

(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**.

(4) Draw neat diagram with proper labeling.

(5) Figures on the right side indicate full marks.

1 Answer any **four**:-

- (a) Justify-Distillation column control is considered to the most difficult task. 5
- (b) Discuss the crystallization process with different regions. 5
- (c) Explain the control parameters in gas turbine. 5
- (d) Explain the need of safety interlock associated with boiler. 5
- (e) Discuss design of hazard free industry. 5

- 2 (a) Explain any two distillation column control strategies. 10
- (b) Explain the objectives of combustion control in Boiler. 5
- (c) How economy is improved using bypass control scheme for H.E. 5

- 3 (a) What is dryer? Explain atmospheric tray dryer control scheme with safety interlocks. 10
- (b) What is necessity of selective control scheme for evaporator, explain with diagram. 10

- 4 (a) With neat block diagram explain the process involved in refinery and also discuss the role of instrumentation engineer. 10
- (b) Explain the following processes: 10
  - i. Penicillin-G production.
  - ii. Milk pasteurization.

- 5 (a) Explain the process flow diagram in iron and steel industry. 10
- (b) Discuss the methods of super saturation in crystallization? Explain construction and operation of circulation magma crystallizer. 10

- 6 Write short notes (any TWO):- 20
  - (a) Temperature control scheme for reactor.
  - (b) Surge and its control techniques in compressor.
  - (c) Furnace control scheme with interlocks.



Duration: 03 Hours.

Total marks: 80

Instructions to the candidates if any:-

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

Q. No.	Marks
Q. 1 Solve any <b>Four</b>	20
a) Classify Human Nervous System	
b) Explain propagation of Action Potential	
c) Explain Half Cell Potential and over potential of Electrode	
d) What is Hounsfield Number in CT?	
e) Compare direct and indirect blood pressure measurement	
Q. 2 a) Explain correlation of heart sounds with electrical and mechanical events of cardiac cycle	10
b) What is evoked potential? Explain EEG recording with suitable block diagram	10
Q. 3 a) Explain EMG measurement with block diagram	10
b) Explain Electrode -Skin interface with its equivalent circuit diagram	10
Q. 4 a) Explain C.T. imaging technique with suitable block diagram	10
b) Explain modes of ultrasound imaging	10
Q. 5 a) Explain rate responsive pacemaker with block diagram	10
b) Explain working of artificial kidney and precautions to be taken	10
Q. 6 a) What is cardiac output? Explain its measurement	10
b) Explain physiological effects of varying values of electric current?	10

Q. P. Code: 25159

Total Marks: 80

3 Hours

Instructions:

- Q1 is compulsory
- Answer any **Three** out of remaining **Five** questions
- Assumptions made should be clearly stated
- Assume any suitable data wherever required but justify the same
- Figure to the right indicate gets full marks
- Illustrate answers with sketches wherever required

Q1. Answer the following.

(20)

- Give classification of singular points. What is meant by limit cycle? Discuss the types of limit cycle with examples.
- How describing function method with Nyquist criteria will be used for prediction of limit cycle? Discuss the stable and unstable limit cycles with examples.
- What is nonminimum phase system? Explain invert response.
- List the uncertainties occur in the system. What are the methods to design the system with consideration of uncertainties.
- What is meant by optimal control problem formulation? What are its requirements? Discuss any one requirement with example.

Q2. (a) for the following system –

(10)

$$\dot{x} = 2x - y - x^2$$

$$\dot{y} = x - 2y + y^2$$

has equilibrium at (0,0) and (1,1). Determine the singular point of the linearized system. Identify the singular point and draw phase portrait.

- Define performance measure. Discuss the performance measures for various optimal control problems.

(10)

Q3. (a) Give definition of 1, 2 and  $\infty$  norm.

(05)

- Compute 2 – norm of the following –

(05)

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

- Obtain the control law which minimizes the performance index –

(10)

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

for the system

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

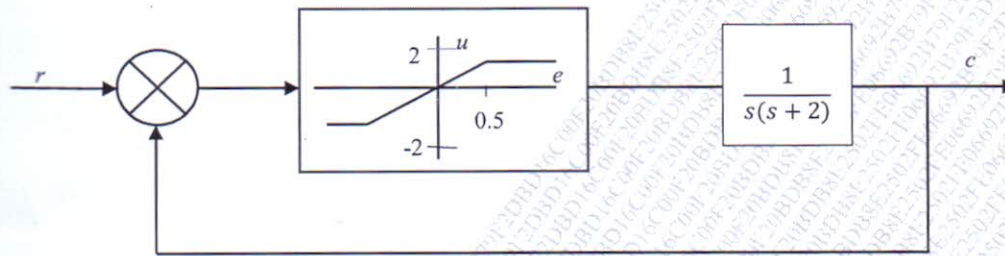


- Q4. (a) Explain in detail the design procedure of IMC. Design IMC controller for plant model (10)

$$G(s) = \frac{(-s + 1)}{(4s + 1)}$$

in order to achieve the response with time constant of 1.2 sec.

- (b) Draw the phase-plane trajectory for the following system. Assume  $x_0 = (0, 1)$  (10)



- Q5. (a) Derive the Describing function for dead-zone nonlinearity. (10)

- (b) Investigate the stability of a system having ON/OFF nonlinearity with amplitude  $\pm 1$  and linear System – (10)

$$G(s) = \frac{3}{s(1+2s)(1+s)}. \text{ Determine amplitude and frequency of the limit cycle.}$$

- Q6. (a) Determine the definiteness of the following Lyapunov functions – (05)

$$i) V(x) = x_1^2 + 4x_2^2 + x_3^2 + 2x_1x_2 - 6x_2x_3 - 2x_1x_3$$

$$ii) V(x) = x_1^2 - 3x_2^2 - 11x_3^2 + 2x_1x_2 - 4x_2x_3 - 2x_1x_3$$

- (b) Discuss the Jump resonance characteristics of nonlinear system with examples. (05)

- (c) Examine the stability of equilibrium state of the following system using Krasovskii method. (05)

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

- (d) Explain the stability of system in the sense of Lyapunov. Draw suitable trajectories. (05)



(3 Hours)

[Total Marks: 80]

- 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) What are the different automation tools? List the vendors.
  - (b) Write a brief note on DCS flow sheet symbols.
  - (c) Explain the functions of RTU in SCADA system.
  - (d) Explain NO and NC relay type instructions of PLC.  
 Give example for AND logic.
2. (a) Explain sinking and sourcing I/O modules of PLC with diagram. [10]  
 (b) What are IEC standard PLC languages? [10]  
 Write a PLC ladder program for the application described by following event sequence. Also represent GUI.
  - i) Fill the tank to level A from valve A.
  - ii) Fill the tank to level B from valve B.
  - iii) Start a timer, heat and stir for 5 min.
  - iv) Open the output valve C until the empty switch engages.
3. (a) Explain DCS integration with PLC and computer and also explain the methods of integration. [10]  
 (b) What is the necessity of SIS? Explain in detail basis SIS layout with neat diagram. [10]
4. (a) What are the different applications of SCADA?  
 Explain how SCADA can be used in application of the oil gas lift system. [10]  
 (b) Explain ISA S95 in connection with MES and ERP enterprise. [10]
5. (a) What is the need of supervisory control in DCS. [05]  
 (b) Define scan interval of SCADA system.  
 Explain factors affecting scan interval. [05]  
 (c) Explain memory organization of PLC in detail. [10]
6. Write Short note on:- (Any Two) [20]
  - (a) Alarm Management system.
  - (b) Compare PLC, DCS and SCADA systems.
  - (c) Centralized and decentralized control system architecture and the problem with centralized controlling.

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**Q. P. Code: 26548**

Time: 3 hours

Marks: 80

1. Solve the following questions for 5 marks

- a. Explain the significance of letters and numbers in - 'ARM7TDMI'.
- b. Explain thumb mode of ARM7TDMI core and compare it with normal mode.
- c. Explain pipelining feature in ARM7TDMI architecture. Justify advantages and disadvantages.
- d. Explain a watchdog and explain its uses.

2.

a. Design a car control embedded system with the following specifications / features:-  
Draw Block Diagram, Flowchart and Real time challenges

- i. It is an electric car
- ii. Steering angle, acceleration, direction (R/F) are inputs from driver
- iii. It control speed, Left/Right steering, Forward/Backward direction
- iv. Displays speed

b. Explain the following ARM7TDMI architecture based instructions as well as their implications.

- i. BL Square
- ii. ADD R0, R1, R2, LSL#3
- iii. MOVEQS R1, R0
- iv. LDR R8, [R3, #4]
- v. STR R2, [R1, #0x100]

- a. Explain the programmer's model (register structure) in ARM7TDMI architecture.
- b. Explain priority inversion problems and solutions

- a. What is the Role of RTOS in embedded systems? Describe some functions of FreeRTOS to implement the functions.
- b. Write a C code to initialize the ADC of LPC2148 and send it through the UART

- a. Explain the timer module of LPC2148
- b. Explain Semaphore, mutex, MessageBox and Queue

- a. Explain Interrupt handling in ARM7TDMi
- b. Explain the ARM9 architecture

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Q.P. Code :24273

[Time: Three Hours]

[ Marks:80]

Please check whether you have got the right question paper.

- N.B:
1. Question.No.1 is compulsory.
  2. Attempt any three questions from remaining five questions.
  3. Assume suitable data if required.

Attempt any four

20

What is a role of Discrete cosine transform image compression

Compute the memory required of an image size 256x256 with 128 gray level.

Differentiate between lossy and lossless compression.

Distinguish between global, local and dynamic thresholding.

Explain the mask for paint detection and line detection.

Show how the K-L transform is useful for reducing the dimension of Image.

10

With a neat block diagram explain the steps involved in typical image processing system.

10

64x64 image, represented by 3 bits/ pixel has following gray level distribution

rk	0	1	2	3	4	5	6	7
nk	790	1023	850	656	329	245	122	81

Perform Histogram Equalization and give new distribution of gray levels show plots of the original and the equalized images.

10

Explain the properties of 2-D DFT.

10

Generate Hattman code for the given image source. Calculate entropy of the same and average length of code generated. Also calculate the compression ratio achived compare to standard binary encoding.

Level	0	1	2	3	4	5	6	7
probability	0.1	0.09	0.02	0.01	0.5	0.2	0.03	0.05

10

Explain the following point processing technique.

Thresholding

Gray level slicing

Digital negative

Bit plane slicing

Explain the process of image segmentation

Region Growing

Region splitting and Merging

What is Hadamard Transform? Calculate the Hadamard transform of given Image

10

4	1	3	2
1	5	2	3
3	2	1	2
2	3	2	1



Q.P. Code :24273

20

Write a short notes on

- i) Euclidean, D4, D8 Dm distance
- ii) Transform coding
- iii) Image compression block diagram with explanation
- iv) Run length coding.

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Q.P. Code : 26761

[Time: Three (3) Hours]

[ Marks:80]

- N.B:
1. Question.No.1 is compulsory.
  2. Attempt any **three (3)** questions from remaining **five (5)** questions.
  3. Assume suitable data wherever necessary.

1. Attempt any four from the following. 20
  - a. State difference between BPCS and SIS.
  - b. What is common cause failure?
  - c. Define: i) failure rate ii) MTTF iii) PFD iv) RRF v) MTBF
  - d. Write short note on dispersion.
  - e. A sack contains two types of marbles, all of the marbles are spotted or stripped and all of the marbles are either green or red. 60 % of the marbles are spotted. 90% of the marbles are green. What is the probability of marbles will be spotted OR green?
2. a. Draw and explain "Safety Instrumented System" with neat block diagram. Justify need of SIS. 10
  - b. Explain designing steps for structured and auditable management of safety life cycle as per IEC standards. 10
3. a. i) Explain significance of safety life cycle. 05
  - ii) Write short on separation of control and safety systems. 05
  - b. Explain different SIS technologies with its advantages and disadvantages. 10
4. a. Consider a system composed of a transmitter, controller and valve. The probability of failure over the next 5 year period for each component is as follows. 10

$P_f(\text{transmitter}) = 0.15$   
 $P_f(\text{controller}) = 0.008$   
 $P_f(\text{valve}) = 0.19$

Over the next 5 year interval, what is the probability of success of this system?
5. a. A water coolant supply system consists of two pumps; one is electrically driven and other is steam driven. 10

Both pumps are continuously operating and together must supply an adequate amount of cool water. The probability of pump A's failure over the one year period is 0.02 and 0.03 is the probability of failing pump B. what is the probability that the cooling water system will fail to operate over the course of one year? Illustrate the situation using fault tree.
6. a. What is the procedure to carry out likelihood analysis? Explain different methods for the same. 10
  - b. Draw and explain in detail, "layers of protection analysis" with neat onion diagram. 10
7. a. Explain SIL determination procedure with suitable flow chart. 10
  - b. i). Explain difference and similarity between physical explosions and vapour cloud explosions 05
    - ii). What are the effects of flammability hazards? 05

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