questions out of remaining **six** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary**.
(5) Notations carry usual meaning.

Q.1 (A) With neat sketch explain the mechatronics design process.   05
   (B) Examine stability by Routh's criterion of control system having   05
        characteristic equation
        $$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 15 = 0$$
   (C) For 8051 microcontroller draw   10
        (i) Neat functional block diagram (architecture)
        (ii) Pin diagram

Q.2 (A) Explain the functions of ports 0, 1, 2, and 3 in 8051   10
         microcontroller
   (B) Convert the following state-space system of a single input single
        output system into a transfer function: 10

$$\left\{\begin{matrix} \dot{x}_1 \\ \dot{x}_2 \end{matrix}\right\} = \begin{bmatrix} -3 & 2 \\ 1 & 1 \end{bmatrix}\left\{\begin{matrix} x_1 \\ x_2 \end{matrix}\right\} + \left\{\begin{matrix} 0 \\ 2 \end{matrix}\right\}u(t)$$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix}\left\{\begin{matrix} x_1 \\ x_2 \end{matrix}\right\}.$$

        Here x_1 and x_2 are state-variables, u(t) is a force vector and y(t)
        being the system response.

Q.3 (A) Two double acting hydraulic cylinders A, B are selected for an   10
         industrial application. The sequence of movement for cylinder
         piston is proposed as below—

                      A+ Delay B+ (AB)-

         Draw step displacement diagram and develop the electrohydraulic
         circuit using 4/3 double solenoid as final directional control valves.
         The piston motions mentioned in bracket is simultaneous.

   (B) Explain following set of instructions of 8051 microcontroller   10
              1. MOV, 2. PUSH, 3. SUBB, 4. DEC, 5. XCHD

                                                              [Please Turn Over]

Q.4 (A) Draw programmable ladder logic diagram for the following sequence of motion of double acting cylinder A (select appropriate final directional control valve):   10

Delay A+ Delay A-

(B) With a neat sketch explain interfacing of HEX-Keyboard with 8051 microcontroller.   10

Q.5(A) Two pneumatic cylinders: A (single acting) and B (double acting) are selected for an industrial application. The sequence of movement for cylinder piston is as proposed below—   10

A+ B+A- Delay B-

Further, 3/2 single solenoid spring return valve for cylinder A and 5/2 double solenoid valve for cylinder B is selected to act as a final directional control valve.

Design electropneumatic circuit for the proposed sequence.

(B) Write a note on i) ON/OFF controller, ii) servomotor   10

Q.6 (A) Draw the root-locus of the control system whose open-loop transfer function is given by   10

$$G(S)H(S) = \frac{K(S+2)}{S(S+5)(S+8)}$$

(B) Define and classify control system   05

(C) What is proportional-integral-differential (PID) controller? Explain role of each of the constituents with neat sketch.   05

Q.7 (A) Sketch Bode plot and assess the stability for the control system having open loop transfer function   10

$$G(S)H(S) = \frac{800}{S^2(S+20)}$$

(B) The transfer function of a system is given as $\dfrac{361}{(S^2 +16S +361)}$. Find the following for a unit step input: 10

(a) Undamped natural frequency
(b) Damping ratio
(c) Damped natural frequency
(d) Settling time
(e) Peak time
(f) Rise time
(g) Percentage overshoot.