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Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. What do you mean by sampling in frequency domain? Derive the relationship for reconstruction of the signal from the samples of the spectrum. **(10 Marks)**

b. Construct W_3 matrix for finding 3 point DFT. Using this matrix, find the DFT of $x(n) = \{0, 2, 2\}$. **(06 Marks)**

c. Establish relationship between DFT and the Fourier series coefficients of a periodic sequence. **(04 Marks)**

2 a. Find the DFT of $x(n) = \{0, 1, 2, 0\}$ and from DFT of x(n) find the DFT of $y(n) = \{0, 0, 1, 2\}$ using properties of DFT. Hence prove the property used. **(10 Marks)**

b. Given $x(n) = \{0, 3, 3\}$ and $h(n) = \{-1, 1, 1\}$ find the DFTs of x(n) and h(n). Hence calculate circular convolution y(n) between x(n) and h(n) using their DFTs. **(10 Marks)**

3 a. A long sequence x(n) is filtered through a filter with impulse response h(n) to yield the output y(n). If $h(n) = \{1, 2\}$ and $x(n) = \{1, 4, 3, 0, 7, 4, -7, -7, -1, 3, 4, 3\}$, compute y(n) using overlap add technique. Use only a 5 point circular convolution in your approach. **(10 Marks)**

b. Explain computation complexities of Direct DFT calculation and DIT FFT algorithm. Compare the results and calculate the speed improvement factor for N = 64. **(10 Marks)**

4 a. A filter with impulse response $h(n) = \{1, 1\}$ is given an input $x(n) = \{0, 2, 4\}$. Find the output of the filter from the DFTs of h(n) and x(n). Use DIT FFT algorithms to calculate DFT and IDFT. **(10 Marks)**

b. What are the similarities and differences between DIT and DIF, FFT algorithms? **(04 Marks)**

c. Write a note on chirp-z transform. **(06 Marks)**

PART – B

5 a. Describe the transformation relation used for converting a LPF into a HPF. **(06 Marks)**

b. Distinguish between Butterworth and Chebyshev type I filter. **(04 Marks)**

c. Design an analog Chebyshev filter for which the squared magnitude response $|H_a(j\Omega)|^2$ satisfies the condition

$$20\log_{10}|H_a(j\Omega)|_{\Omega=0.2\pi} \geq -1$$

$$20\log_{10}|H_a(j\Omega)|_{\Omega=0.3\pi} \leq -15$$

(10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

6 a. Consider the system function

$$H(z) = \frac{1+\frac{1}{5}z^{-1}}{\left(1-\frac{1}{2}z^{-1}+\frac{1}{3}z^{-2}\right)\left(1+\frac{1}{4}z^{-1}\right)}$$

i) Realize the system in direct form – 1
ii) Realize in cascade form
iii) Realize in parallel form. **(12 Marks)**

b. Consider an FIR lattice filter with coefficients $K_1 = 0.65$, $K_2 = -0.34$ and $K_3 = 0.8$. Find its impulse response. Draw the equivalent direct form structure. **(08 Marks)**

7 a. What are the advantages and disadvantages with the design of FIR filter using window function? **(06 Marks)**

b. Explain the following windows with their frequency responses, used in FIR filter design:
i) Rectangular window
ii) Hanning window
iii) Hamming window. **(06 Marks)**

c. Design a lowpass FIR filter using frequency sampling technique having a cutoff frequency of $\frac{\pi}{2}$ rad/sample. The filter should have linear phase and length of 17. **(08 Marks)**

8 a. The system function of the analog filter is given as

$$H_a(s) = \frac{s+0.1}{(s+0.1)^2+9}$$

Obtain the system function of the IIR digital filter by using impulse invariance method. **(06 Marks)**

b. Explain the bilinear transform method of IIR filter design. What is warping effect? Explain the poles and zeros mapping procedure. **(10 Marks)**

c. Compare the impulse invariance and bilinear transform methods. **(04 Marks)**

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10EC53

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Analog Communication

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. Define Probability Density Function and discuss the properties of PDF. **(06 Marks)**

b. The random variable 'Y' is the function of another random variable 'X' in such a way that X = cos(x) and 'X' is uniformly distributed in the interval $(-\pi, \pi)$ ie

$$f_x(x) = \begin{cases} \dfrac{1}{2\pi} & \text{for } -\pi < x < \pi \\ 0 & \text{otherwise} \end{cases}$$

Determine the expected value of 'Z'. **(06 Marks)**

c. A random variable X is Gaussian distributed with mean $m_x = 5$ and variance $\sigma_x^2 = 64$. What is the probability of obtaining 'X' between -3 and 13? **(08 Marks)**

2 a. Explain the detection of square-law detector using relevant diagram, mathematical analysis and waveform. **(07 Marks)**

b. Discuss the ring modulator with necessary equations and waveform to generate DSBSC wave. **(07 Marks)**

c. An amplitude modulated waveform has the form $X_C(t) = 10[1 + 0.5\cos 2000\,\pi t + 0.5\cos 4000\,\pi t] \times \cos(20{,}000\pi t)$.

i) Sketch the spectrum of $X_c(f)$.

ii) Find the average power content in each spectral component including the carrier.

iii) Modulation index. **(06 Marks)**

3 a. Define Hilbert transform and explain its properties. **(06 Marks)**

b. Let $S_u(t)$ denote the SSB signal obtained by transmitting only upper sideband and let $\hat{S}_u(t)$ denotes its Hilbert transform. Show that:

i) $m(t) = \dfrac{2}{A_c}\left[S_u(t)\cos(2\pi f_c t) + \hat{S}_u(t)\sin(2\pi f_c t)\right]$

ii) $\hat{m}(t) = \dfrac{2}{A_c}\left[\hat{S}_u(t)\cos(2\pi f_c t) - S_u(t)\sin(2\pi f_c t)\right]$ **(08 Marks)**

c. With neat block diagram, explain for SSB modulated wave using phase discrimination with relevant expressions method. **(06 Marks)**

4 a. Describe the filtering technique method used for generating VSB modulated wave. **(10 Marks)**

b. Discuss the transmission and reception of a number of independent signal over a single communication channel by modulating different carrier signals. **(10 Marks)**

PART – B

5 a. Distinguish between amplitude modulation and frequency modulation. **(06 Marks)**

b. Discuss the indirect method of generating frequency modulation using relevant block diagram. **(08 Marks)**

c. In a FM system, the modulating fly f_m = 1kHz, the modulating voltage A_m = 2 volt and the deviation is 6kHz. If the modulating v_g is raised to 4 volt, then what is the new deviation? If the modulating voltage is further increased to 8 volts and modulating fly is reduced to 500Hz what will be deviation? **(06 Marks)**

6 a. Mention the comparison between NBFM and WBFM. **(06 Marks)**

b. Discuss the characteristics of balanced slope detector model. **(06 Marks)**

c. With the block diagram approach, explain the operation of FM stereo system. **(08 Marks)**

7 a. Discuss about the different sources of noise and explain the classification of Internal Noise. **(06 Marks)**

b. Derive the equation of equivalent noise temperature of amplifier connected in cascade. **(06 Marks)**

c. An amplifier has a noise figure of 19dB and power gain of 15dB. It is connected in cascade to an amplifier. Whose noise figure is 20dB? Calculate the overall noise figure for this connection. **(08 Marks)**

8 a. Derive the figure of merit of noise in DSBSC systems using coherent detection. **(10 Marks)**

b. Calculate the figure of merit of an AM receiver operating on single tone AM. **(10 Marks)**

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Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Microwaves and Radar

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Derive the transmission line equations by the method of distributed circuit theory. **(10 Marks)**
b. What is impedance matching? Explain single stub matching and double stub matching. **(10 Marks)**

2 a. Derive electric and magnetic field equation in rectangular wave guides for TE modes. **(10 Marks)**
b. Explain faraday rotation and discuss microwave isolator. **(10 Marks)**

3 a. With a neat sketch, explain the TRAPATT diode and draw its characteristics. **(10 Marks)**
b. Explain the parametric amplifier with equivalent circuit. Give the advantages of parametric amplifier. **(10 Marks)**

4 a. State the properties of S-parameter. Explain S-matrix representation of multiport network. **(10 Marks)**
b. Explain symmetrical z and y matrix for reciprocal network. **(10 Marks)**

PART – B

5 a. With a neat diagram, explain the working of a precision type phase shifter. **(10 Marks)**
b. What are waveguide tees? With a neat diagram explain E-plane and H-plane tees. **(10 Marks)**

6 a. Explain briefly dielectric losses, ohmic losses and radiation losses in microstrip lines. **(10 Marks)**
b. How microwaves are transmitted? Name basic types of planar transmission lines. Explain the construction and field pattern for microstripline. **(10 Marks)**

7 a. What is radar? With a neat block diagram, explain the operation of radar. **(10 Marks)**
b. Derive the radar range equation starting from the power density of isotropic antenna. List the applications of radar. **(10 Marks)**

8 a. Explain single delay line canceller and frequency response of the single delay line canceller. **(10 Marks)**
b. With a neat block diagram, explain the operation of MTI Doppler signal processor. **(10 Marks)**

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10EC55

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data may be suitably assumed.***

PART – A

1 a. Define the terms symbol rate and self information with examples for each. **(04 Marks)**

b. Justify the statement "The information content of a message is a logarithmic function of its probability of emission." **(06 Marks)**

c. Consider the state diagram of Fig.Q1(c),
i) Compute the state probabilities
ii) Find entropy of each state
iii) Find the entropy of the source

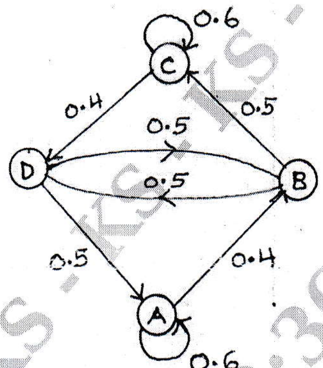

Fig.Q1(c) **(10 Marks)**

2 a. Explain the Shanon's encoding algorithm for generating binary codes. **(05 Marks)**

b. Apply Shannon's encoding algorithm to the following set of messages and obtain code efficiency and redundancy. **(05 Marks)**

m_1	m_2	m_3	m_4	m_5
$\frac{1}{8}$	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{8}$

c. With the aid of a suitable block diagram, explain discrete data communication channel, discrete communication channel and continuous channel. **(10 Marks)**

3 a. State and explain properties of mutual information. **(07 Marks)**

b. A transmitter transmits five symbols with probabilities 0.2, 0.3, 0.2, 0.1 and 0.2. Given the channel matrix P(B/A), calculate (i) H(B) (ii) H(A, B).

$$P(B/A) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1/4 & 3/4 & 0 & 0 \\ 0 & 1/3 & 2/3 & 0 \\ 0 & 0 & 1/3 & 2/3 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

(08 Marks)

c. Explain how a communication channel is represented. What is a channel matrix? Explain. **(05 Marks)**

4 a. State and prove channel capacity theorem. State its implications. **(08 Marks)**

b. A voice grade channel of the telephone network has a bandwidth of 3.4 kHz.

i) Calculate channel capacity of a telephone channel for a signal-to-noise ratio of 30 dB.

ii) Calculate the minimum signal to noise ratio required to support information transmission through the telephone channel at the rate of 4800 bits/sec. **(08 Marks)**

c. An analog signal has a 4 kHz bandwidth. The signal is sampled at 2.5 times the Niquist rate and each sample is quantized into 256 equally likely levels. Assume that the successive samples are statistically independent. Find the information rate of this source. **(04 Marks)**

PART – B

5 a. Explain the matrix representation of linear block codes. **(06 Marks)**

b. Define and illustrate the following with an example.

i) Hamming weight

ii) Hamming distance **(04 Marks)**

c. For a systematic (7, 4) linear block code, the parity matrix P is given by

$$[P] = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$

i) Find all possible valid code vectors.

ii) Draw the corresponding encoding circuit.

iii) For a received code vector R = [0111110] detect and correct the error that has occurred.

iv) Draw a syndrome calculation circuit. **(10 Marks)**

6 a. A (15, 5) cyclic code has a generator polynomial $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$.

i) Draw the block diagram of an error encoder.

ii) Draw the syndrome calculator for this code. **(10 Marks)**

b. For a (7, 4) cyclic code with received vector V = [1110101] with a generator polynomial $g(x) = 1 + x + x^3$, draw the syndrome configuration circuit and correct the error in received vector. **(10 Marks)**

7 Write short notes on:

a. RS codes

b. Golay codes

c. Shortened cyclic codes

d. Burst error correcting codes **(20 Marks)**

8 a. Bring out the differences between "Block code" and "convolution codes". Explain with a simple diagram the encoder for convolutional codes. **(06 Marks)**

b. Consider the (3, 1, 2) convolutional code with $g^{(1)} = (110)$, $g^{(2)} = (101)$ and $g^{(3)} = (111)$.

i) Find constraint length

ii) Find rate efficiency

iii) Draw the encoder block diagram

iv) Find the code word for the message sequence (11101) using time-domain and transfer approach. **(14 Marks)**

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10EC56

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fundamentals of CMOS VLSI

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. Explain the enhancement transistor action of MOSFET DEVICE. Draw its output characteristics, mention the region of operation. **(10 Marks)**

b. Explain fabrication of CMOS using nwell process. **(06 Marks)**

c. Compare the CMOS with BiCMOS technology. **(04 Marks)**

2 a. Draw the DC characteristics of CMOS inverter, mention the region of operation. Derive the mid-point voltage equation for CMOS inverter. Discuss the effect of B_n/B_p ratio on DC characteristics. **(12 Marks)**

b. A NMOS transistor is operating with following parameter:
$V_{GS} = 3.9V$ $U_{th} = 1V$, $W/L = 100$
$\mu_n Cox = 90\ \mu A/v^2$ find I_D for i) $V_{DS} = 5U$ ii) $U_{DS} = 2.1V$. **(08 Marks)**

3 a. Describe the pass characteristics of nMOS and pMOS device. Realize 2 input XOR gate with pass transistor and CMOS. **(06 Marks)**

b. Draw the schematic diagram and slick diagram for Boolean expression $y = \overline{(A+B)C}$ using CMOS logic. Use colour/monochromatic codes. **(06 Marks)**

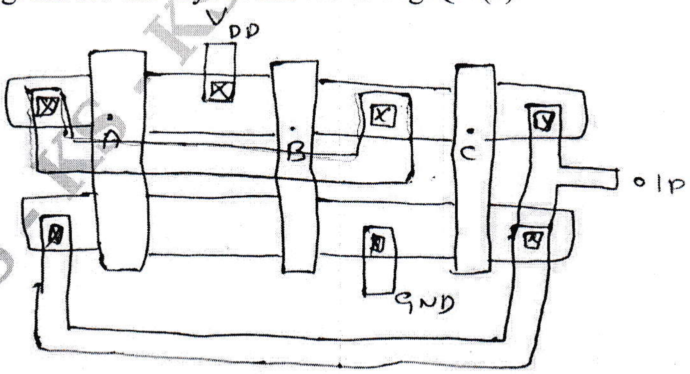
c. Realize $\overline{(A+B)(C+D)}$ using
i) Pseudo nMOS logic
ii) Dynamic CMOS logic
iii) CMOS logic
iv) Domino logic. **(08 Marks)**

4 a. What is mean by λ-based design rule represent each layers of CMOS with it standard colour code and dimension as per the design rule. **(06 Marks)**

b. Discuss the advantages and disadvantages of scaling the MOS device. Derive the scaling factor for following:
i) Gate delay
ii) Carrier density in the channel
iii) Channel resistance R_{on}. **(08 Marks)**

c. Draw the circuit diagram for the layout shown in Fig.Q.4(c). **(06 Marks)**

Fig.Q.4(c)



PART – B

5 a. Differentiate between pass transistor and transmission gate. **(04 Marks)**

b. In the circuit shown in the Fig.Q.5(b). Find V_1, V_2, V_3 and V_4. Justify your answer $V_{DD} = 5V$, $V_{24} = 0.7V$. **(06 Marks)**

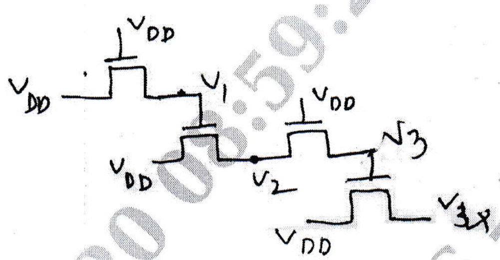


Fig.Q.5(b)

c. Draw the schematic diagram of BiCMOS 3 input NOR gate. Explain circuit operation. Draw the stick diagram for the same. **(10 Marks)**

6 a. What is mean by C^2MOS logic (clocked CMOS). Illustrate with example of 2 i/p x – OR gate. **(08 Marks)**

b. Explain the design of 4 bit barrel shifter with neat diagram. **(12 Marks)**

7 a. Explain how ALU functions can be implemented with adder. **(10 Marks)**

b. Explain with block diagram carry look ahead adder. **(10 Marks)**

8 a. Explain nMOS and CMOS pseudo-static memory cell with relevant diagram. **(10 Marks)**

b. Mention the performance parameters of design process. Explain optimization of nMOS and CMOS inverter. **(10 Marks)**

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10TE52

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. If the DFT of $x(n) \leftrightarrow X(k)$ then prove that DFT $\{W_N^{-\ell n}x(n)\} = X(k-\ell))N,\ 0 \le k \le N-1$. **(06 Marks)**

b. Compute the N-point DFT of the sequence $x(n) = \text{Cos}(nw_0)$, $w_0 = \frac{2\pi}{N}k_0, 0 \le n \le N-1$ **(06 Marks)**

c. Find the IDFT of the 4-point sequence $X(k) = \{4, -j2, 0, j2\}$. **(08 Marks)**

2 a. Consider the sequence
$x(n) = 4\delta(n) + 3\delta(n-1) + 2\delta(n-2) + \delta(n-3)$
(i) find the 6-point DFT of the sequence x(n)
(ii) find the finite length sequence y(n), which has a DFT equal to real part of X(k). **(10 Marks)**

b. Let X(k) be a 14-point DFT of length -14 real sequence x(n). The first 8 samples of X(k) are
$X(0) = 12, X(1) = -1 + j3\ \ X(2) = 3 + j4$
$X(3) = 1 - j5, X(4) = -2 + j2\ \ X(5) = 6 + j3$
$X(6) = -2 - j3, X(7) = 10$
Find the remaining samples of X(k). Also evaluate the following :
i) x(0) ii) x(7) iii) $\sum_{n=0}^{13} x(n)$ iv) $\sum_{n=0}^{13} |x(n)|^2$ **(10 Marks)**

3 a. State and prove Geortzel algorithm. **(05 Marks)**

b. Let X(w) denote the Fourier Transform of a sequence $x(n) = \left(\frac{1}{2}\right)^n u(n)$. Let $x_1(n)$ denote a sequence of finite duration of length '10' that is $x_1(n) = 0$ for $n < 0$ and $x_1(n) = 0$ for $n \ge 10$. The 10-point DFT of $x_1(n)$ denoted by $x_1(k)$ corresponds to 10 equally spaced samples of X(w) that is $X_1(k) = X(w)\,|_{w=\frac{2\pi k}{10}}$ determine $x_1(n)$? **(07 Marks)**

c. Perform $x(n) * h(n)$ for the sequences x(n) and h(n) using overlap – add fast convolution technique h(n) = (1, 1, 1) and x(n) = (1, 2, 0, –3, 4, 2, –1, 1, –2, 3, 2, 1, –3) **(08 Marks)**

4 a. Derive the 8-point DIT radix -2 FFT algorithm to find the DFT of a sequence x(n). **(10 Marks)**

b. Find the 8-point DFT of a real sequence x(n) = {1, 2, 2, 2, 1, 0, 0, 0} using DIF – FFT. Draw the signal flow graph indicating x(n) and intermediate value of X(k). **(10 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – B

5 a. A Butter-worth low pass filter has to meet the following specifications
   (i) Pass band gain $K_p = -1dB$ at $\Omega_p = 4rad/sec$
   (ii) Stop band attenuation greater than or equal to 20dB at 8 rad/sec.
Determine the transfer function Ha(S) of the lowest orders Butter-worth filter to meet the above specifications. **(12 Marks)**

b. Transform the analog filter

$H_a(s) = \frac{(s+1)}{s^2+5s+6}$ into H(z) using Impulse Invariance transformation take T = 0.1 Sec. **(08 Marks)**

6 a. A Chebyshev I filter of order N = 3 and unit bandwidth is known to have pole at S = – 1.
   (i) Find the other poles of filter and parameter '$\in$'
   (ii) The analog filter is mapped to z – domain using bilinear transformation with T = 2
Find the transfer function H(z) of digital filter. **(12 Marks)**

b. Explain the backward difference method of design of digital filter. **(04 Marks)**

c. What are the advantages of bilinear transformation method of digital filter? **(04 Marks)**

7 a. Design a low pass filter with a cutoff frequency $W_c = \frac{\pi}{4}$, a transition width $\Delta w = 0.02\pi$ and a stopband ripple, $\delta_s = 0.01$. Use Kaiser window design method. **(15 Marks)**

b. List the differences between IIR and FIR filters. **(05 Marks)**

8 a. A linear time invariant digital IIR filter is specified by the following transfer function.

$$H(z) = \frac{(z-1)(z-2)(z+1)z}{\left[z-\left(\frac{1}{2}+j\frac{1}{2}\right)\right]\left[z-\left(\frac{1}{2}-j\frac{1}{2}\right)\right]\left[z-j\frac{1}{4}\right]\left[z+j\frac{1}{4}\right]}$$

Realize the system in following forms
   (i) Direct form I
   (ii) Direct form II. **(06 Marks)**

b. Consider a second order LTI system described by difference equation

$$y(n) = \frac{1}{16}y(n-2) + x(n)$$

   (i) Determine the unit sample response, h(n) of the system
   (ii) Determine the direct form II, parallel form and cascade realizations of the system
   (iii) Find an expression for the frequency response of the system. **(08 Marks)**

c. Realize the linear – phase FIR filter having the following impulse response

$$h(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2) + \frac{1}{4}\delta(n-3) + \delta(n-4)$$ **(06 Marks)**

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10TE54

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Transmission Lines and Waveguides

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of Smith chart is permitted.***

PART – A

1 a. Define a transmission line and derive the equations for voltages and current at any point on a transmission line and also write the expression for α, β wavelength and velocity of propagation. **(12 Marks)**

b. A Generator of 10V, 1000 Hz supplies power to a 100 km transmission line having the following parameters: R = 10.4 Ω/km, L = 0.00367 H/km, G = $0.8 * 10^{-6}$ ℧/km, c = 0.0835 μF/km. Find Z_0, Γ, λ, V_p of the transmission line. **(08 Marks)**

2 a. Mention the condition for K-low pass filter and derive the expression for cut-off frequency, characteristic impedance and design values for L and C for K-low pass filter of T type. **(12 Marks)**

b. What are standing waves? Construct standing wave patterns for (i) Z_R = open circuited (ii) Z_R = short circuited (iii) $Z_R = 3Z_0$ (iv) $Z_R = Z_0/3$ **(08 Marks)**

3 a. Explain the applications and properties of Smith chart. **(10 Marks)**

b. A 300 Ω line feeding an antenna has a standing wave ratio of 4 and the distance from load to the first voltage minimum is 28 cm, if the frequency is 150 MHz. Design a single stub matching system to eliminate standing wave. **(10 Marks)**

4 a. Explain the steps involved in double stub matching. Using: (i) Quadrature spacing between two stubs (ii) Three Eighths wavelength spacing between the stubs. **(10 Marks)**

b. For a load of $Z_R = 46 + j115\Omega$ and a line of characteristic impedance $Z_0 = 400\ \Omega$, design a double stub matching system choosing the distance between the stubs equal to $(3\lambda/8)$ at an operating frequency of 75 MHz. **(10 Marks)**

PART – B

5 a. State the properties of 'S' parameters. Prove the symmetry properties and unitary properties of 'S' parameters. **(10 Marks)**

b. With necessary condition, write the Scattering matrix representation of Multiport Network. **(10 Marks)**

6 a. Derive the expression for propagation constant, cut off frequency, group velocity, phase velocity for TE_{min} mode in rectangular waveguide. **(10 Marks)**

b. Explain the constructional features and working principles of the following directional couplers: (i) Two hole directional couplers (ii) Bathe Hole directional couplers **(10 Marks)**

7 a. Explain construction features and working principle of the Gunn diode and explain mode of operation. **(10 Marks)**

b. Explain the RWH theory. **(10 Marks)**

8 a. What are the Avalanche Transit-Time devices? Explain the Impatt diode with necessary diagrams. **(10 Marks)**

b. Explain the operation of parametric amplifiers with equivalent circuit. **(10 Marks)**

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