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10EC52

Fifth Semester B.E. Degree Examination, Aug./Sept. 2020
Digital Signal Processing

Time: 3 hrs.

Max. Marks: 100

Note: *1. Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. Use of Filter Tables are not permitted.

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. Find the N – point DFT of the sequence x(n) interms of Cos function

$$x(n) = \begin{cases} \frac{1}{5}, & 0 \le n \le 2 \\ 0, & \text{otherwise} \end{cases}$$

(06 Marks)

b. Compute the 10-point DFT of the sequence

$$x(n) = \cos\left(\frac{2\pi n}{10}\right), 0 \le n \le 9.$$

(06 Marks)

c. Let a sequence $x(n) = \{\underset{\uparrow}{2}, 3, 2, 1\}$ and its DFT $x(k) = \{\underset{\uparrow}{8}, -j2, 0, j2\}$. Compute :

i) DFT of the 12-point signal described by $x_1(n) = \{x(n).x(n).x(n)\}$

ii) 12-point zero interpolated signal $h(n) = x\left(\frac{n}{3}\right)$.

(08 Marks)

2 a. Let X(k) denotes a 6-point DFT of a sequence $x(n) = \{\underset{\uparrow}{1}, -1, 2, 3, 0, 0\}$ without computing the IDFT, determine the 6-point sequence g(n) whose 6-point DFT is given by $G(k) = W_3^{2k}X(k)$

(06 Marks)

b. Evaluate $y(n) = x(n) \circledast_8 h(n)$ for the sequences

$x(n) = e^{j\pi n}, 0 \le n \le 7$

$h(n) = u(n) - u(n-5)$.

(06 Marks)

c. Give the 8-point sequence x(n) is $x(n) = \begin{cases} 1, & 0 \le n \le 3 \\ 0, & 4 \le n \le 7 \end{cases}$. Compute the DFT to the sequence

$$x_1(n) = \begin{cases} 1, & n = 0 \\ 0, & 1 \le n \le 4 \\ 1, & 5 \le n \le 7 \end{cases}$$. Use the suitable property of DFT.

(08 Marks)

3 a. Find the output y(n) of a filter whose impulse response h(n) = { 1, –2, 1} and input signal x(n) = {3, 1, –2, 1, –1, 2, 4, 3, 6 }. Use a 8 - point circular convolution and also use over Lap-add method.

(08 Marks)

b. Calculate the percentage saving in calculations in a 512-point radix – 2FFT, when compared to direct DFT.

(05 Marks)

c. What is signal segmentation? Explain the procedure used for over Lap – save method.

(07 Marks)

4 a. Develop DIF – FFT algorithm for N = 8 and draw the complete signal graph. Using this signal flow graph, compute the DFT of the sequence.
$x(n) = \{1, -1, 1, -1, 1, 0, 0, 0\}$. **(14 Marks)**

b. Consider a finite length sequence $x(n) = \{\underset{\uparrow}{1}, 2, 3, 4, 5, 6\}$ find X(3) using Goertzel algorithm. Assume initial conditions are zero. **(06 Marks)**

PART – B

5 a. Explain Analog to Analog Frequency Transformation. **(05 Marks)**

b. What is Chebyshev polynomials and mention its properties. **(05 Marks)**

c. Find the order of a Low pass Butterworth filter to meet the following specifications.
$\delta_P = 0.001$, $\delta_S = 0.001$
$\Omega_P = 1$ rad/sec, $\Omega_S = 2$ rad/sec **(05 Marks)**

d. What are the advantages and disadvantages of IIR Filters? **(05 Marks)**

6 a. Obtain Parallel form Realization of system Transfer function

$$H(z) = \frac{1 + \frac{1}{2}z^{-1}}{\left(1 - z^{-1} + \frac{1}{4}z^{-2}\right)\left(1 - z^{-1} + \frac{1}{2}z^{-2}\right)}.$$ **(10 Marks)**

b. What are the features of a FIR Lattice structure? **(05 Marks)**

c. Realize the following FIR system with minimum number of multipliers
$h(n) = \{-0.5, 0.8, -0.5\}$ **(05 Marks)**

7 a. A filter is to be designed with the following desired frequency response

$$H_d(e^{jw}) = \begin{cases} 0, & \frac{-\pi}{4} \le w \le \frac{\pi}{4} \\ e^{-j2w}, & \frac{\pi}{4} < |w| \le \pi \end{cases}$$

Determine the filter coefficient $h_d(n)$ if the window function is defined as

$$w(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$$ **(10 Marks)**

b. Find the impulse response h(n) of a linear phase FIR filter of length = 4 for which the frequency response at w = 0 and $w = \frac{\pi}{2}$ is specified as

$H_r(0) = 1$ and $H_r\left(\frac{\pi}{2}\right) = \frac{1}{2}$ **(07 Marks)**

c. Mention the advantages of Window Technique. **(03 Marks)**

8 a. Design an IIR digital filter that when used in a prefilter A/D – H(z) – D/A structure, will satisfy the following analog specification of Chebyshev filter.
i) LPF with – 2dB cutoff at 100Hz
ii) Stopband attenuation of 20DdB or greater at 500Hz
iii) Sampling rate 4000 samples/sec **(14 Marks)**

b. Obtain the digital filter. equivalent of the analog filter shown in Fig Q8(b). Using impulse invariance method. Assume $f_s = 8f_c$, where f_c – cutoff frequencies of the filter.

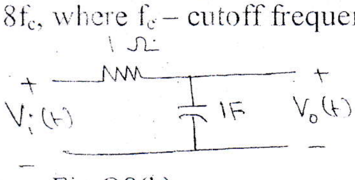

Fig Q8(b) **(06 Marks)**

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10EC53

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Analog Communication

Time: 3 hrs. Max. Marks:100

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

PART - A

1 a. List the properties of Autocorrelation function. **(04 Marks)**

b. A random variable has a probability density function

$$F_X(x) = \begin{cases} \frac{5}{4}(1-x^4) & 0 \le x \le 1 \\ 0 & \text{Elsewhere} \end{cases}$$

Find i) $E[X]$ ii) $E[4X+2]$ and iii) $E[X^2]$. **(06 Marks)**

c. The random process $X(t) = A\cos(2\pi f_c t + \theta)$, where θ is the random variable, that is uniformly distributed over the interval $(-\pi, \pi)$. Determine
i) The auto correlation function X(t) ii) Power spectral density
iii) Average power of X(t). **(10 Marks)**

2 a. Determine the optimal efficiency of amplitude modulation. **(06 Marks)**

b. What is the importance of COSTAS receiver? Explain its working principles with a suitable block diagram. **(08 Marks)**

c. Consider the wave obtained by adding a non – coherent carrier $A_C \cos(2\pi f_c t + \phi)$ to the DSBSC waver $m(t)\cos 2\pi f_c t$, where m(t) is the message waveform. This waveform is applied to as ideal envelope detector. Find the resulting detector output. Evaluate the output for
i) $\phi = 0$ ii) $\phi \ne 0$ and $m(t) << \frac{A_c}{2}$. **(06 Marks)**

3 a. Highlight the advantages of Quadrature amplitude multiplexer and explain its QAM system with a suitable block diagram. **(06 Marks)**

b. Determine the Hilbert Transform of the function given below :

$$g(t) = \begin{cases} 1 & \text{for } |t| \le \frac{T}{2} \\ 0 & \text{Elsewhere} \end{cases}$$ **(04 Marks)**

c. Generate SSBSC wave using frequency discrimination method with a suitable block diagram. **(10 Marks)**

4 a. Describe the generation and detection of VSB with a necessary block diagram. **(09 Marks)**

b. Let the incoming narrow – band signal of bandwidth 10KHz and mid – band frequency which may lie in the range 0.535 – 1.605 MHz. It is required to translate this signal to a fixed frequency band centered at 0.455 MHz. Determine the range of tuning that must be provided in the local oscillator. **(05 Marks)**

c. Describe the working principle of frequency division multiplexing. **(06 Marks)**

PART - B

5 a. With a neat circuit diagram, describe the direct method of generating FM. Also explain feedback scheme for frequency stabilization of a frequency modulator in direct method. **(10 Marks)**

b. The equation for an FM wave is given by $s(t) = 10 \sin [5.7 \times 10^8 t + 5 \sin 12 \times 10^3 t]$. Calculate i) Carrier frequency ii) Modulating frequency iii) Modulation index iv) Frequency deviation and v) Power dissipated in 100Ω resistor. **(06 Marks)**

c. Explain Carson's rule. **(04 Marks)**

6 a. Explain the working principle of balanced slope detector with a suitable circuit. **(08 Marks)**

b. Explain with relevant block diagram FM stereo multiplexing system. **(08 Marks)**

c. Explain Threshold in FM. **(04 Marks)**

7 a. Define and explain the following :
i) Noise equivalent bandwidth ii) Equivalent Noise bandwidth. **(08 Marks)**

b. Three amplifiers have the following specifications :

Amplifier 1	$F_1 = 8$ dB	$G_1 = 42$dB
Amplifier 2	$F_2 = 9$ dB	$G_2 = 38$dB
Amplifier 3	$F_3 = 5$ dB	$G_3 = 22$dB

The amplifiers are connected in cascade. Find the overall Noise figure. **(06 Marks)**

c. Deduce FRII's formula. **(06 Marks)**

8 a. Derive an expression for figure of merit of an AM receiver, with envelope detector. **(10 Marks)**

b. Explain the working principle of pre – emphasis and de – emphasis in FM system and high – light their applications. **(10 Marks)**

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10EC54

Fifth Semester B.E. Degree Examination, Aug./Sept.2020

Microwaves and Radar

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 allowed.***

PART – A

1 a. Define the following terms as referred to a transmission line:
(i) Standing waves
(ii) Reflection coefficient
(iii) VSWR
(iv) Transmission coefficient
(v) A matched transmission line **(10 Marks)**

b. A load impedance of (60 – j80)Ω is to be matched to a 50Ω coaxial line by using a single short circuited stub. The wave length of operation in 1 meter. Using Smith chart, find:
(i) The VSWR
(ii) Location 'd' of the stub with respect to load and length 'ℓ' of the stub
(iii) The position of first V_{max} and first V_{min} of the standing wave with respect load end. **(10 Marks)**

2 a. With constructional diagram, explain the working of a Faraday rotation isolator. **(08 Marks)**

b. A matched isolator has insertion loss of 0.5 dB and isolation loss of 25 dB. Find the scattering matrix of the isolator. **(04 Marks)**

c. With a diagram, explain a four port circulator that uses two directional couplers. Explain with diagram how a four port microwave circulator can be realized using two magic Tees. **(08 Marks)**

3 a. With relevant plots, waveforms and constructional diagrams, explain Gunn effect in a n-type GaAs slice. What are the differences between micro wave transistors and microwave TEDs? **(10 Marks)**

b. Write a note on PIN diode. With diagrams, show any three applications of PIN diode, explain these in briefly. **(10 Marks)**

4 a. Prove that the impedance and admittance matrices are symmetrical for a reciprocal network junction. **(06 Marks)**

b. Write the S-matrix for an n-port network. **(06 Marks)**

c. Starting from the impedance matrix equation, prove the symmetry property of S-matrix of reciprocal networks. **(08 Marks)**

PART – B

5 a. With neat diagram, explain the construction and working of a precision type variable waveguide attenuator, with matched ports. Derive its S-matrix. **(09 Marks)**

b. Starting from the characteristics of H-plane waveguide Tee junction derive its S-matrix. **(07 Marks)**

c. With diagram, explain how a magic-Tee can be used as a duplexer in RADAR system. **(04 Marks)**

6 a. Explain the constructional features microstrip lines. Discuss the characteristic impedance and effective relative dielectric constant of a microstrip line. **(09 Marks)**

b. Briefly explain the various losses in microstrip lines. **(06 Marks)**

c. A lossless parallel strip line has a conducting strip width W. The dielectric substrate separating the two conducting strips has a relative dielectric substrate of 6 and thickness of the dielectric substrate is 4 mm. Calculate:

(i) The required width W of the conducting strip in order to have a characteristic impedance of 50Ω.

(ii) The strip line capacitance

(iii) The strip line inductance

(iv) The phase velocity of the wave in the parallel strip line **(05 Marks)**

7 a. Derive the simple form of RADAR range equation. **(07 Marks)**

b. What are the applications of RADARs? **(06 Marks)**

c. A RADAR transmitter operates at 10 GHz and transmits 250 KW of peak pulse power. If the antenna used by the transmitter and receiver has a gain of 4000 and the power received from a target at 50 km is 10^{-11} W, what is the RADAR cross section of the target? **(07 Marks)**

8 a. Explain the principle and working of MTI radar with a block diagram. What are its advantages? **(10 Marks)**

b. With a neat block diagram of a delay line canceller explain the working principle. In the case of single delay line canceller derive the expression for the amplitude of the output. Hence draw the amplitude versus frequency plot. **(10 Marks)**

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10EC55

Fifth Semester B.E. Degree Examination, Aug./Sept. 2020
Information Theory and Coding

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Find an expression for average information content of symbols in long independent sequence and prove that $H(s)_{max} = \log_2 M$ when all 'M' symbols are equally likely independent. **(06 Marks)**

b. State diagram of stationary mark off source is given in Fig.Q1(b). Calculate H, G_1, G_2 and verify that $G_1 > G_2 > H$.

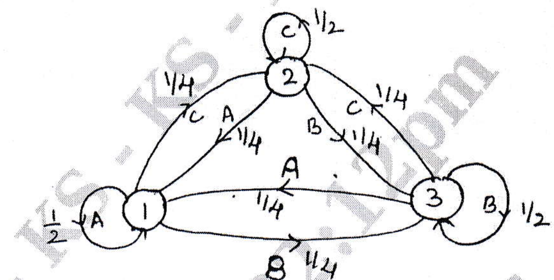

Fig.Q1(b) **(14 Marks)**

2 a. For a discrete memoryless source of entropy H(s). Show that the average code word length (L) for any distortionless source encoding speed is bounded by $L \geq H(s)$. **(06 Marks)**

b. A source has 6 symbols with probabilities P1 to P6 such that $P_1 = P_2 > P_3 = P_4 > P_5 = P_6$. If $P_6 = \frac{1}{12}$ construct Shannon code for the above messages and determine the efficiency of the code. **(07 Marks)**

c. Consider a source with 8 alphabets A to H with respective probabilities of 0.22, 0.20, 0.18, 0.15, 0.10, 0.08, 0.05, 0.02. Construct a quaternary compact code and determine the code efficiency. **(07 Marks)**

3 a. Prove that mutual information is always non-negative i.e $I(A, B) \geq 0$. **(08 Marks)**

b. A channel has the following characteristics

$$P(Y/X) = \begin{array}{c} \\ x_1 \\ x_2 \end{array} \overset{\begin{array}{cccc} y_1 & y_2 & y_3 & y_4 \end{array}}{\begin{bmatrix} 1/3 & 1/3 & 1/6 & 1/6 \\ 1/6 & 1/6 & 1/3 & 1/3 \end{bmatrix}}$$

Find H(s), H(Y), H(x, y) and channel capacity if r = 1000 samples/sec. Assume $P(x_1) = P(x_2) = \frac{1}{2}$. **(08 Marks)**

c. List the properties of Noiseless and deterministic channel. **(04 Marks)**

4 a. State Shannon's Hartley law and prove that $C_\infty = 1.44(S/N)$. (07 Marks)

b. A Gaussian channel has a bandwidth of 4KHz and a two –sided noise power spectral density $\eta/2$ of 10^{-14} watts/Hz, signal power at the receiver has to be maintained at a level less than or equal to 0.1mW. Calculate the capacity of the channel. (07 Marks)

c. A channel diagram and the corresponding channel matrix P(B/A) of a deterministic channel are shown in Fig.Q4(c). Obtain its channel capacity.

$$P(b_j/a_i) = \begin{array}{c} \\ a_1 \\ a_2 \\ a_3 \\ a_4 \\ a_5 \\ a_6 \end{array} \begin{array}{c} \begin{array}{ccc} b_1 & b_2 & b_3 \end{array} \\ \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \end{array}$$

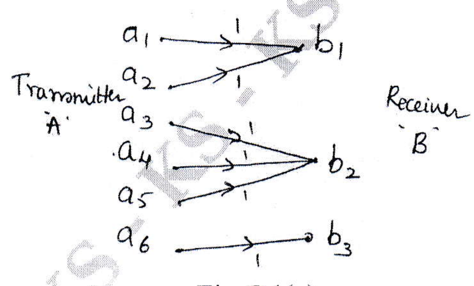

Fig.Q4(c)

(06 Marks)

PART – B

5 a. Prove that $GH^T = 0$ and $CH^T = 0$. (06 Marks)

b. The parity check bits for (8, 4) linear block code are generated by

$C_5 = d_2 \oplus d_3 \oplus d_4$

$C_6 = d_1 \oplus d_2 \oplus d_4$

$C_7 = d_2 \oplus d_3 \oplus d_4,$

$C_8 = d_1 \oplus d_3 \oplus d_4.$

Where $d_1d_2d_3d_4$ are message bits. Find G, H minimum weight of their code and draw the corresponding encoding and syndrome calculation circuit. (14 Marks)

6 a. Consider the (7, 4) cyclic code generated by g(x), $g(x) = 1 + x + x^3$. Write the encoder circuit and find the codeword for the message 1011, 0101. If the received code z(x) = 1110101, draw the syndrome calculation circuit and correct the single error in the received vector. (14 Marks)

b. Explain with neat block diagram, decoding circuit of cyclic codes. (06 Marks)

7 Write short notes on :

a. RS codes

b. Golay codes

c. Shortened cyclic codes

d. Cyclic redundancy check codes. (20 Marks)

8 Consider (2, 1, 3) convolution code with $g^{(1)} = [1\ 0\ 1\ 1]$, $g^{(2)} = [1, 1, 1, 1]$. Draw the encoder block diagram, using generator matrix find the code and verify the same using transform domain method for the message sequence 10111. Draw the code tree and find the code using code tree. (20 Marks)

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10EC56

Fifth Semester B.E. Degree Examination, Aug./Sept. 2020
Fundamentals of CMOS VLSI

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. With neat diagram, explain the step by step procedure of fabrication steps of CMOS P-well process and write the mark sequence. **(10 Marks)**

b. Derive the necessary expressions for V_{out} in all the regions of CMOS inverter? Explain. **(10 Marks)**

2 a. What is body effect? Which parameters are responsible for it? **(08 Marks)**

b. Explain the Pseudo-NMOS logic structure and their salient features with example. **(08 Marks)**

c. Compare CMOS and bipolar technologies. **(04 Marks)**

3 a. Explain the operation of CMOS dynamic logic. Also discuss the cascading problem of dynamic CMOS logic. **(10 Marks)**

b. Implement using CMOS logic structure and its stick diagram:

(i) $Z = \overline{A + B + CD}$.

(ii) $Z = \overline{A(D+E) + BC}$ **(10 Marks)**

4 a. What are the scaling factors of,

(i) Parastic capacitance C_X.

(ii) Power dissipation per unit area P_a. **(04 Marks)**

b. Two nMOS inverters are cascaded to drive capacitive load $C_L = 16C_g$ as shown in Fig. Q4(b). Calculate pair delay V_{in} to V_{out} interms of τ. **(06 Marks)**

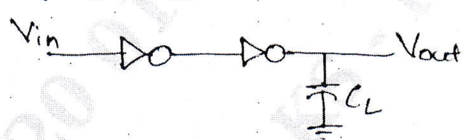

Fig. Q4 (b)

c. Explain with circuit diagram the super buffers with inverting type and non-inverting type of nMOS. **(10 Marks)**

PART – B

5 a. Explain structured design of bus arbitration logic for n-line bus. **(10 Marks)**

b. Discuss the architectural issues to be followed in the design of VLSI subsystems. **(10 Marks)**

6 a. Design a 4:1 multiplexer using nMOS logic and CMOS logic. **(10 Marks)**

b. Explain the implementation of ALU functions with a standard adder. **(10 Marks)**

7 a. How to read or write and hold the bit in SRAM cell? **(10 Marks)**

b. Discuss CMOS pseudo-static memory cell with stick diagram. **(10 Marks)**

8 a. Explain sensitized path based testing for combinational logic. **(10 Marks)**

b. Write a note on testability and testing. **(10 Marks)**

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