(3 Hours)   **[Total Marks: 80]**

N.B:
     (1) Question No.1 is **compulsory.**
     (2) Answer any **three** questions from Question Nos. 2 to 6.
     (3) Assume suitable data if necessary.

1   Answer any FOUR of the following questions:-

     (a) Justify-Vapor recompression enhances the efficiency of   5
        evaporators.
     (b) Explain the need of vacuum distillation. How pressure control   5
        is achieved in such type of distillation.
     (c) Explain terms- Fouling and LMTD in relation to heat   5
        exchanger.
     (d) Discuss start-up heater controls with safety interlock.   5
     (e) Discuss instrumentation involved and technique used in   5
        process of milk pasteurization.

2   (a) Explain shrink and swell effect. How reduction in shrink and   10
        swell effect is achieved using three element drum level control.
     (b) How hot spot and cold spot formation is controlled in reactor.   10
        Draw and explain with control scheme.

3   (a) Draw process flow diagram of Iron and steel industry. Discuss   10
        instrumentation hardware involved in it.
     (b) Draw distillation tower and explain function of each part. Also   10
        discuss types of distillation.

4   (a) Draw crystallization curve. Discuss in which region   10
        crystallization process is carried out and why?
     (b) With PI & D explain cooling crystallizer with its control.   05
     (c) Discuss surge phenomenon in compressor. Draw and explain   05
        anti-surge control scheme.

5   (a) Explain the term Dryer. Draw and explain atmospheric tray   10
        dryer control scheme.
     (b) Define intrinsic safety. Discuss the techniques to reduce   10
        explosion hazard.

6   (a) Draw and explain selective control scheme of evaporator.   10
     (b) Draw and explain feed forward and bypass control scheme of   10
        heat exchanger.

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Duration: 03 Hours.   **Total marks: 80**

Instructions to the candidates:-

N.B. (1) Question No. **1** is **compulsory**.
  (2) Answer any **Three** out of remaining questions.
  (3) Assumptions made should be **clearly** stated.

Q.1 Solve any **Four**   **20**

 a) Explain refractory periods of cell

 b) What is blood circulation? Explain its types

 c) What are CNS and PNS of human body?

 d) What is Hounsfield Number in CT?

 e) Compare direct and indirect blood pressure measurement

Q.2 a) Explain generation of Action potential and its propagation   **10**

 b) Explain respiratory track and measurement of respiratory parameters   **10**

Q.3 a) Explain EEG measurement with 10-20 Electrode system   **10**

 b) What is Cardiac Output? Explain its measurement with suitable diagram   **10**

Q.4 a) Compare X ray, CT and Ultrasound imaging   **10**

 b) What is fibrillation? Explain working of DC defibrillator machine   **10**

Q.5 a) Explain working of heart lung machine   **10**

 b) Explain earthing and ground schemes for medical equipment's   **10**

Q.6 a) What is NMR? Explain MRI principle   **10**

 b) Explain working of X ray machine with block diagram   **10**

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Sem - VII - CBSGS.

Duration: 3 Hours   **Total Marks :80**

Note:

1. Question one is compulsory.

2. Solve any three from remaining and suitable data

Q1.   **Solve any four**   20

a.   Explain in detail Physical nonlinearity which has memory?

b.   Draw sinusoidal response of saturation with dead zone nonlinearity and write the response equation.

c.   Differentiate linear and nonlinear system in detail

d.   Explain Lyapnov theorem in details

e.   Derive classical control "c" from the IMC controller 'q'

Q2. a   10

     Explain in detail Jump response with example

Q2. b   Formulate the describing function for relay with dead zone.   10

Q3.a   For the system described by, investigate variant gradient method to find Lyapnov's function   10
        For non linear system,

$$\dot{x}_1 = -2x_2$$

$$\dot{x}_2 = -2x_2 + 2x_1 x_2^2$$

Q3.b   Design the optimal controller via Riccati equation for the system   10

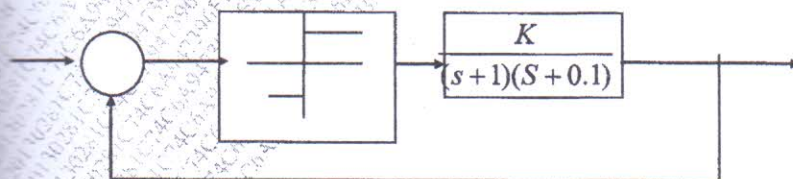$$\dot{x} = \begin{bmatrix} 0 & 1 \\ 2 & -1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

        to minimize the performance index

$$J = \int_0^\infty (x_1^2 + x_2^2 + u^2) dt$$

Q4.a   Investigate Stability using Describing function of following system which has unity relay   10
        signal as a nonlinearity.

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Q4.b. Determine stability using Krasovskii method   10

$$\dot{X}_1 = -X_1;$$

$$\dot{X}_2 = X_1 - 2X_2 - X_2^3$$

Q5.a. Explain in details IMC based PID controller Design/tuning.   10

Q5.b. Using different equilibrium point comment of singular point and draw trajectories   10

$$\dot{x}_1 = -x_1^3 + x_2$$
$$\dot{x}_2 = x_1 - x_2^3$$

Q6a. Give definition of 1,2, and ∞ norm   04

Q6b Compute 2-norm of following,   06

$$A = \begin{bmatrix} 0.8 & 0 \\ 0 & 1.7 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 0 \\ 0 & 5 \end{bmatrix}$$

Q6c   10

Draw Phase trajectory using delta method for given system and comment of stability, intinal condition is (0,0)

$$\ddot{x} + 5\dot{x} + 4x = 0$$

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N.B: (1) Question No. **1** is compulsory.
(2) Attempt any **Three** questions from remaining.
(3) Figures to the right indicate full marks.

1. Answer the following: -   [20]
   a) List the technical necessity and state the expectations of automation.
   b) Explain the programming devices that are used to enter the program in PLC.
   c) What is data highway? Discuss the relative features of a data highway.
   d) With neat block schematic, explain the functions of RTU.

2. a) A railway station has 3 platforms A, B and C. A train is coming into the station.
      It has to be given entry to platform A if A is empty. If both A and B are occupied
      then it has to be given to platform C. If all the platforms are full, then the train has to wait.
      Design the necessary ladder logic diagram.
   b) Explain the various selection criteria that must be considered for selection of a suitable   [05]
      PLC for a specific process control.
   c) Explain sinking and sourcing input modules of PLC with neat diagram.   [05]
                                                                                                     [10]

3. a) What is the need of DCS integrating with PLC and Computer?
      Explain the methods of integration.
   b) With neat block diagram, explain Hybrid control system architecture.   [10]
                                                                                                     [10]

4. a) Explain with neat diagram, a system that allows an MTU to store data in central data store.   [10]
   b) What is Scan interval of SCADA?
      Explain the factors affecting the scan interval with examples.
                                                                                                     [10]

5. a) What is ERP? Explain the typical modules of ERP.
   b) Explain the terms: - i) Alarm Suppression, ii) Alarm Rationalization.   [05]
   c) Explain IEC 61508 life cycle model.   [05]
                                                                                                     [10]

6. Write note on: - (Any Two)   [20]
   a) Advanced PLC instructions.
   b) Hierarchical levels in any automated plant.
   c) MES and layers of communications between business and control system.

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[Time: 3 Hours]   **[Marks:80]**

Please check whether you have got the right question paper.

N.B: 1. Question No.1 is compulsory.
         2. Solve any three questions of the remaining questions.
         3. Assume any suitable data if required.

Q.1	Answer the following **(any four):-**	20
a.	Explain discrete cosine transform.	
b.	Distinguish between Global, Local and Dynamic Thresholding.	
c.	Explain the Masks for Point detection and Line detection.	
d.	Classify image compression techniques. Give examples.	
e.	What do you mean by unitary matrix and orthogonal matrix?	

Q.2 a. Code the following data stream using Huffman coding aaaaaabbbccccdde   10

      b. Perform Histogram equalization for following Image. Plot original and the   10
equalized histogram

5	6	5	2	5
5	6	4	6	6
1	0	5	3	5
1	5	3	6	6
1	5	5	7	5

Q.3 a. Given are five points, use Hough Transform to draw a line joining these   10
points.
(1,4) (2,3) (3,1) (4,1) (5,0)

      b. Let v={0,1} . Compute distances D_e, D_4, D_8 and D_m; between pixels p(3,0)   10
and q(2,3)

0	1	1	1
1	0	0	1
1	1	1	1_q
1_p	1	1	1

Q.4 a. Explain with block diagram Fundamental steps in Digital Image Processing.   10

      b. Explain the properties of 2-D DFT.   10

Q.5 a. Explain Region Based Segmentation.   10

      b. Explain following morphological operations.   10
i) Dilation ii) Erosion iii) Opening iv) Closing

Q.6   Write short notes on the following: 20
a. Haar Transform
b. Weiner filter
c. High Boost Filter
d. Homomorphic Filter

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Sem-VII - CBSGS.

(3 Hours)

Total Marks: 80

N.B. 1. Question No.01 is **compulsory**

    2. Attempt any **Three** questions from remaining **Five** questions

    3. Assume suitable data wherever required

1.   Answer the following (Any Four)   20

   a. Compare basic process control system and SIS.
   b. What is safety life cycle? Discuss the need of SLC.
   c. What do you understand by mutually exclusive and non- mutually exclusive event? Explain.
   d. An explosion in the process area of a plant does not affect any normally occupied buildings. The personnel density is 0.002 per square meter and the capital density is 150000 per square meter. The explosion has fatality effect zone of $5600 m^2$ and equipment damage effect zone of $2400\ m^2$. The vulnerability of both personnel and capital in these effect zones is 100 percent. What is the consequence of this explosion in terms of probable loss of life (PLL) and estimated value (EV).
   e. What is low demand mode and high demand mode operation for SIL selection? Explain.

2. a. Draw and explain safety life cycle for IEC 61508.   10

   b. A hazard assessment team considers two recommended safety instrumented functions (SIFs). They have performed quantitative analysis of the risk, yielding a consequence of PLL= 0.21 for the first event and a consequence of PLL= 2.5 for the second event. A LOPA yielded likelihood of 1/576 events per year for both events. The facility for which this SIF is being considered has a maximum individual risk of fatality criterion of 2.0×10^{-5} and uses 'risk-averse' societal risk criteria where the risk aversion factor is 2. Using an SIL- only assignment, an SIL-plus-RRF assignment, and a 'fractional' SIL assignment, Select the most appropriate safety integrity level specification for this situation.   10

3. a. Discuss in detail risk matrix method for SIL determination.   10
   b. Discuss in detail prevention layers.   10

4. a. Explain in detail fault propagation modelling for likelihood analysis.   10
   b. What is safety instrumented function? Explain in detail using any examples.   10

5. a. Write advantages and disadvantages of relay system and solid state device system. 10
   b. What are the methods uses for consequence analysis? Explain in detail.   10

6. a. Consider a system composed of a transmitter, controller, and valve. 10
   The probability of failure, over the next five-year period, for each of the components
   is as follows:-

   $$P_{f,transmitter} = 0.15 \quad P_{f,controller} = 0.008, \quad P_{f,valve} = 0.19$$

   Over the next five-year interval, what is the probability of success of this system?

   (Use AND and OR logics ,and compare the solution)

   b. Explain in detail the SIL determination using risk graph method. 10

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