

- N.B. :** (1) Question No. 1 is **compulsory**.  
 (2) Attempt any **four** out of remaining **six** questions.  
 (3) Assume **suitable** data wherever **necessary**.

1. (a) Explain reach and stroke of a robot. 5  
 (b) Discuss Total Work Envelope (TWE) and Dexterous Work Envelope (DWE). 5  
 (c) Compare area and line descriptors. 5  
 (d) Differentiate between hard and soft automation. 5

2. (a) Explain D-H algorithm. Develop D. K. analysis of 4 axis SCARA robot. 15  
 (b) Explain composite rotation matrix (CRM) algorithm. 5

3. (a) Discuss work envelope of a 4 axis SCARA robot. 10  
 (b) Develop IK analysis of 2-axis planar articulated Robot. 10

4. (a) Explain how straight line motion can be obtained using an articulated robot. 10  
 (b) Explain linear interpolation with parabolic blends. Discuss its advantages over piecewise linear interpolation. 10

5. (a) 10

0	0	1	1	0	0
1	1	1	1	1	1
0	0	1	1	0	0

For the above image, calculate area, centroid, first order moments, second order moments, central moments and principal angle.

- (b) Discuss edge detection technique. Explain the significance of edge threshold. 10

6. (a) Compare the joint variable vector  $q = [q_1, q_2, q_3, q_4]^T$  for the following TCV of SCARA.  $w(q) = [203.4, 662.7, 557, 0, 0, -1.649]^T$ . 10

- (b) Explain the effect of Moment of Inertia on the dynamic performance of a robot. 10

7. Short notes on :- 20

- (a) Shrink and Swell operators  
 (b) Gross motion planning  
 (c) Robot classification.

Con. 5615-10.

(3 Hours)

[Total Marks : 100]

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  - (4) Illustrate answers with **sketches** wherever **required**.
  - (5) **Figures** to the **right** indicate **full** marks.
1. (a) What is simulation of Mechatronics system ? Explain the basic functions and 20  
different steps in simulation process of Mechatronics system.
  - (b) Give different types of volume control valves and explain in brief.
  - (c) Explain various tuning methods of PID controller.
  - (d) Explain ultrasonic sensors with neat diagrams.
  2. (a) Explain Mechatronics design process in detail with neat diagram. 8
  - (b) Explain various properties of sensor. 8
  - (c) What is Range sensor and what are its applications ? 4
  3. (a) Explain construction and applications of brushless D.C.Motor. 5
  - (b) Explain construction and operation of stepper motor. 5
  - (c) Explain Data Acquisition and Control System. 10
  4. (a) Draw the ladder diagram for the following :- 12  
As start push button is pressed – Motor M1 is ON for 10 sec. and heater is ON  
for 15 sec. After 20 sec. Motor3 is ON for 05 sec. If inbetween stop button is  
pressed all above stops.
  - (b) Explain Temperature sensors used in Mechatronics. 8
  5. (a) Explain P, PI, PD and PID controller with the help of circuit diagram. 8
  - (b) What is adaptive control system ? Compare the performance of different adaptive 12  
control system.
  6. (a) What is Fuzzy logic ? What are the applications of Fuzzy logic in Mechatronics. 10
  - (b) Explain Mechatronics control in Automated manufacturing in details with diagrams. 10
  7. (a) Write the steps the installation of I/O cards and software. 8
  - (b) What is Microsensor ? Give the basic fabrication process steps of Microsensor. 8
  - (c) Explain Digital controller with neat block diagram. 4



Con. 6237-10.

(3 Hours)

[ Total Marks : 100

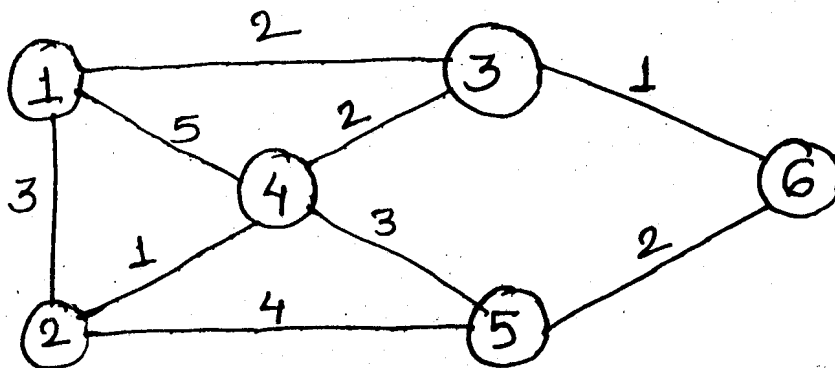
- N.B. :** (1) Question No. 1 is **compulsory**.  
 (2) Attempt any **four** questions from the remaining.  
 (3) Assume **suitable** data if **necessary**.  
 (4) **Illustrate** answers with sketches whenever **required**.  
 (5) **Figures** to the **right** indicate **full** marks.

1. Answer any four :- 20
- (a) Explain the turn on and turn off characteristics of SCR.
  - (b) Explain the triggering circuit using IC TBA 785.
  - (c) Need of cooling of a power device in detail.
  - (d) What is inverter ? Explain voltage commutated inverter with neat diagram.
  - (e) Draw and explain the operating regions of IM with the help of torques - speed characteristics.
  - (f) Draw and explain two quadrant chopper operation.
2. (a) Explain the operating modes of TRIAC. Draw and explain the operation of fan regulator circuit with DIAC - TRIAC arrangement. 10
- (b) Explain the pulse triggering method using UJT synchronized circuit for full wave configuration with suitable waveforms. 10
3. (a) Draw and explain series inverter circuit with suitable waveforms. Also state the limitations of series inverter. 10
- (b) Draw and explain auxiliary commutated single phase bridge inverter by using some suitable voltage and current waveforms. 10
4. (a) Explain the operation of Jones chopper alongwith the waveforms at - 10
- (i) Voltage at main SCR & current
  - (ii) Voltage and current at auxiliary SCR
  - (iii) Voltage across capacitor
  - (iv) Voltage across load.
- (b) Derive the expressions for commutating components L & C for a voltage commutated chopper. Also, discuss the assumptions made for designing the components. 10
5. (a) Draw the neat diagram for 3- $\phi$  semiconverter feeding highly inductive load. Assuming continuous and ripple free output current. Draw the output voltage waveforms for  $\alpha = 30^\circ$ , measured from natural angle delay i.e.  $\pi/6$ . Clearly show the conducting sequence of the devices. 10
- (b) In single phase fully controlled bridge rectifier feeding with active load. Derive and draw the necessary waveforms - 10
- (i) Average load voltage
  - (ii) Average and rms load current.
6. (a) Explain the slip-power recovery scheme in a.c. drives. 10
- (b) Draw and explain the power ckt. of semiconverter feeding separately excited d.c. motor. Explain with typical voltage and current waveforms, the operation in continuous and discontinuous armature current mode. 10

6. (a) Explain the slip-power recovery scheme in a.c. drives. 10
- (b) Draw and explain the power ckt. of semiconverter feeding separately excited d.c. motor. Explain with typical voltage and current waveforms, the operation in continuous and discontinuous armature current mode. 10
7. Write short notes on any **four** :- 20
- (a) Effect of source inductance on output voltage of FWCR
- (b) V-I characteristic of SCR
- (c)  $\frac{dv}{dt}$  and  $\frac{di}{dt}$  protection circuits.
- (d) Parallel inverter
- (e) V/f control for IM.
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- N.B.** (1) Question No. 1 is compulsory.  
 (2) Attempt any four questions out of remaining six questions.  
 (3) Assume suitable data if necessary.

1. (a) How do the layers of TCP/IP model correlate to the layers of OSI model ? 5  
 (b) Distinguish between the ATM and frame relay. 5  
 (c) What are the conditions to be satisfied for a valid CRC generator polynomial ? 5  
 Draw the block diagram of CRC generator. 5  
 (d) Explain CSMA/CD protocol. 5
2. (a) Explain ADSL in detail. 10  
 (b) What are the different types of circuit switches ? Explain each with neat diagrams. Also explain blocking in circuit switches. 10
3. (a) Sketch HDLC frame structure. With respect to it explain — 10  
 (i) Piggybacking  
 (ii) Bit stuffing  
 (iii) Data transfer modes  
 (iv) Types of frames in HDLC.  
 (b) Compare Go-back-N ARQ and selective reject ARQ. What is the maximum window size for both ? 10
4. (a) What is congestion control in packet switched network ? How it can be avoided ? 10  
 (b) Differentiate between :— 10  
 (i) Statistical TDM and synchronous TDM.  
 (ii) In band signalling and out band signalling.
5. (a) Apply Dijkstra's and Bellman Ford algorithm to the given network and find the least cost path between the source node 1 to all other nodes. 10



- (b) Explain LAN protocol architecture with IEEE 802 reference. Sketch the general MAC frame format and LLC PDU structure. Explain the functions of different fields. 10

6. (a) Explain ISDN with the help of :— 10  
    (i) Architecture and  
    (ii) ISDN channels.
- (b) Explain ATM adaptation layer and ATM cell in detail. 10
7. Write short notes on any **four** of the following :— 20
- (a) DTE-DCE interface
  - (b) FDM
  - (c) SS7
  - (d) FDDI
  - (e) Transmission Impairments.
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