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

Instructions:
1. Question.No.1 is compulsory.
2. Attempt any three questions from remaining five questions.
3. Assume suitable data wherever necessary.

1 Attempt the following: 20

a. Determine the convolution of following signals:

$x(t) = e^{-4t}u(t)$

$h(t) = u(t-2)$

b. Determine the Fourier series coefficients of the signal,

$x(n) = \{1, 1, 0, 0\}$.

c. State any two properties of Fourier transform.

d. Determine Laplace transform and sketch ROC of the signal,

$x(t) = (e^{-2t} - e^{-3t})u(t)$.

2 a. Determine the z-transform and sketch the ROC of the signal 10

$$x(n) = \begin{cases} 0, & n \geq 0 \\ -a^n, & n \leq -1 \end{cases}$$

b. Sketch the waveforms of the following signals: 4

1. $x(t) = u(t) - u(t-2)$
2. $x(t) = u(t+1) - 2u(t)$

c. Determine the total energy of the following signal: 6

$$x(t) = \begin{cases} 5-t, & 4 \leq t \leq 5 \\ 1, & -4 \leq t \leq 4 \\ 5+t, & -5 \leq t \leq -4 \end{cases}$$

3 a. Define signal. Explain classification of signals. 10

b. Determine Fourier transform and sketch the magnitude and phase response of 10

$x(n) = \{-2, -1, 0, 1, 2\}$. Use $\omega = 0, \pm\frac{\pi}{4}, \pm\frac{\pi}{2}, \pm\frac{3\pi}{4}, \pm\pi\ rad/sec$.

TURN OVER

4 a. Determine the Fourier series coefficients for 7

$x(t) = (t + t^2), -\pi \leq t \leq \pi.$

b. Determine the unit impulse response $h(t)$ of the system described by the following differential equation: 7

$\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2y(t) = \frac{dx(t)}{dt} + 2x(t)$. Use Laplace transform.

c. Determine the response of the system given in 4(b) for $x(t) = 4e^{-2t}u(t)$. 6

5 a. Compute the linear convolution of following signals using analytical method: 10

$x(n) = \{1, 3, 5, 2, 1\}$

$h(n) = \{2, 1, 2, 1, 3\}$

b. Determine the response of the system described by the following difference equation: 10

$y(n) = \frac{5}{6}y(n-1) - \frac{1}{6}y(n-2) + x(n)$ to the input $x(n) = \delta(n) - \frac{1}{3}\delta(n-1)$.

6 a. Determine, whether following systems are memory-less, stable, causal, linear and time-invariant: 10

1. $y(t) = x(2 - t)$
2. $y(n) = x(n/2)$

b. Determine the inverse z-transform using partial fraction method: 10

$$X(z) = \frac{1}{1 - 1.5z^{-1} + 0.5z^{-2}}$$

(3 Hours) [Total Marks: 80]

N.B.:

1) Question no.1 is compulsory.
2) Attempt any **three** questions out of remaining **five** questions.
3) Assume suitable data if necessary.
4) Figure to right indicate full marks.

1		Answers the following questions (Attempt any FIVE)	20
	a	Define Embedded system. Explain the characteristics of embedded system?	
	b	Compare microprocessor and microcontroller with example.	
	c	Write a program to divide two 8 bit numbers. In which register the quotient and reminder will be stored?	
	d	Explain in brief the structure of TMOD and TCON.	
	e	Draw a block diagram of 8051 based digital weighing machine.	
	f	Write any eight important features of 8051 microcontroller.	
2	a	Write a program to convert BCD number to ASCII number.	8
	b	Draw and explain the architecture of 8051 microcontroller.	8
	c	Explain the on chip memory organization of 8051	4
3	a	Draw and interfacing diagram to interface Digital to Analog Converter (DAC) to 8051 and write a program to generate triangular waveform.	10
	b	Draw and Interfacing a 16 x 2 LCD to 8051 and write a program to display your name on the same	10
4	a	Write a program to transmit 'WELCOME' on serial communication port of 8051 with baud rate of 4800 and crystal frequency of 11.0592 MHz.	10
	b	Write a program to generate a square wave on the port pin P1.1 of 8051. Assume suitable data.	10

5 a Draw an interfacing diagram to interface 4KB of RAM to 8051. Which interfacing signals are required and why? 10

b Explain with block diagram traffic light controller design with 8051. 10

6 a Show how to interface an ADC to 8051 with suitable diagram and the programming procedure. 10

b How to design Data Acquisition System with 8051 microcontroller? Justify the requirement of the various components of the system. 10

(3 hours)

[Total marks 80]

N.B.: (1) Question no. 1 is compulsory

(2) Write any 3 questions from remaining

(3) Figures to the right indicates full marks

1. **Attempt any four.** **(20)**

a. Derive transfer function of state model .Also draw the block diagram representation of state model.

b. Explain derivative and integral error compensation

c. Define "Vander Monde matrix".

d. Explain the design procedure for finding STM using Cayley Hamilton theorem.

e. Write procedure to determine Matrix "K" Using Transformation Matrix "T" for pole-placement method.

2. **a.** Consider the system given by **(10)**

$$\frac{Y(s)}{U(s)} = \frac{s+3}{s^2+3s+2}$$

Obtain state-space representations in the controllable canonical form, observable canonical form, and diagonal canonical form.

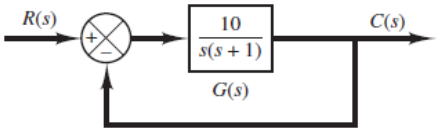
b. State necessary and sufficiency conditions for complete state controllability and observability. **(10)**

Find if following system is complete state controllable and complete state observable or not.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}1 & 1\\ -2 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$$

$$y = [1 \quad 0]\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

3. **a.** Consider the position control system shown in Figure below. **(10)**



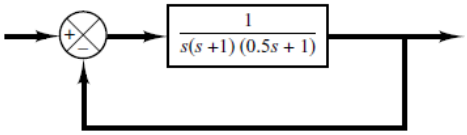
The feed-forward transfer function is $G(s) = \frac{10}{s(s+1)}$.

Design suitable compensator for desired parameters as; $\zeta = 0.5$ and $\omega_n = 3\ rad/sec$.

b. Describe Lag Compensation Techniques Based on the Frequency-Response Approach. **(10)**

4. **a.** Explain Lag–lead Compensation Techniques Based on the Root-Locus Approach. **(10)**

b. Consider the system shown in Figure below. **(10)**



The open-loop transfer function is given by $G(s) = \frac{1}{s(s+1)(0.5s+1)}$.

It is desired to compensate the system so that the static velocity error constant Kv is 5 sec–1, the phase margin is at least 40°, and the gain margin is at least 10 dB.

5. **a.** Consider the system **(10)**

$$\dot{x} = Ax + Bu$$
$$y = Cx$$

Where

$$A = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 0 & 1 \end{bmatrix}$$

Design a full-order state observer.

b. For the unity F/B system with PID Controller is used to control the system, the plant T.F. is $G(s) = \frac{1}{s(s+1)(s+5)}$. Determine PID Controller. **(10)**

6. **a.** Determine the state transition matrix for the system having : **(10)**

$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$.

Find the homogenous response if the initial conditions are :

$X(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.

b. Write significance of state transition matrix. What are properties of state transition matrix? **(05)**

c. Designing PID controller using Root-Locus, give steps. **(05)**

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

Please check whether you have got the right question paper.

N.B: 1. **Q.1** is **compulsory**
2. Attempt **any three** questions

1. Attempt any **five** **20**

1) Explain various parts of Globe control valve and its Material.
2) Explain in brief about control valve i) Rangability ii) FTO and FTC
3) Compare pneumatic, Hydraulic and Electronic system.
4) Compare conventional vs SMART Transmitter.
5) Describe working of solenoid valve.
6) Explain Relay and contactor in brief.

2. a) With suitable sketch Explain working of FORCE balance valve positioner. **10**

b) Explain with neat block diagram Features and working of Intelligent transmitter. **10**

3. a) With suitable sketch explain working of single and Double acting cylinder. **10**

b) Explain working of various control valves and their industrial applications. **10**

4. a) With suitable sketch explain closed tank Level measurement using DP Transmitter. **10**

b) Explain with neat diagram three phase motor control circuit using control components. **10**

5. a) What is converter? With suitable sketch explain current to pneumatic converter. **10**

b) Explain with neat diagram Air compressor and distribution system. **10**

6. Write short notes on **20**

a) Volume booster
b) Hydraulic pump
c) Calibration of transmitters
d) RFID

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

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

1		Answer the following	20
	a	Give comparative study of thermal sensors.	
	b	Explain working principle of digital humidity temperature smart sensor.	
	c	Explain MEMS fabrication technique LIGA.	
	d	Explain the need of dissolved oxygen measurement and any one sensor for the same.	
2	a	List various types of sensors based on Physical transduction principle and explain any two.	10
	b	Explain various techniques of etching for MEMS sensor fabrication.	10
3	a	Explain elastomer chemiresistor type chemical sensors.	10
	b	Explain photolithography technique in detail.	10
4	a	Give comparative study of analog to digital converters used for sensor signal conditioning.	10
	b	Explain sensors for soil moisture measurement in agriculture.	10
5	a	Explain construction and working of ADXL345 accelerometer.	10
	b	List various mechanical sensors and explain application of any one sensor in detail.	10
6		Write short note on any two	20
	a	Sensors for food processing	
	b	Thin Film Deposition techniques for MEMS sensor	
	c	Carbon Dioxide Measurement	

(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 Solve any four **20**

(a) Define local and global minimum, maximum
(b) Write a short note on design constraints and design vector
(c) Prove that "Dual of the Dual is Primal"
(d) Determine the direction for the following function

$$F(x) = 3{x_1}^2 + 2x_1 + 2{x_2}^2 + 7;$$
$$d = (-1,1) at\ x = (2,1)$$

(e) Determine local minimum, local maximum and inflection of the function

$$f(x_1, x_2) = 3{x_1}^2 - 2x_1x_2 + 5{x_2}^2 + 8x_2$$

Q2 (a) State and prove the properties of gradient of vector. **10**

(b) Find the minimum value of F(α) = 2-4α+e^{α} by using golden section method with accuracy of 0.01 **10**

Q3 (a) State and prove necessary and sufficient condition for single variable optimization problem. **10**

(b) A firm uses Lathes milling machines to produce 2 machine parts the table below represents the machining times required for each part the machining time available on different machines and the profit on each machine part **10**

Type of machine	Machining time required for the machine part (minutes)		Maximum time available per week (minutes)
	I	II	
Lathes	12	6	3000
Milling Machines	4	10	2000
Grinding Machines	2	3	900
Profit per unit	Rs. 40	Rs. 100	

Find the number of parts I and II to be manufactured per week to maximize the profit

Q4 (a) Find the minimum **10**

$$f = \lambda^5 - 5\lambda^3 - 20\lambda + 5$$

by using quadratic interpolation method

(b) Three grades of coal A,B,C contains phosphorus and Ash as impurities. In a particular industrial process,a fuel up to 100 ton(max) is required which should contain Ash not more than 3% and phosphorus not more than 0.03%. It is desired to maximize the profit while satisfying these conditions. There is an unlimited supply of each grade. The percentage of impurities and the profits of grades are given below **10**

Coal	Phosphorous (%)	Ash (%)	Profit (Rs/ton)
A	0.02	3.0	12.00
B	0.04	2.0	15.00
C	0.03	5.0	14.00

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Q5 (a) Use the two-phase simplex method to **10**

Maximize $Z = 5x_1 - 4x_2 + 3x_3$,

Subject to $2x_1 + x_2 - 6x_3 = 20$,

$6x_1 + 5x_2 + 10x_3 \leq 76$,

$8x_1 - 3x_2 + 6x_3 \leq 50$

$x_1, x_2, x_3 \geq 0$

(b) Minimize $f(x_1, x_2) = x_1 - x_2 + 2{x_1}^2 + 2x_1x_2 + {x_2}^2$ starting from the point X=[0,0] by using conjugate gradient method **10**

Q6 (a) Use the method of Lagrangian multiplier to solve the following problem **10**

Optimize $z = 2{x_1}^2 + {x_2}^2 + 3{x_3}^2 + 10x_1 + 8x_2 + 6x_3 - 100$

Subject to constraint

$$g(x) = x_1 + x_2 + x_3 = 20$$

and $x_1, x_2, x_3 \geq 0$

(b) Write the algorithm for steepest descent method. **10**

(3 Hours) Total mark: 80

N.B (1) Question **No.1 is compulsory**
(2) Solve any **three** questions of remaining **five**
(3) Assume suitable data if necessary

Q1 (a) List difference between file System and database management System? (5)
(b) Explain generalization and specialization with example? (5)
(c) Explain ACID properties in transaction? (5)
(d) Explain triggers in SQL? (5)

Q2 (a) Explain the steps of an algorithm for ER to relational mapping ? (10)
(b) Design an ER diagram for the University databse. Your diagram should have all the needed details. You may make any reasonable assumptions but you have to state them clearly. (10)

Q3 (a) Explain DDL, DML and DCL statements with example? (10)
(b) Consider the following relation
Employee (Emp-name, street, city)
Works (Emp-name, Comp-name, salary)
Company (Comp-name, city)
Manages (Emp-name, Manger-name)
Write the SQL queries for the following statements:
(i) Find name of employees who work for SBI.
(ii) Find name and cities of residence of all employees who work for SBI.
(iii) Find all employees who don't work for SBI.
(iv) List names of the company starting with letter 'A'.

Q4 (a) What is functional dependency? Explain BCNF and 4NF with examples? (10)
(b) Explain any four Relational Algebra operators with example? (10)

Q5 (a) Explain conflict and view Serializibility with example? (10)
(b) Explain different protocols in concurrency control? (10)

Q6 Explain the following terms:
(a)System catalog (5)
(b) Meta data (5)
(c) Views in SQL (5)
(d) Integrity constraint (5)

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(3 hours)

[Total marks 80]

N.B.: (1) Question no. 1 is compulsory

(2) Write any 3 questions from remaining

(3) Figures to the right indicates full marks

1. Answer the following **(20)**

a. Explain acceptance angle, numerical aperture, skew rays, meridional rays,
b. Explain principle of working of APD with their characteristics.
c. Advantages and disadvantages of FOS.
d. Describe launching of light into an optical fiber.

2. a. Explain in details the Intensity-type fiber optic sensor using micro-bending for Liquid Level Measurement. **(10)**
b. Explain Flow measurement using FBG. **(10)**

3. a. Explain OTDR with neat sketch. **(10)**
b. Write down the various laser applications in industry and explain any one. **(10)**

4. a. Differentiate between Pre-Amplifier, Booster Amplifier and In-line Amplifier w.r.t fiber optic instrumentation. **(10)**
b. Explain in details Beam splitters. **(10)**

5. a. What do you mean by Fiber Optic Sensors? Classify them Based on the sensor location, Based on operating principles and Based on application. **(10)**
b. A silica optical fiber has core refractive index of 1.4 and the cladding index of refraction is 1.35.Determine **(10)**
i) The critical angle
ii) Numerical aperture
iii) The acceptance angle

6. Write short note. **(20)**
a. LED & PIN
b. Flow Measurements using a Simple Fiber Optic Technique
c. Wavelength modulated sensors
d. Intensity modulated sensors

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