TE / ETRX / SEM-V / C.2019 / NOV. 2023

Paper / Subject Code: 32321 / Principles of Control System

Duration 3 Hours **[Maximum Marks 80]**

NOTE: 1) Question 1 is **compulsory**
2) Solve **any three** from the remaining five questions
3) Assume suitable data if necessary.
4) Figures to the right indicate full marks

Q.1. Answer any Four of the following

a. Explain with appropriate examples, open loop and closed loop systems. **5**

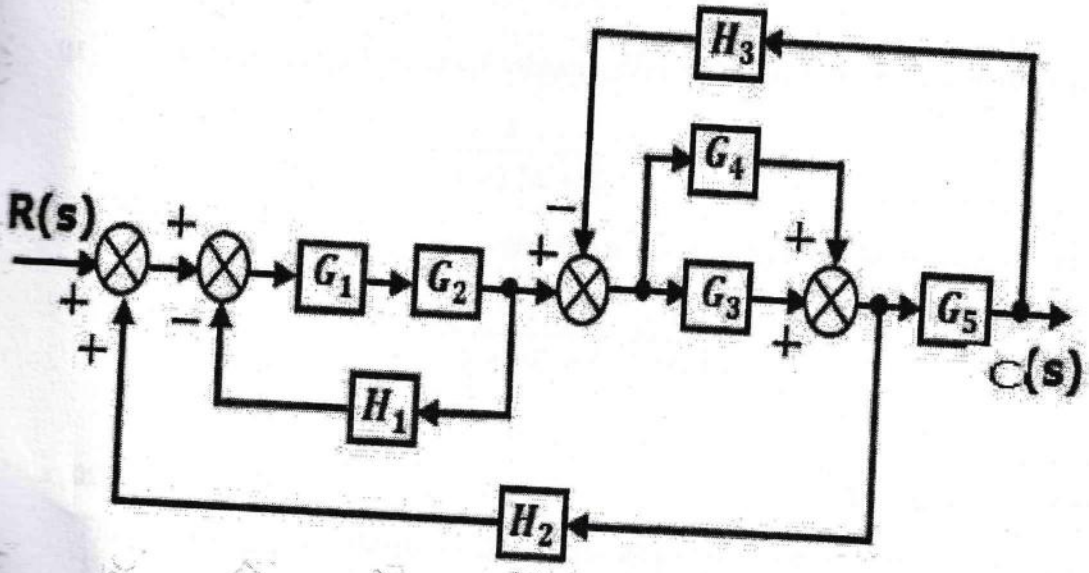
b. Explain the Mason's gain formula with reference to SFG Technique. **5**

c. With an example, determine the relative stability of a system using Routh stability criterion. **5**

d. Define gain margin and phase margin. Explain how to find them from magnitude versus phase plot. **5**

e. What is the Nyquist Criterion. **5**

Q.2. a. Find the transfer function of the block diagram shown in figure by using block diagram reduction method. **10**



b. Determine the stability of the control system having characteristic equation **10**

$S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$

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Q3. a. A unity feedback system is characterized by a loop transfer function 10

$$G(s) = \frac{k}{s\,(s+10)}$$

Determine gain k, so that the system will have a damping ratio of 0.5.
For this value of k, determine T_s, M_p, T_p for a unit step.

b. Sketch the polar plot for the system having transfer function $G(s) = \frac{1}{s\,(1+s)^2}$ 10

Q.4.a. Draw the Root locus for the system. 10

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

Determine the value of k for marginal stability and critical damping.

b. A feedback control system has $G(s)\,H(s) = \frac{100(s+3)}{s\,(s+1)(s+5)}$ 10

Draw Bode plot and comment on stability.

Q.5. a. Draw the Nyquist plot for the given open loop transfer function and test the stability. 10

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

b. Obtain the state model for the system with transfer function. 10

$$\frac{Y(s)}{U(s)} = \frac{3S+4}{s^2+5s+2}$$

Q.6. Short note on (Any 2) 20

a. Frequency domain specifications for second order under damped system

b. Special cases with Routh Criterion

c. Concept of Controllability

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(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 **[20]**

a Differentiate between Bilinear Transformation and Impulse Invariance Methods

b Determine the zeros of the following FIR systems and indicate whether the system is minimum, maximum or mixed phase.

$$H_1(z) = 6 + z^{-1} - z^{-2}$$
$$H_2(z) = 1 - z^{-1} - 6z^{-2}$$

c Compute 4-point DFT of a causal four sample sequence given by x(n)= {j, 0, j, 1}

d State and prove any two properties of DFT

e What is multirate DSP? State its applications.

2 a Compute DFT of the following sequence using DIT FFT algorithm **[10]**
x(n) = {0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0}

b Write a short note on pipelining in the DSP processor and MAC unit. **[10]**

3 a Given H(s) = [3/(s+2)(s+3)], T=0.1 sec. Design digital IIR filter using BLT method. Explain advantages of BLT over IIM method **[10]**

b Realize the following IIR filter function by lattice realization structure. **[10]**

$$H(z) = \frac{1}{1 + \frac{3}{4}z^{-1} + \frac{1}{2}z^{-2} + \frac{1}{4}z^{-3}}$$

4 a Design a linear phase FIR low pass filter using rectangular window by taking 7 samples of window sequence and with cutoff frequency wc=0.2π rad/sample **[10]**

b Design a FIR low pass filter with the following desired frequency response. **[10]**

$$H(e^{j\omega}) = \begin{cases} e^{-j2\omega}, & -\frac{\pi}{4} \le w \le \frac{\pi}{4} \\ 0, & Otherwise \end{cases}$$

5 a Explain concept of decimation by integer D. **[10]**

b Find the circular convolution of the sequences using DFT **[10]**
X(n)={1, 2, 1, 2} and h(n)={4, 0, 4, 0}

6 a Write a short note on Limit cycle oscillations **[10]**

b Write a short note on Product quantization error and input quantization error **[10]**

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Duration: 03 Hrs. **Max. Marks 80**

Instructions:

(1) Question 1 is compulsory, solve any three from remaining questions
(2) Assume suitable data if necessary.
(3) Diagrams to be drawn neatly.

Question No.		Max. Marks
Q1(A)	Draw block diagram of OPAMP and explain function of each block..	05
Q1(B)	Draw the circuit diagram of opamp as two input adder and derive the expression of output voltage.	05
Q1(C)	Explain any one application of comparator	05
Q1(D)	Compare 78XX and IC 723 voltage regulator.	05
Q2(A)	Draw the circuit diagram and explain the operation of sample and hold circuit, state its application areas.	10
Q2(B)	Design first order High pass fitter using opamp at a cut off frequency of 1Khz, having pass band gain of 2.	10
Q3(A)	Draw the circuit diagram and explain the operation of precision half wave rectifier. Derive the expression of output voltage. Sketch its transfer characteristics.	10
Q3(B)	Design square wave generator using opamp to have output voltage = ±5 volts,frequency 1khz,with 75% duty cycle. Assume VCC = ± 14volts.	10

Q4(A)	Draw neat circuit diagram and explain the operation of dual slope type analog to digital converter. What are its advantages and disadvantages.	10
Q4(B)	Draw neat circuit diagram and explain the operation of monostable multivibrator using IC 555.List specifications of IC555.	10
Q5(A)	Design a IC 555 based symmetrical square wave generator for 1.4 KHz frequency of Vcc= 5 V.Draw all waveforms.	10
Q5(B)	Design inverting amplifier using Op-Amp for voltage gain of -6.8 with complete analysis. Which type of feedback is used in this amplifier?	10

Solve any **TWO** of the following.

Q6(A)	Explain different types of protections provided in IC 723 voltage regulator.	10
Q6(B)	Draw block diagram and explain the operation of PLL,Explain any one application of PLL..	10
Q6(C)	Draw circuit diagram and explain the operation of wein bridge oscillator using OPAMP.State formula for frequency of oscillations.	10

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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 questions.
3) Assume suitable data wherever necessary.

1. Answer the following **(any four):** **20**
   a What are the advantages of digital communication?
   b Explain Gaussian distribution.
   c State and explain Shannon-Hartley Capacity theorem.
   d Explain the need of equalizers to overcome ISI.
   e State the desirable properties of line codes.

2. a A systematic block code has parity check equations as given below:
   $p1 = m1 + m2 + m4$ $p2 = m1 + m3 + m4$ $p3 = m1 + m2 + m3$
   where mi are the message bits and pi are the parity bits.
   a) Find the Generator matrix and the Parity check matrix for this code **4**
   b) How many errors can be detected and corrected? **4**
   c) If the received codeword is {0010110}, find the syndrome. **2**
   b The generator polynomial for a (7,4) systematic cyclic code is $g(x) = 1+x+x^3$
   i) Draw the shift register implementation of encoder and syndrome calculator for this code. **4**
   ii) Find the codeword for the message {0101} **3**
   iii) Assume that the first bit of the codeword in (ii), suffers transmission error. Find the syndrome at the receiver. **4**

3. a Explain OQPSK modulation with a proper block diagram and waveforms. **10**
   b Explain BFSK modulator and demodulator with a block diagram. Draw also, a constellation diagram. **10**

4. a Prove that the mean of sum of two random variables is the sum of the mean of the two random variables. **10**
   b For the data sequence 11011001 draw the following line codes: NRZ-L, NRZ-M, bipolar RZ, AMI, Manchester code. **05**
   c Draw signal space representation of BPSK and QPSK, and find their Euclidean distance.

5. a A discrete memory less source (DMS) has an alphabet of five symbols with the probabilities: **10**

Symbol	S1	S2	S3	S4	S5
Probability	0.36	0.14	0.17	0.22	0.11

   i) Construct Huffman code.
   ii) Find the code efficiency.
   For the DMS described above,
   i) Construct Shannon-Fano code.
   ii) Find the code efficiency.
   b Explain the duobinary encoding and decoding. State the advantages of duobinary encoding. **10**

6. Write a short note on: **10**
   a) Central limit theorem
   b) Raised cosine filter
   c) Matched filter
   d) OFDM

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Duration: 3hrs **[Max 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	[20]
	a	What is data structure? List out areas in which data structures are applied extensively.	[5]
	b	What is a graph? Explain the representation techniques.	[5]
	c	What do you understand by stack overflow and underflow? Write a algorithm to check for overflow and underflow condition of stack.	[5]
	d	Explain the concept of circular queue? How is it better than a linear queue?	[5]
	e	Explain the expression tree with an example.	[5]
2	a	Write an algorithm to convert given infix to postfix expression using stack.	[10]
	b	Explain circular queue and priority queue with examples.	[10]
3	a	What is a Linked List? Write an algorithm to delete the node at the end of the singly Linked List.	[10]
	b	What is Huffman coding? Write an algorithm to construct Huffman tree.	[10]
4	a	Explain the tree traversal methods with examples.	[10]
	b	What is a Binary Search Tree? Design a Binary Search Tree for the following elements: 50, 20, 70, 10, 40, 90, 60, 100	[10]
5	a	Write a short note on BFS and DFS algorithm.	[10]
	b	Consider the following array DATA: 53 64 23 66 98 12 76 44 33 10 Write an algorithm to find an element 22 from the above array using binary search.	[10]
6	a	Explain Comparison of sorting Techniques.	[10]
	b	Explain the collision resolution techniques.	[10]

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