3 Hours **Max. Marks: 80**

Instructions:
1. Question number **1 is compulsory**.
2. Attempt any **three** questions from the remaining five questions.
3. Assume suitable data wherever necessary.
4. Figure to the right indicates full marks.

Q1. Answer any four questions. [20]

a) Define time domain specifications of a second order system

b) Construct Signal Flow Graph for the following set of equation:
Y2 = G1 Y1 – G2 Y4
Y3 = G3 Y2 + G4 Y3
Y4 = G5 Y1 + G6 Y3
where Y4 is the output.

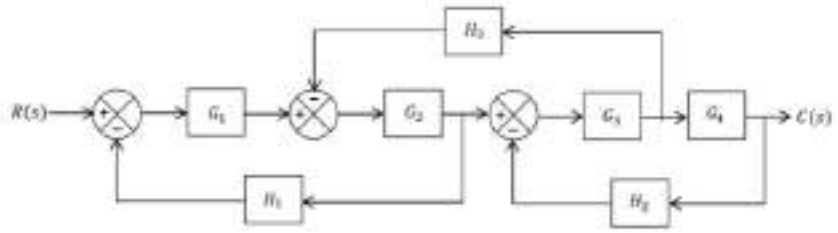
c) Define Gain Margin and Phase Margin.

d) Explain in brief any three criteria for selection of transducers.

e) Draw and explain in brief the block diagram of a Data Acquisition System.

Q2.

a) For the block diagram shown below calculate the transfer function C(s)/R(s) using block diagram reduction technique. [10]



b) For the characteristic equation given below, calculate the range of k (if any) for a stable, unstable and marginally stable system. Also calculate the frequency of the system when system is marginally stable. [10]
Characteristic Equation: $s^4 + 5s^3 + 5s^2 + 4s + k = 0$

Q3.

a) Draw the Root Locus for the system and comment on the stability. [10]

$$G(s)H(s) = \frac{k}{s(s+3)(s+6)}$$

b) Explain working principle, ranges and applications of [10]
(i) resistance temperature detectors (RTD) and (ii) thermocouple temperature transducers.

Q4.

a) For the system shown below, sketch the Bode Plot (Magnitude and Phase plot both) and hence find the gain margin and phase margin of the system and comment on the stability. [10]

$$G(s)H(s) = \frac{100}{s(s+2)\,(s+25)}$$

b) For system having transfer function $\frac{25}{s^2+6s+25}$, calculate: [10]

(i) rise time
(ii) peak time
(iii) maximum peak overshoot
(iv) settling time

Q5.

a) For the system shown below, sketch the Nyquist Plot and comment on the stability. [10]

$$G(s)H(s) = \frac{10}{(s+1)(s+2)\,(s+3)}$$

b) Explain with proper diagrams the working of a SCADA system and its architecture. [10]

Q6. Attempt any four questions. [20]

a) For a type 0 system, write the values for error constants and steady state error with unit step, unit ramp and unit parabolic input.

b) Write short note on adaptive control systems.

c) Write short note on fiber optic instrumentation.

d) Write short note on strain gauge.

e) Compare between radio and landline telemetry system.

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

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1 Attempt any FOUR

a Transform the following formula into CNF ~(p→q)V(r→ p) [05]

b If A ={1, 2,3, 4} and B={ a b c d} , determine whether the following functions are one-to-one or onto. [05]

f={ (1,a),(2,a),(3,b),(4,d)}

g= (1,d),(2,b),(3,a),(4,c)

c Define regular expression and write a regular expression for language: [05]

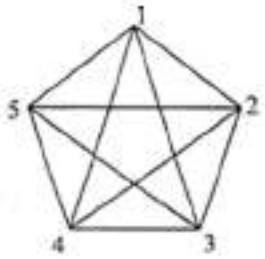
i) Strings containing at least one 'a' over Σ = {a, b,c}.

ii) Strings containing odd number of b's over Σ= {a, b}.

d Differentiate between Moore and Mealy machine. [05]

e Prove using Mathematical Induction that :- $1+3+5+...+(2n-1) = n^2$ [05]

2 a Define with example Euler path, Euler circuit, Hamiltonian path, and Hamiltonian circuit. Determine if the following diagram has Euler circuit and Hamiltonian circuit and state the path/circuit. [10]

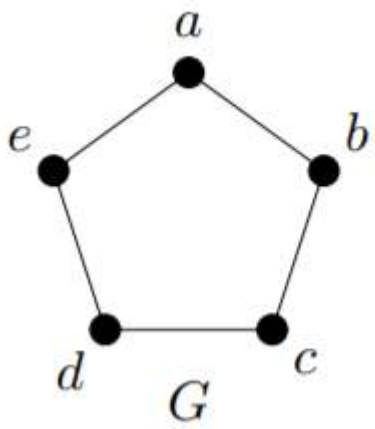


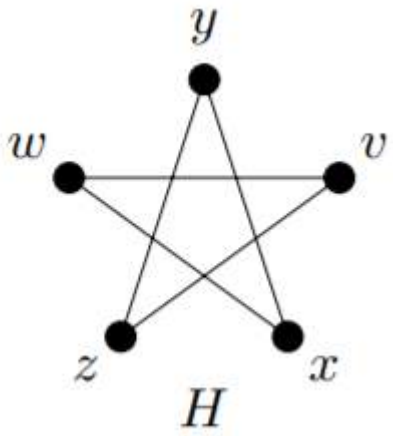
b Write short note on Types of Grammar [10]

3 a Draw the Hasse diagram for D105 and [10]

i) Write the pairs in a relation set R.
ii) What are the Maximal and Minimal elements?
iii) Mention Chains and Ant chains from above set.
iv) Is it a lattice?

b Define Isomorphic graphs.Check whether following graphs are Isomorphic? [10]





4 a Design DFA in which input is valid if it starts either in '011' or '100' over Σ={0,1}. [10]

b Design Moore m/c to change occurrence of "abb" to "aba" over Σ= {a,b}. [10]

5 a Design NFA for recognizing the strings that end in "aa" over ∑ = {a,b} & convert above NFA to DFA. [10]

b Let G be the grammar [10]

S→ aB | bA
A→ a |aS| bAA
B→ b |bS| aBB

Find leftmost derivation, rightmost derivation and parse tree for the string "bbaaabbaba" .

6 a Reduce the following Grammars to the Chomsky normal form [10]

S →1A | 0B
A →1 AA | 0S | 0
B →0BB | 1S |1

b Define PDA and design a PDA to accept an odd length palindrome over {a,b}. [10]

Time: 3 hrs. **Max. Marks: 80**

N.B. : 1. Q1 is compulsory
2. Attempt any three questions from Q2 to Q6.
3. Figures to the right indicate full marks.

Q1. (a) Evaluate the integral $\int_C \frac{z^2}{(z-i)(z+2)^2}\,dz$, C: $|z-i|=1$. **5**

(b) A r.v. X has the distribution **5**

x:	0	1	2	3	4	5	6	7
p(x):	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

Find i) k ii) evaluate $P(X<6)$

(c) Find the usual inner product between the two vectors $(2,1,-3)$ **5**
and $(-1,1,2)$. Find the norm of each vectors and verify the Cauchy Schwarz inequality.

(d) The given data indicates weight x and heights y of 1000 men. $\bar{x}=150$ lbs, **5**
$\bar{y}=68$ inches, $\sigma_x=20$ lbs, $\sigma_y=2.5$ inches, $r=0.6$. John weighs 200 lbs.
Find the line of regression of y on x and estimate the height of John.

Q2. (a) Find the Extremal of $\int_{x_1}^{x_2} \sqrt{1+(y')^2}\,dx$. **6**

(b) Find the Laurent series expansion of $\frac{z+2}{z^2-1}$ convergent in the **6**
domain $|z|>1$.

(c) Reduce the quadratic form $x_1^2+2x_2^2+2x_3^2-2x_1x_2+x_1x_3-2x_2x_3$ **8**
to diagonal form by congruent transformation. Obtain the transformation applied in the reduction and Find the rank, index and class value.

Q3. (a) Find the Extremal of $\int_0^1 y\,y' + (y'')^2 \; dx$, **6**

$y(0) = 0,\ y'(0) = 1,\ y(1) = 2,\ y'(1) = 4$

(b) From a vessel containing 3 white and 5 black balls, 4 balls are transferred into an empty vessel. From this vessel a ball is drawn and found to be white. Find the probability that out of four balls transferred 3 are white and 1 is black. **6**

(c) Find a singular value decomposition of the matrix $\begin{bmatrix} 1 & 1 \\ 1 & -1 \\ 1 & -1 \end{bmatrix}$. **8**

Q4. (a) Evaluate the integral $\int_C \frac{\sin^2 z}{z^3} \; dz,\ C : |z| = 1,$ using Cauchy integral formula. **6**

(b) Using Gram Schmidt method, find an orthogonal set of vectors corresponding to $(1,1,0,1), (-1,0,1,0), (0,0,1,-1)$. **6**

(c) After correcting 50 pages of the proof of a book, the proof reader finds that there are on the average 2 errors per 5 pages. How many pages would one expect to find with 0, 1, 2, 3 errors in 1000 pages of the first print of the book. **8**

Q5. (a) Evaluate the Integral $\int_C \bar{z} \; dz$ along astraight line from $z = 0$ to $z = 4 + 2i$. **6**

(b) Find the rank correlation coefficient for the following data. **6**

x	:	10	12	18	16	15	40
y	:	12	18	20	15	50	25

(c) Using Rayleigh-Ritz method, find an approximate solution for the **8**

Extremal of $\int_0^1 (y')^2 - 4y^2 + 2x^2 y \; dx,\ y(0) = 0,\ y(1) = 0$

Q6. (a) If $f(x)=\begin{cases}\frac{x}{2} & 0<x<2\\ 0 & \text{otherwise}\end{cases}$ is a pdf of a random variable X, then **6**

find $E(X)$, $\text{var}(X)$, $\text{var}(3X)$.

(b) Let $W_1=\{(x,y)\mid x,y \text{ are real numbers, } y=mx\}$ and **6**

$W_2=\{(x,y)\mid x,y \text{ are real numbers, } xy\geq 0\}$. Show that

W_1 is a subspace and W_2 is not a subspaces of two dimensional space .

(c) A Chemical Engineer is investigating the effect of process operating **8**

temperature x on product yield y. The study results in the following data

x :	100	110	120	130	140	150	160	170	180	190
y :	45	51	54	61	66	70	74	78	85	89

Find the equation of the least square lines which will enable us to predict

(i) yield on the basis of temperature (ii) temperature on the basis of yield.

Time: 3 Hours **Marks: 80**

Note:

1. Question number one is compulsory
2. Solve any 3 out of remaining five
3. Figures to the right indicates full marks

Q.1 Answer any four. 20

a) Explain the significance of hold,reset and ready signals in 8086 processor.
b) Explain following instructions of 8051 microcontroller with an example
   i. MOVX
   ii. CJNE
   iii. JB
   iv. SWAP
c) Explain the advantage of the pipelining feature in 8086 architecture.
d) Draw and explain the PSW register of 8051 microcontroller.
e) Compare Microprocessor and Microcontroller.

Q.2 a) Explain the Architecture of 8086 microprocessor. 10

b) Explain operating modes of 8255 PPI. 10

Q.3 a) Explain addressing modes of 8086 10

b) Write a 8051 assembly language program to find the number of positive and negative numbers in an array. 10

Q. 4 a) Design an 8086 based Maximum Mode system working at6 MHz having the following: 10

32KB EPROM using 16KB chips,128KB RAM using 32KB chips.

b) Write a 8086 assembly language program to check whether a string is Palindrome or not. 10

Q. 5 a) Explain the block diagram of 8259 Programmable Interrupt Controller in detail. 10

b) Explain various timer modes of 8051. 10

Q. 6 Write short notes on (Any 3) 20

1. Memory segmentation
2. Interfacing of a DC motor to microcontroller.
3. Internal memory organization of 8051
4. Interfacing ADC to 8051

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

N.B.: (1) Question No. 1 is **Compulsory**.
(2) Attempt any **three** questions out of the remaining **five**.
(3) Each question carries 20 marks and sub-question carry equal marks.
(4) Assume suitable data if required.

Q.1 Solve any **Four** from the following: **20**

a Draw the transfer characteristics of MOS transistors state the significance of threshold voltage.

b List different types of Diff-Amp and state which one is preferred.

c State and explain Miller's theorem.

d State the features of IC 555 Timer.

e Explain the advantages of Switching Voltage Regulator over the Linear Voltage regulator.

Q.2 a Describe the general frequency response of an amplifier and define the low, mid and high frequency ranges. Define low cut off and high cut off frequency for the amplifier. **10**

b Draw a neat circuit diagram for non-inverting Amplifier. State what type of feedback is employed in the circuit. Derive the expression for the gain of an amplifier. Design a circuit to obtain the gain of 11. **10**

Q.3 a Draw small signal equivalent circuit of dual input balanced output MOSFET differential amplifier. Derive the expression for A_D (Differential mode gain), A_{CM} (Common mode gain) and CMRR. **10**

b. Draw the circuit diagram for Trans- resistance Amplifier (Current to Voltage converter). State different applications of the circuit. **10**

Q.4 a Draw the circuit diagram and explain the operation of RC Wien Bridge oscillator Design the circuit to oscillate with frequency 2 KHz. **10**

b Draw the circuit diagram of differentiator using OPAMP and derive the expression of output voltage. State its applications. **10**

Q.5 a Draw neat circuit diagram and explain the operation of Astable multivibrator using IC 555. How you will modify the circuit to achieve 50% Duty Cycle. **10**

b Draw the circuit diagram of basic MOSFET differential amplifier and explain its operation. Sketch and explain its DC transfer characteristics. **10**

Q.6 a Define following OPAMP parameters. State its ideal and practical value for 741 IC. **10**

i)Input offset voltage ii) Slew rate iii) CMRR iv)Input bias current iv) Power Supply Rejection Ratio)Input resistance.

b Design the Schmitt Trigger Circuit (Regenerative Comparator) to obtain the Hysteresis of 2Volts. **10**
