

(3 Hours)

[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**.

1. (a) Explain execution of simple turning operation on CNC lathe machine in reference to the following key elements of Mechatronics — **10**
- (i) Information Systems
 - (ii) Mechanical Systems
 - (iii) Electrical Systems
 - (iv) Computer Systems
 - (v) Sensors and Actuators
 - (vi) Real-Time Interfacing.
- (b) Explain instructions CMP M, ORA R, LDA, LXI R_p, INR R. **5**
- (c) Using Routh's criterion examine the stability of the control systems, whose characteristics equation is given as — **5**
- $$S^8 + 5S^6 + 2S^4 + 3S^2 + 1 = 0$$
2. (a) Explain the architecture of 8086 microprocessor with neat sketch. **10**
- (b) (i) Differentiate between Electrical Drives and Actuators **10**
- (ii) Explain basic concept in serial I/O.
3. (a) Two double acting pneumatic cylinders A, B are selected for an industrial application. The sequence of movement for cylinder is as indicated below — **10**
- (AB) + Delay (AB)–
- Draw the electropneumatic circuit using 5/2 double solenoid as final directional control valves. The auxiliary condition is that single cycle or multi-cycle can be selected.
- (b) A unity feedback robot arm has a open-loop transfer function — **10**
- $$G(S) = \frac{300(S + 100)}{(S + 10)(S + 40)}$$
- Draw Bode plot and comment on its stability.
4. (a) Draw programmable logic diagram for the following sequence of operation — **10**
- Delay A+ Delay A–
- (b) Write short notes on — **10**
- (i) Adaptive control in manufacturing
 - (ii) Relays.
5. (a) Two double acting hydraulic cylinders A, B are selected for an industrial application. **10**
- The sequence of movement for cylinder is as indicated below—
- Delay A+ Delay B+ Delay B– A–
- Draw the electrohydraulic circuit using 4/3 double solenoid as final directional Control valves.

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- (b) Explain 8253 with functional block diagram. **5**
- (c) For an unity feedback system, output response is observed as — **5**
 $C(t) = 1 + 0.504 e^{-3.07t} - 1.504 e^{-2.18t}$
 Determine its natural frequency and damping ratio. Assume unit step input.

6. (a) Write short note on reduction gear stepper motor. **5**
- (b) Explain successive approximation A/D converter. **5**
- (c) Sketch the Polar Plot for **10**

$$G(S)H(S) = \frac{100}{(S+2)}$$

7. (a) The world's largest telescope has primary mirror of diameter of 10 m and consists of a mosaic of 36 hexagonal segments with the orientations of each segment actively controlled. This unity feedback system for the mirror segments has — **10**

$$G(S) = \frac{K(S+0.5)}{S(S^2+2S+2)}$$

Sketch the root locus for the above mentioned control system.

- (b) A second order system has unity feedback and open loop transfer function — **10**

$$G(S) = \frac{500}{S(S+15)}$$

- (i) Draw the block diagram for closed loop system.
- (ii) What is characteristic equation ?
- (iii) What is damping ratio and natural frequency values ?
- (iv) Calculate peak time, peak overshoot and settling time for the system output when excited by unit step input.
- (v) Sketch transient response for unit step input.
- (vi) If input is ramp of 0.5 rad/s, calculate steady state error.
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