

**N.B. :** (1) Question No. 1 is **compulsory**.

(2) Attempt any **four** questions out of remaining **six** questions.

(3) Assume **suitable** data wherever **required** and justify the **same**.

1. Answer any **four** of the following. 20
  - (a) Explain the importance of real time interfacing system in mechatronics? State the different types of the interface systems.
  - (b) What is simulation of mechatronics systems ? Explain the basic functions and different steps in simulation process of mechatronic systems.
  - (c) Give the classification of the different types of sensors used in mechatronics and explain them.
  - (d) Write fundamental laws, which are used in mechatronics where applications involved with rigid body systems are used.
  - (e) Explain fluid power energy input devices.
  
2. (a) What are the advanced approaches in mechatronics? Explain it with the help of model based monitoring system. 10  
(b) For the transformer with input voltage  $V$ ,  $N_1$  &  $N_2$  be the number of turns of primary and secondary winding respectively,  $R_1$  and  $L_1$  a series resistance and inductance at the primary,  $Z_{load}$  – the load impedance at the secondary coil,  $I_1$  and  $I_2$  the primary and secondary current. Draw the transformer circuit, transformer impedance diagram and transformer block diagram. 10
  
3. (a) For a permanent magnet Stepper motor, Derive and explain the top level block diagram and drive circuit model. Hence give block diagram for four phase PM stepper motor model. 12  
(b) Explain the importance of zero and span circuit. Design a Zero and Span circuit for a pressure sensor and A/D converter for the following specifications. P- Pressure,  $V_T$ - Sensor output,  $V_0$  – Output of amplifier  
at  $P = 0$ ,  $V_T = 1.2V$ ,  $V_0 = 0V$  at  $P = 100$  psia,  $V_T = 2.2 V$ ,  $V_0 = 5V$ . 8
  
4. (a) Design a PI Controller using Bode Technique for the plant  $G(s) = 1/(S + 10)$ , such that following performance spec are met,  $ess(step) = 0$ ,  $ess(ramp) \leq 0.05$   $\xi = 1$ ,  $\tau = 0.1$  sec. The system is stable. 12  
(b) What is Fuzzy control? Explain the elements of Fuzzy logic system. 8
  
5. (a) Device a circuit that could be used with a conveyor belt which is used to move an item to a work station. The presence of the item is detected by means of a breaking a contact activated by a beam of light to a photosensor. There it stops for 100 S for an operation to be carried out before moving on and off the conveyor. The motor and the belt is started by a normally open start switch and stopped in normally closed switch. 10  
(b) Explain various methods of PID controller tuning. 5  
(c) Explain the basic functions of various components of DAS and control system. 5
  
6. (a) Explain series and parallel mechanical elements. What is grounded-chair representation ? Explain. 10  
(b) Three mode controller has  $K_p$  as 2,  $K_I$  as  $0.1/S$ ,  $K_D$  as  $1.0 S$ , and a set point output of 50%. The error start at zero and changes at  $5\%/S$  for 2 S before becoming constant for 3 S. It then decreases at  $2\%$  to zero and remains at zero. What will be the controller output at : (i) 0 Sec, (ii) 3 Sec, (iii) 7 Sec ? 10
  
7. Write short notes on the following :- 20
  - (a) Velocity Control
  - (b) Converting impedance diagram into block diagram
  - (c) Micro-sensors
  - (d) Over-framing.