USN 1KT07EC411

06EC52

Fifth Semester B.E. Degree Examination, June-July 2009
Digital Signal Processing

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer any FIVE full questions choosing at least two from each part.***
2. ***Missing data if any may be suitably assumed.***
3. ***Use of normalized chebyshev, Butterworth prototype tables not allowed.***

Part A

1 a. Define DFT. Establish a relationship between the Fourier series coefficients of a continuous-time signal and DFT. **(07 Marks)**

b. The N-point DFT of the N-point sequence, $x(n)=e^{-j\left(\frac{\pi}{N}\right)n^2}$, for N even is $X(k)=\sqrt{N}e^{-j\frac{\pi}{4}}e^{j\left(\frac{\pi}{N}\right)k^2}$. Determine the 2N-point DFT of the 2N-point sequence $y(n)=e^{-j\left(\frac{\pi}{N}\right)n^2}$, assuming that N is even. **(05 Marks)**

c. i) Let N = 4M, where M is an integer. Let

$$X(k)=\begin{cases}0.5, & k=M\\ 0.5, & k=3M\\ 0, & \text{otherwise}\end{cases}.$$

Compute x(n). Let $y(n)=(-1)^n x(2n)$, $0\le n\le 2M-1$. Compute V(k).

ii) Evaluate the sum $s=\sum_{n=0}^{15}x_1(n)x_2^*(n)$ when $x_1(n)=\cos\left(\frac{3\pi n}{8}\right)$, $x_2(k)=3$, $0\le k\le 15$. **(08 Marks)**

2 a. Determine 4-point circular convolution of the following pair of length-4 sequences using single DFT and IDFT computations: x(n)=(3, 2, 1, 4), h(n) = (2, 1, 1, 3) **(08 Marks)**

b. Given that x(n)=(2, 1), ω(n)=x(n)*y(n) and ω(n)=(6,–1,7,–4) compute the sequence y(n) using DFT. **(07 Marks)**

c. Find the output y(n) of a filter whose impulse response is h(n)=(1, -2) and input signal x(n)= (3, -2, 4, 1, 5, 7, 2, -9) using overlap-add method. Use only 5-point circular convolution in your approach. **(05 Marks)**

3 a. For sequence x(k)=(5, 3-j2, -3, 3+j2), determine x(2) using Goertzel algorithm. Assume that the initial conditions are zero. **(06 Marks)**

b. Develop the DIF-FFT algorithm to compute IDFT. Write the signal flow graph for N = 8. **(10 Marks)**

c. What are the orders of Butterworth and Chebyshev filters necessary to meet the following design specifications?

$\delta_P=\delta_S=0.01$, $\Omega_P = 0.6682$ rad/sec, $\Omega_S = 1$ rad/sec. **(04 Marks)**

4 a. A sequence x(n) is filtered using a first-order LTI system with an impulse response h(n) giving output y(n). A 4 point DFT and IDFTs via radix-2 FFT algorithms are used to compute y(n). Select these algorithms appropriately and write the signal flow graph between normal ordered x(n) and y(n). What is the length of a non zero padded sequences x(n) and h(n) where y(n) represents alias-free output of the circular convolution? **(12 Marks)**

b. Show that the product of two complex numbers (a+jb) and (c+jd) can be performed with three real multiplications and five additions. **(03 Marks)**

4 c. Consider the system in figure Q4 (c), where x(n), h(n) and y(n) are finite-length real sequences. Use DFT and IDFTs to compute y(n) in terms of x(n) and h(n). **(05 Marks)**

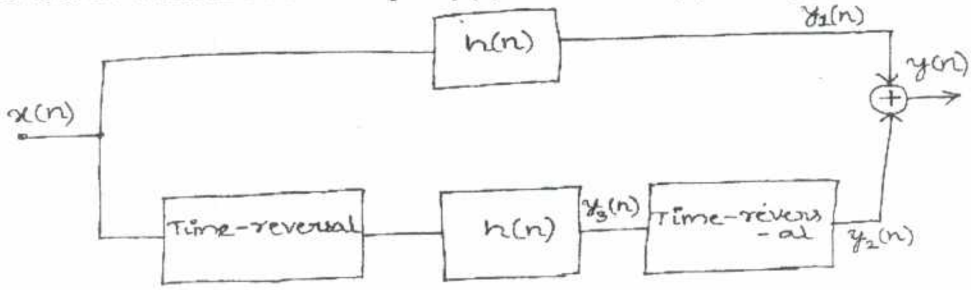

Fig. Q4 (c)

Part B

5 a. Show that the bilinear transformation maps.

i) The $j\Omega$ axis in s-plane onto the unit circle, $|z|=1$.

ii) The left half s-plane, $\text{Re}(s)<0$ inside the unit circle, $|z|<1$. **(05 Marks)**

b. Figure Q5 (b) shows the frequency response of an infinite-length ideal multi-band real filter. Find h(n), impulse response of this filter. Present the sketch of implementation of $\omega(n)h(n)$ (Truncated impulse response of this filter) via block diagram. Where $\omega(n)$ is a finite length window sequence? **(12 Marks)**

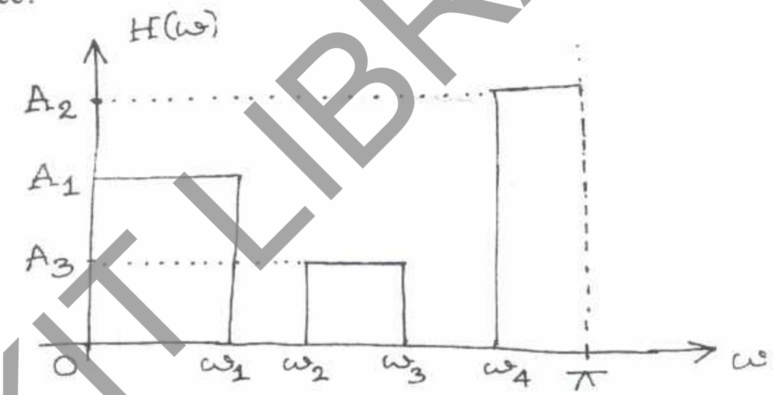

Fig. Q5 (b)

c. We are interested to design an FIR filter with a stopband attenuation of 64 dB and $\Delta\omega=0.05\pi$ using windows. Provide the means to achieve precisely this attenuation using suitable window function. **(03 Marks)**

6 a. The transfer function of analog low pass filter is given by $H(s)=\frac{(s-1)}{(s^2-1)(s^2+s+1)}$. Find H(z) using impulse invariance method. Take T = 1 sec. **(06 Marks)**

b. Design a linear phase highpass filter using the Hamming window for the following desired frequency response.

$$H_d(\omega)=\begin{cases} e^{-j3\omega} & \frac{\pi}{6}\le|\omega|\le\pi \\ 0 & |\omega|<\frac{\pi}{6} \end{cases}$$

$\omega(n)=0.54-0.46\cos\left(\frac{2\pi n}{N-1}\right)$, where N is the length of the Hamming window. **(08 Marks)**

6 c. Let $H(s)=\frac{1}{s^2+\sqrt{2}s+1}$, a second-order low pass Butterworth filter prototype having the half-power point at $\Omega = 1$. Determine the system function for the digital bandpass filter using bilinear transformation. The cutoff frequencies for the digital filter should lie at $\omega_L=\frac{5\pi}{12}$ and $\omega_u=\frac{7\pi}{12}$. Take T = 2. **(06 Marks)**

7 a. Obtain the direct form II, cascade and parallel structures for the following difference equation. $y(n)=\frac{3}{4}y(n-1)-\frac{1}{8}y(n-2)+x(n)+\frac{1}{3}x(n-1)$. **(08 Marks)**

b. Design a digital lowpass Butterworth filter using Bilinear transformation method to meet the following specifications. Take T = 2 sec.
Passband ripple ≤ 1.25 dB
Passband edge = 200 Hz
Stopband attenuation ≥ 15 dB
Stopband edge = 400 Hz
Sampling frequency = 2 kHz **(12 Marks)**

8 a. Design a linear phase lowpass FIR filter with 7 taps and a cutoff frequency of $\omega_C=0.3\pi$ using the frequency sampling method. **(06 Marks)**

b. A z-plane pole-zero plot for a certain digital filter is shown in figure Q8 (b). The filter has unity gain at DC. Determine the system function in the form,
$H(z)=A\left[\frac{(1+a_1z^{-1})(1+b_1z^{-2}+b_2z^{-2})}{(1+c_1z^{-1})(1+d_1z^{-1}+d_2z^{-2})}\right]$ giving the numerical values for parameters A, a_1, b_1, b_2, c_1, d_1 and d_2. Sketch the direct form II and cascade realizations of the system. **(09 Marks)**

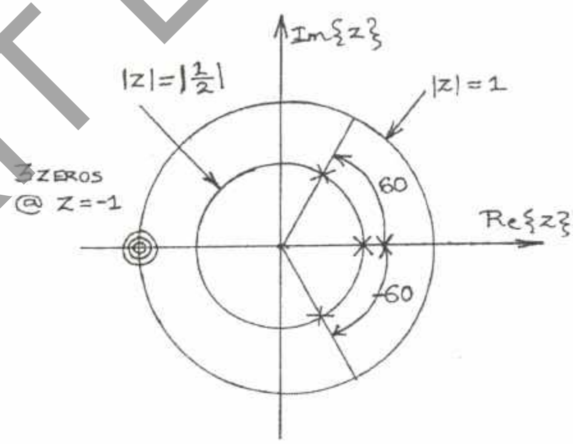

Fig. Q8 (b)

c. Determine the parameters K_m of the Lattice filter corresponding to the FIR filter described by the system function,
$H(z)=1+1.38z^{-1}+1.311z^{-2}+1.337z^{-3}+0.9z^{-4}$ **(05 Marks)**

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Fifth Semester B.E. Degree Examination, June-July 2009
Analog Communication

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Discuss the properties of Gaussian process. **(10 Marks)**
b. Define mean, correlation and covariance function. **(06 Marks)**
c. A random variable has PDF given by : $f_x(x) = 2e^{-2x}$ for $x \geq 0$.
Find the probability that it will take a value between 1 and 3. **(04 Marks)**

2 a. Define standard form of amplitude modulation and explain the time and frequency domain expression of AM wave. **(06 Marks)**
b. Explain with the help of a neat sketch, how a square law modulator is used to generate AM. **(08 Marks)**
c. A carrier wave $4 \sin (2\pi \times 500 \times 10^3 t)$ volts is amplitude modulated by an audio wave $[0.2 \sin 3 [(2\pi \times 500t)] + 0.1 \sin 5[2\pi \times 500t]]$ volts. Determine the upper and lower sideband and sketch the complete spectrum of the modulated wave. Estimate the total power in the sideband. **(06 Marks)**

3 a. Explain how ring modulator can be used to generate DSB – SC modulation. **(10 Marks)**
b. Define Hilbert transform. State and prove the properties of Hilbert transform. **(05 Marks)**
c. With neat block diagram, explain the operation quadrator carrier multiplexing. **(05 Marks)**

4 Explain with neat block diagram of DSB – SC, the following:
a. Detection using costas receiver. **(06 Marks)**
b. Derive the time domain descriptions of VSB modulated signal. **(06 Marks)**
c. With a neat block diagram, explain AM radio. **(08 Marks)**

PART – B

5 a. Derive an expression for the spectrum of FM wave with sinusoidal modulation. **(07 Marks)**
b. With neat block diagram, explain Armstrong method of FM generation. **(07 Marks)**
c. Compare narrow band and wide band FM. **(06 Marks)**

6 a. The equation for an FM wave is given by : $S(t) = 10 \sin [5.7\times10^8 t + 5 \sin (12\times10^3 t)]$ volts
Calculate : i) carrier frequency ii) modulation frequency iii) modulation index iv) frequency deviation v) power dissipation in 100Ω. **(05 Marks)**
b. Explain with relevant mathematical expressions the demodulation of a FM signal using PLL. **(10 Marks)**
c. In the fig.Q6(c) shown below, find out in the carrier frequency, frequency deviation and modulation index at point A and B. Assume that at the output of the mixer, the additive frequency component is being selected. **(05 Marks)**

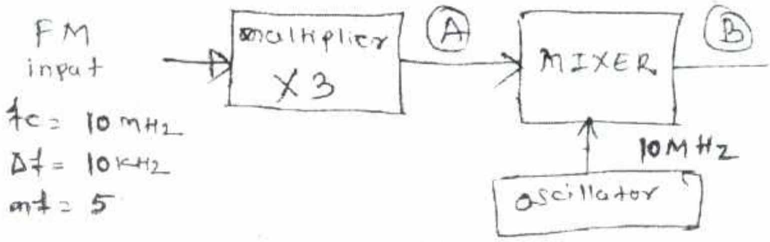

Fig.Q6(c)

7 a. Explain the following terms :
i) Short noise ii) Thermal noise ii) White noise iv) Noise figure
v) Transit Time Noise. **(10 Marks)**

b. Derive an expression for overall equivalent noise temperature of the cascade connection of any number of noise for two part network. **(05 Marks)**

c. A satellite receiving system consist of a Low Noise Amplifier (LNA) that has a gain of 47dB and a noise temperature of 120^0K, a cable with loss of 6.5dB and the main receiver with a noise factor of 7dB. Calculate the equivalent noise temperature of the overall system referred to the input for the following connections.
i) LNA at the input followed by the cable connecting to the main receiver.
ii) The input direct to the cable, which is connected to the LNA, which in turn is connected to the main receiver. **(05 Marks)**

8 Write short notes on:
a. Pre – emphasis and Define – emphasis in FM. **(08 Marks)**
b. Noise in SSB receiver. **(06 Marks)**
c. Balanced slope detector. **(06 Marks)**

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Fifth Semester B.E. Degree Examination, June-July 2009
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.Assume any missing data suitably.
3.Smith chart can be provided if required.

PART – A

1 a. Define and derive expressions for reflection coefficient and transmission coefficient for a transmission line. **(08 Marks)**
b. Write a note on impedance matching for transmission lines. **(08 Marks)**
c. A transmission line has the following parameters:
$R = 2\ \Omega/m$, $G = 0.5$ mmho/m, $f = 1$ GHz, $L = 8n$ H/m, $C = 0.23$pF
Calculate : i) the characteristic impedance ii) the propagation constant. **(04 Marks)**

2 a. Derive the relevant equations for the propagation of TE waves in a rectangular waveguide and explain how the dominant mode is obtained. **(12 Marks)**
b. Explain Faraday notation isolator with a neat sketch. **(08 Marks)**

3 a. What is a Hybrid Tee? Derive its scattering matrix. **(10 Marks)**
b. Define coupling factor, directivity of a directional coupler. Explain two hole directional coupler. **(10 Marks)**

4 a. With neat sketches explain the working of a Gunn diode in the Gunn mode and LSA mode. **(10 Marks)**
b. With relevant diagrams, explain IMPATT diode operation and mechanism of oscillations. **(10 Marks)**

PART – B

5 a. What are the losses in microstrip lines? Explain radiation losses. **(08 Marks)**
b. A shielded strip line has the following parameters:
Dielectric constant of the insulator (polystyrene): $\epsilon_r = 2.56$, Strip width : $w = 25$ mils, strip thickness: $t = 14$ mils, shield depth : $d = 70$ mils. Calculate i) the k factor ii) the fringe capacitance iii)the characteristic impedance of the line. **(05 Marks)**
c. Write a note on microwave precession phase shifter. **(07 Marks)**

6 a. Derive the radar range equation. Discuss the effects of each parameter on the maximum detection range of the radar. **(08 Marks)**
b. Explain Doppler frequency shift for moving targets. **(07 Marks)**
c. A marine radar operating at 10 GHz has a maximum range of 50 km with an antenna gain of 4000. The transmitter has a power of 250 kW and a minimum detectable signal of 10^{-11}W. Determine the cross-section of the target the radar can sight. **(05 Marks)**

7 a. With a neat block diagram, explain the advantage of I and Q channels in digital MTI Doppler signal processor. **(10 Marks)**
b. Explain with a block diagram the working of a MTD. **(10 Marks)**

8 Write short notes on:
a. Microwave attenuator.
b. Schottky Barrier diode.
c. DLC in radar.
d. Parametric amplifiers. **(20 Marks)**

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Fifth Semester B.E. Degree Examination, June-July 2009

Digital Switching Systems

Time: 3 hrs. Max. Marks:100

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

Part A

1 a. Explain various types of network structures. **(05 Marks)**
b. Explain frequency division multiplexing with respect to a suitable block diagram. **(08 Marks)**
c. Design any one type of PDH with a suitable diagram. **(07 Marks)**

2 a. Highlight the advantages and disadvantages of crossbar switch. **(06 Marks)**
b. Describe the functions of switching system. **(06 Marks)**
c. Explain the working of distribution frame in strowger exchange. **(08 Marks)**

3 a. What is grading? Describe various types of gradings. **(05 Marks)**
b. Design a two-stage network to connect 12 incoming trunks to 9 outgoing trunks and arrive at the optimum solution. **(08 Marks)**
c. Deduce the total number of cross points to three stage switching network with N incoming and M outgoing trunks. **(07 Marks)**

4 a. Derive second Erlang's distribution formula. **(08 Marks)**
b. On an average, during the busy hour, a company makes 180 outgoing calls of average duration of 3 minutes. It receives 400 incoming calls of average duration 6 minutes. Find:
i) The outgoing traffic.
ii) The incoming traffic.
iii) The total traffic. **(06 Marks)**
c. A group of 20 trunks provides a grade of service of 0.01 when offered 12 E of traffic,
i) How much is the GOS improved if one extra trunk is added to the group?
ii) How much does the GOS deteriorate if one trunk is out of service? **(06 Marks)**

Part B

5 a. Explain time-space-time switch with a suitable diagram. **(06 Marks)**
b. Explain frame synchronization. **(06 Marks)**
c. A T-S-T network has 20 incoming and 20 outgoing PCM highways, each conveying 30 channels. The required grade of service is 0.01. Find the traffic capacity of the network if:
i) Connection is required to a particular free channel on a selected outgoing highway i.e. mode 1.
ii) Connection is required to a particular outgoing highway, but any free channel it may be used. (i.e. mode 2). **(08 Marks)**

6 a. Explain the working of operating system indicating the basic software architecture of a typical digital switching system. **(12 Marks)**
b. With a suitable diagram, explain software linkages during a call. **(08 Marks)**

7 a. Explain the interfaces of digital switching central office. **(10 Marks)**
b. Highlight the strategy for improving software quality. **(10 Marks)**

8 a. Explain generic switch software with respect to a suitable block diagram. **(10 Marks)**
b. Explain recovery stage of initialization process with examples. **(10 Marks)**

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Fifth Semester B.E. Degree Examination, June-July 2009

Fundamentals of CMOS VLSI

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 assumed suitably.

PART – A

1 a. Explain the action of enhancement mode transistor for different values of Vgs and Vds. **(07 Marks)**
b. How is an nMOS transistor fabricated? Explain with neat sketches. **(10 Marks)**
c. What is a tristate inverter? Explain. **(03 Marks)**

2 a. Derive the CMOS–inverter dc characteristics graphically, from p-device & n-device characteristics and show all operating regions. **(10 Marks)**
b. What is a noise margin? Obtain the values of V_{IL}, V_{IH}, V_{OL} & V_{OH} from transfer characteristics of a typical inverter. **(06 Marks)**
c. What is λ-based design? What are the merits and demerits? **(04 Marks)**

3 a. Give the λ-based design rules for different layers, p and n MOSFETS and contact cut. **(08 Marks)**
b. Obtain the stick diagram and layout of a two-way selector with enable. **(06 Marks)**
c. Draw the circuit schematic and stick diagram of CMOS 2-input NAND gate. **(06 Marks)**

4 a. What are the features of CMOS domino logic? Explain with neat diagrams. **(06 Marks)**
b. Define sheet resistance and standard unit of capacitance □C_g.
Calculate the ON resistance for nmos inverter with R_{sn}= 10kΩ, Z_{pu}= 4 & Z_{pd}= 1. **(06 Marks)**
c. Obtain the expression for total delay for N stages of nmos & cmos inverters in terms of width factor f and delay τ. **(08 Marks)**

PART – B

5 a. What are the scaling factors for :
Gate capacitance C_g Max. operating frequency f_o
Current density J Power speed product P_T **(08 Marks)**
b. What are the properties of nmos and pmos switches? How is transmission gate useful? **(06 Marks)**
c. Obtain the logic implementation of a 4-way multiplexer using nmos switches. **(06 Marks)**

6 a. Draw the basic form of a two-phase clock generator and explain. **(07 Marks)**
b. How to implement arithmetic and logic operations with a standard adder? Explain with the help of logic expressions. **(06 Marks)**
c. Explain structured design approach for a parity generator. **(07 Marks)**

7 a. What is structured design process? Explain. **(08 Marks)**
b. What are the system timing considerations? **(06 Marks)**
c. Show the functioning of a single transistor dynamic memory cell. **(06 Marks)**

8 Write short notes on:
a. I/O pads,
b. Test and testability
c. Pseudo nmos logic
d. Bi-cmos logic. **(20 Marks)**

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