

(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 evaporators. 5
 - (b) Explain the need of vacuum distillation. How pressure control is achieved in such type of distillation. 5
 - (c) Explain terms- Fouling and LMTD in relation to heat exchanger. 5
 - (d) Discuss start-up heater controls with safety interlock. 5
 - (e) Discuss instrumentation involved and technique used in process of milk pasteurization. 5
- 2
 - (a) Explain shrink and swell effect. How reduction in shrink and swell effect is achieved using three element drum level control. 10
 - (b) How hot spot and cold spot formation is controlled in reactor. Draw and explain with control scheme. 10
- 3
 - (a) Draw process flow diagram of Iron and steel industry. Discuss instrumentation hardware involved in it. 10
 - (b) Draw distillation tower and explain function of each part. Also discuss types of distillation. 10
- 4
 - (a) Draw crystallization curve. Discuss in which region crystallization process is carried out and why? 10
 - (b) With PI & D explain cooling crystallizer with its control. 05
 - (c) Discuss surge phenomenon in compressor. Draw and explain anti-surge control scheme. 05
- 5
 - (a) Explain the term Dryer. Draw and explain atmospheric tray dryer control scheme. 10
 - (b) Define intrinsic safety. Discuss the techniques to reduce explosion hazard. 10
- 6
 - (a) Draw and explain selective control scheme of evaporator. 10
 - (b) Draw and explain feed forward and bypass control scheme of heat exchanger. 10

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**

- Explain refractory periods of cell
- What is blood circulation? Explain its types
- What are CNS and PNS of human body?
- What is Hounsfield Number in CT?
- 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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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 Lyapunov 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

10

Formulate the describing function for relay with dead zone.

Q3.a

10

For the system described by, investigate variant gradient method to find Lyapunov’s function For non linear system,

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

$$\dot{x}_2 = -2x_2 + 2x_1x_2^2$$

Q3.b.

10

Design the optimal controller via Riccati equation for the system

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

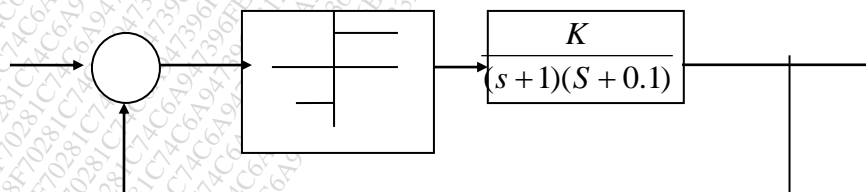
to minimize the performance index

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

Q4.a.

10

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



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, initial condition is (0,0)

$$x^2 + 5x + 4x = 0$$

- 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. [05]
 - b) Explain the various selection criteria that must be considered for selection of a suitable PLC for a specific process control. [05]
 - c) Explain sinking and sourcing input modules of PLC with neat diagram. [10]

3. a) What is the need of DCS integrating with PLC and Computer? Explain the methods of integration. [10]
 - b) With neat block diagram, explain Hybrid control system architecture. [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. [05]
 - b) Explain the terms: - i) Alarm Suppression, ii) Alarm Rationalization. [05]
 - c) Explain IEC 61508 life cycle model. [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.

N.B.:

- 1) Question no.1 is compulsory.
- 2) Attempt any three questions out of remaining five questions.
- 3) Assume suitable data if necessary.

- | | | |
|---|---|----|
| 1 | Solve following | 20 |
| | a Explain thumb mode of ARM7TDMI core and compare it with normal mode | |
| | b Explain watchdog and its applications | |
| | c Explain embedded system project development cycle | |
| | d List features of LPC2148 | |
| 2 | a Explain programming model of LPC2148. | 10 |
| | b Explain on chip ADC module of LPC2148 and Write c code to initialize the ADC. | 10 |
| 3 | a Explain PWM signal generation using LPC2148. | 10 |
| | b Explain interrupt handling in LPC2148. | 10 |
| 4 | a Explain heater controller application with PID controller | 10 |
| | b Explain serial port programming for communication with PC | 10 |
| 5 | a Explain task scheduling algorithms used in RTOS. | 10 |
| | b Explain semaphores, mutex, MessageBox and Queue | 10 |
| 6 | Answer any two | 20 |
| | a Explain interrupt handling in LPC2148. | |
| | b Write brief note on CPLD and FPGA | |
| | c Explain priority inversion problem and its solution | |

[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 aaaaaabbbcccccddde **10**
- b. Perform Histogram equalization for following Image. Plot original and the equalized histogram **10**

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 points. **10**
(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 $p(3,0)$ and $q(2,3)$ **10**

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

(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 5600m² and equipment damage effect zone of 2400 m². 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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(3 Hours)

Total Marks: 80

- N. B. 1) Question No. 1 is compulsory.
 2) Answer any 3 questions from the remaining 5 questions.
 3) Assume suitable data wherever necessary.

Q1 (a) Explain global maxima and local maxima with an example. 20

(b) Determine whether the following function is convex or concave:

$$f(X) = -8x^2$$

(c) Write dual of the following:

$$\text{Minimize } Z = 3x_1 - 2x_2 + 4x_3$$

$$\text{subject to } 3x_1 + 5x_2 + 4x_3 \geq 7$$

$$6x_1 + x_2 + 3x_3 \geq 4$$

$$7x_1 - 2x_2 - x_3 \leq 10$$

$$x_1 - 2x_2 + 5x_3 \geq 3$$

$$4x_1 + 7x_2 - 2x_3 \geq 2$$

$$x_1, x_2, x_3 \geq 0$$

(d) Determine whether the given direction at the point is direction of descent for the following function:

$$f(X) = x_1^2 + x_2^2 - 2x_1 - 2x_2 + 4; d = (2,1) \text{ at } X = (1,1)$$

Q2 (a) A firm manufactures two products A & B on which the profits earned per unit 20

are Rs.3 and Rs.4 respectively. Each product is processed on two machines M1 and M2. product A requires one minute of processing time on M1 and two minutes on M2, while B requires one minute on M1 and two minutes on M2. Machine M1 is available for not more than 7 hrs 30 min, while Machine M2 is available for not more than 10 hrs during any working day. Find the number of units of product A and B to be manufactured to get maximum profit.

$$\text{Maximize } Z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2$$

(b) *subject to* $x_1 + 2x_2 = 2,$

$$x_1, x_2 \geq 0$$

TURN OVER

- Q3 (a) Minimize $f(x_1, x_2) = x_1^2 + x_2^2 - 2x_1x_2$ using Conjugate Gradient Method starting at point (1,0). 20
 (b) What is statement of optimization problem? Explain following terminology – design vector, objective function, design constraints, constraint surface.

- Q4 (a) Verify the K-T conditions for the following: 20
 Maximize $Z = 10x_1 + 4x_2 - 2x_1^2 - x_2^2$
 subject to $2x_1 + x_2 \leq 5$,
 $x_1, x_2 \geq 0$

- (b) Write component continuity equation for a perfectly mixed batch reactor with simultaneous reactions (first order, isothermal)



- Q5 (a) Z can be expressed as a function of x and y as $Z = ax + b \ln(xy)$ where, a and b are constants. The data relating these variables is listed below 20

Z	2	5	4
x	1	2	2
y	2	1	2

Determine values of a and b that give the best fit of the equation to the data using least squares technique.

- (b) Solve by Two phase method

$$\text{Maximize } Z = x_1 + 2x_2$$

$$\text{subject to } -x_1 + 3x_2 \leq 10$$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$x_1 + 3x_2 \geq 2$$

$$x_1, x_2 \geq 0$$

- Q6 (a) State and prove properties of gradient vector.
 (b) Find the maximum of the function $f(x) = x - 4x + e^x$. Using golden section method within an accuracy of 0.01, let b = 3 and a = 0.

Duration 3Hrs**Total Marks: 80**

Note: Question 1 is compulsory based on entire syllabus.

Solve any 3 main questions out of remaining.

Q1 Answer any four

20 marks

- What is the multipath propagation? Draw diagram and explain
- What is WiFi? Explain.
- Compare TDMA CDMA
- What is the work of security manager in W-HART?
- How do paging system work?

Q2. Answer the following

- Compare i-mode versus WAP 10marks
- What is WSN? Explain in detail. What are the applications of WSN 10marks

Q3 Answer the following

- Draw and explain block diagram (showing all components) of W-HART 10marks
- What is O-QPSK? Draw the pulse stream diagram showing O-QPSK 10marks

Q4 Answer the following

- Explain minimum phase shift keying MSK. 10marks
- What is FHSS? Explain 10marks

Q5 Answer the following

- Explain Bluetooth and its architecture 10marks
- Draw the WAP programming model and explain. 10marks

Q6 Write short notes on (any four)

20marks

- Frequency reuse pattern 7.
 - Present scenario in wireless communication
 - OFDM technique
 - System redundancy in W-HART
 - Compare 1G, 2G, 3G, 4G
-