CBCS SCHEME

USN | | | | | | | | | | |

15EC52

Fifth Semester B.E. Degree Examination, July/August 2021
Digital Signal Processing

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions.*

1 a. Compute the N-point DFT of the sequence, $x(n) = a.n \quad 0 \le n \le N-1$. **(08 Marks)**

b. Obtain the relationship between DFT and Z-transform. **(04 Marks)**

c. Find the Inverse DFT of the sequence $X(K) = (2, 1+j, 0, 1-j)$. **(04 Marks)**

2 a. Compute the 8-point DFT of the sequence x(n) given below:
$x(n) = (1, 1, 1, 1, 0, 0, 0, 0)$. **(06 Marks)**

b. Compute the N-point DFT of the sequence,
$x(n) = a^n, \quad 0 \le n \le N-1$. **(04 Marks)**

c. Find the IDFT of 4-point sequence,
$X(K) = (4, -j2, 0, j2)$ using the DFT. **(06 Marks)**

3 a. In many signal processing applications, we often multify an infinite length sequence by a window of length N. The time-domain expression for this window is,

$$w(n) = \frac{1}{2} + \frac{1}{2}\cos\left[\frac{2\pi}{N}\left(n - \frac{N}{2}\right)\right]$$

What is the DFT of the windowed sequence, $y(n) = x(n)w(n)$? Keep the answer in terms of X(n). **(07 Marks)**

b. Let x(n) be a real sequence of length N and its N-point DFT is given by X(K) . Show that :
(i) $X(N-K) = X^*(K)$. (ii) X(0) is real, and
(iii) If N is Even, $X\left(\frac{N}{2}\right)$ is real. **(09 Marks)**

4 a. Let x(n) = (1, 2, 0, 3, -2, 4, 7, 5). Evaluate the following :
(i) X(0) (ii) X(4) (iii) $\sum_{K=0}^{7} X(K)$ (iv) $\sum_{K=0}^{7} |X(K)|^2$ **(08 Marks)**

b. Perform x(n)*h(n), $0 \le n \le 11$ for the sequence x(n) and h(n) given below using overlap-add based fast convolution technique. Choose appropriately number of points of circular convolution.
h(n) = (1, 1, 1)
and x(n) = (1, 2, 0, -3, 4, 2, -1, 1, -2, 3, 2, 1, -3) **(08 Marks)**

5 a. Find the 4 point circular convolution of x(n) and h(n) given in Fig. Q5 (a) using radix-2 DIF-FFT algorithm. **(08 Marks)**

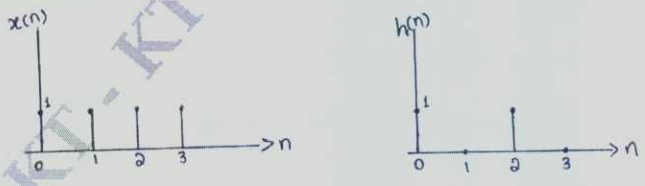

Fig. Q5 (a)

b. Find the 8-point DFT of sequence x(n), x(n) = (1, 1, 1, 1, 0, 0, 0, 0) using DIT-FFT radix-2 algorithm. Use the butterfly diagram. **(08 Marks)**

6 a. Derive the DIT-FFT algorithm. **(08 Marks)**

b. Find number of complex multiplications and complex additions in finding 512 point DFT. **(02 Marks)**

c. Find the 4-point real sequence x(n) if its 4-point DFT samples are $X(0) = 6$, $X(1) = -2+j2$, $X(2) = -2$. Use DIF–FFT algorithm. **(06 Marks)**

7 a. Draw the block diagrams of direct form-I and direct form-II realization for a digital IIR filter described by the system function,

$$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}.$$ **(08 Marks)**

b. Obtain a parallel realization for the system described by,

$$H(z) = \frac{\left(1 + z^{-1}\right)\left(1 + 2z^{-1}\right)}{\left(1 + \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)\left(1 + \frac{1}{8}z^{-1}\right)}.$$ **(08 Marks)**

8 a. Design an analog bandpass filter to meet the following frequency domain specifications:

(i) a -3.0103 dB upper and lower cut-off frequency of 50 Hz and 20 kHz.
(ii) a stopband attenuation of atleast 20 dB at 20 Hz and 45 kHz and
(iii) a monotonic frequency response. **(08 Marks)**

b. Let $H_a(s) = \frac{s + a}{(s + a)^2 + b^2}$ be a casual second order transfer function. Show that the casual second order digital function H(z) is obtained from $H_a(s)$ through impulse invariance method is given by,

$$H(z) = \frac{1 - e^{-aT}\cos bTz^{-1}}{1 - 2\cos bTe^{-aT}z^{-1} + e^{-2aT}z^{-2}}.$$ **(08 Marks)**

9 a. The desired frequency response of a low pass filter is given by,

$$H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j3w}, & |w| < \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < |w| < \pi \end{cases}.$$

Determine the frequency response of the FIR filter if Hamming window is used with N = 7. **(08 Marks)**

b. Determine the co-efficients K_m of the lattice filter corresponding to FIR filter described by the system function,

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

Also, draw the corresponding second order lattice structure. **(08 Marks)**

10 a. A low pass filter is to be designed with the following desired frequency response:

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

Determine the filter co-efficients $h_d(n)$ and $h(n)$ if $w(n)$ is a rectangular window defined as follows:

$$w_R(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$$

Also find the frequency response, H(w) of the resulting FIR filter. **(06 Marks)**

b. 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)**

c. Realize an FIR filter with impulse response h(n) given by,

$$h(n) = \left(\frac{1}{2}\right)^n [u(n) - u(n-4)]$$

Using direct form – I. **(04 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

15EC53

Fifth Semester B.E. Degree Examination, July/August 2021
Verilog HDL

Time: 3 hrs. Max. Marks:80

Note: ***Answer any FIVE full questions.***

1 a. Explain a typical design flow for designing VLSI IC circuit using block diagram. **(06 Marks)**

b. Develop virolog code for 4-bit ripple carry counter and with neat block diagram explain design hierarchy for the same. **(10 Marks)**

2 a. Explain to-down design methodology and bottom up design methodology. **(10 Marks)**

b. Explain the importance of HDL and also mention useful features of verilog HDL. **(06 Marks)**

3 a. Explain the following data-types with an example in verilog :
i) Nets ii) Registers iii) Vectors iv) Arrays. **(08 Marks)**

b. Explain the below mentioned system tasks NAND complier directives with examples :
i) $display ii) $monitor iii) 'Define iv) 'Include. **(08 Marks)**

4 a. With a neat block diagram explain components of verilog module. **(06 Marks)**

b. Explain part connection rules. **(06 Marks)**

c. Write a verilog code for SR latch using and gates as elements. **(04 Marks)**

5 a. What are rise, fall and turnoff delays? How they are specified in verilog. **(06 Marks)**

b. Design and develop verilog code for an 4-bit ripple carry adder using 1-bit fulladder as a component. Also write stimulus for 4-bit ripple carry fulladder. **(10 Marks)**

6 a. For the schematic network shown below. Write a verilog code for gate level implementation with delay s mentioned :

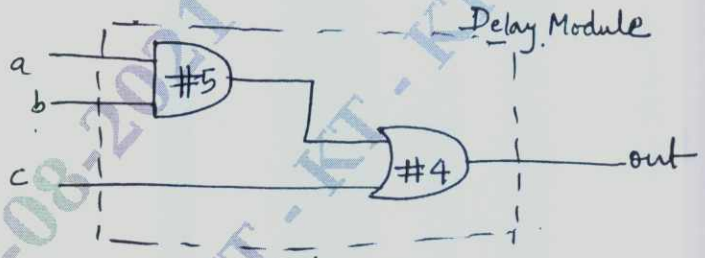

Fig.Q6(a)

Also write stimulus for the above example. **(06 Marks)**

b. Write a verilog code for :
i) 2 : 1 mux with conditional operator
ii) 4 : 1 mux with conditional operators
iii) 4 : 1 mux using logic equation
iv) 2 : 1 mux using logic equation. **(10 Marks)**

7 a. Explain with examples always and initial statements. **(08 Marks)**

b. Explain blocking assignment statements and non-blocking assignment statements with relevant examples. **(08 Marks)**

8 a. Explain sequential and parallel blocks with examples. **(08 Marks)**

b. Write a verilog code for :

i) 4 : 1 multiplexer using case statement

ii) 4 – bit counter with behavioral description. **(08 Marks)**

9 a. Explain design tool flow diagram with block diagram. **(08 Marks)**

b. i) Write VHDL dataflow description for – 4 – bit equality comparator using logic equations and block diagrams. **(04 Marks)**

ii) Write VHDL structural description for 4-bit comparator with necessary block diagrams. **(04 Marks)**

10 a. Explain the declaration of constant, variable and signal in VHDL, with example. **(08 Marks)**

b. Explain attributes in VHDL. **(04 Marks)**

c. Write a VHDL code for half adder using behavioral description. **(04 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

15EC54

Fifth Semester B.E. Degree Examination, July/August 2021
Information Theory and Coding

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Define Self Information , Energy , Rate of Information. **(03 Marks)**

b. A single TV picture is viewed as an array of black, white and grey dots with roughly 500 rows and 600 columns. It is assumed that these dots take one of the 10 brightness levels. Find the information conveyed by one picture. **(04 Marks)**

c. Prove Extremal property of Entropy using Total derivative formula. **(09 Marks)**

2 a. Prove that $H.(S^m) = m.H(s)$ bits/sym. **(06 Marks)**

b. Students graduating from an Engineering department this year shows the following tendency
i) Some go abroad ii) Some join MNCs in India iii) Remaining join PG course.
The tendency in the next year is given below.
i) 50% of those who went abroad will return back to India, out of which 80% would join MNCs in India and remaining take PG course.
ii) Among those who remain in India 80% go abroad.
iii) Those who had remained in India have not swapped their fields.
Based on the information given above write the suitable model and determine entropy of the source. **(10 Marks)**

3 a. What do you mean by Source Encoding? List its properties. **(04 Marks)**

b. A DMS produces six symbols with probabilities of occurances $\frac{1}{3}, \frac{1}{6}, \frac{1}{12}, \frac{1}{24}, \frac{1}{3}, \frac{1}{24}$.
Encode the symbols using Shannon Fano algorithms. Compute Average code work length and efficiency. **(05 Marks)**

c. Consider a statistically independent value whose source alphabet $S = \{S_0, S_1, S_2, S_3, S_4, S_5\}$ with $P = \{0.5, 0.25, 0.125, 0.0625, 0.03125, 0.03125\}$. Using Shannon Encoding Algorithm , find Code words and compute Minimum average length, Efficiency and Variance. **(07 Marks)**

4 a. Prove Source Coding theorem. **(07 Marks)**

b. A DMS has an alphabet $S = \{S_1, S_2, S_3, S_4, S_5, S_6\}$ with $P = \left\{\frac{1}{3}, \frac{1}{4}, \frac{1}{8}, \frac{1}{8}, \frac{1}{12}, \frac{1}{12}\right\}$. Construct Huffman code by taking the code alphabet $X = \{0, 1, 2\}$. Find code efficiency and write decision tree. **(05 Marks)**

c. Write an explanatory note on Lempel Ziv algorithm. **(04 Marks)**

5 a. Compute all entropy functions and write the graphical model for channel given below :

$$P(xy) = \begin{bmatrix} 0.25 & 0 & 0 & 0 \\ 0.1 & 0.3 & 0 & 0 \\ 0 & 0.05 & 0.1 & 0 \\ 0 & 0 & 0.05 & 0.1 \\ 0 & 0 & 0.05 & 0 \end{bmatrix}$$ **(07 Marks)**

b. Show that I(X ; Y) = H(X) – H(X|Y) bits/sym. **(04 Marks)**

c. Compute channel capacity for the channel given below : $P(Y/X) = \begin{bmatrix} 0.7 & 0.3 \\ 0.4 & 0.6 \end{bmatrix}$. **(05 Marks)**

6 a. For the JPM given below , compute Data transmission rate, Channel capacity, Efficiency and Redundancy. $r_s = 1000$ sym/sec

$$P(xy) = \begin{bmatrix} 0.05 & 0 & 0.2 & 0.05 \\ 0 & 0.1 & 0.1 & 0 \\ 0 & 0 & 0.2 & 0.1 \\ 0.05 & 0.05 & 0 & 0.1 \end{bmatrix}.$$ **(07 Marks)**

b. Derive an expression for Differential Entropy. **(04 Marks)**

c. A black and white TV picture may be viewed as 3×10^5 pixel per frame with 10 distinct equi probable brightness levels. Assume that rate of transmission is 30 picture frames/second and SNR = 30db. Using Channel Capacity theorem, compute minimum bandwidth to support for error free transmission of Video signal. **(05 Marks)**

7 a. Consider the (T, 4) Linear Block Code, whose generator matrix is

$$G = \left[\begin{array}{cccc:ccc} 1 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{array}\right]$$

i) Find all code words ii) Find Parity check matrix 4

iii) Find minimum Hamming weight and distance. **(04 Marks)**

b. Obtain the code word for the message (1 0 1 0) for a (7, 4) cyclic code with $g(x) = 1 + x + x^3$. Use a four stage shift register for encoding. **(07 Marks)**

c. Write the decoding circuit for an (n , k) Linear Block Code and Decoding steps. **(05 Marks)**

8 a. Design a Single error correcting Hamming code for a message of length 4. **(04 Marks)**

b. In a Linear Block Codes the syndrome is given by $S_1 = r_1 + r_2 + r_3 + r_5$, $S_2 = r_1 + r_2 + r_4 + r_6$ $S_3 = r_1 + r_3 + r_4 + r_7$.

i) Find the parity check matrix.

ii) Write the syndrome computation circuit.

iii) What is the syndrome for the received data (1 0 1 1 0 1 1) and correct it. **(06 Marks)**

c. Design a syndrome calculator circuit for a (7,4) cyclic code having $g(x) = 1 + x + x^3$. Verify the circuit for receiving code vector R = [1 1 0 1 0 0 1]. **(06 Marks)**

9 a. Consider the (2, 1, 2) convolution encoder with $g^{(1)} = (111)$, $g^{(2)} = (101)$.

i) Find the constraint length ii) Find the rate iii) Draw the encoder block diagram

iv) Find the output of the message (1 0 0 1 1) using Time Domain Approach

v) Find the output of the message (1 0 0 1 1) using Transform Domain Approach. **(12 Marks)**

b. Write short note on Golay codes. **(04 Marks)**

10 a. For (2, 1, 3) Convolution encoder with $g_1 = (1\ 0\ 1\ 1)$, $g_2 = (1\ 1\ 0\ 1)$.

i) Draw State diagram ii) Draw Tree diagram iii) Draw Trellis diagram and Code word for the message (1 1 1 0 1). **(12 Marks)**

b. Write an explanatory note on Viterbi Algorithm. **(04 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

15EC562

Fifth Semester B.E. Degree Examination, July/August 2021
Object Oriented Programming Using C++

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Explain the structure of C++ program. Write a C++ program to find area of circle. **(05 Marks)**

b. With neat diagrams explain insertion (<<) and Extraction (>>) operators present in C++. **(05 Marks)**

c. List out various operators present in C++ and explain the below operators with example:
i) Scope Resolution Operator (: :) ii) endℓ iii) setw. **(06 Marks)**

2 a. List out different datatypes used in C++ and explain user defined datatypes present in C++. **(06 Marks)**

b. Explain conditional branching statements with their syntax and examples. **(05 Marks)**

c. Explain looping statement with their syntax and examples. **(05 Marks)**

3 a. What is inline function? List out the characteristics of inline function and give an example. **(05 Marks)**

b. Define function overloading? Write a program to demonstrate function overloading. **(05 Marks)**

c. What is class? Explain creation of class and objects to find factorial of a given number. **(06 Marks)**

4 a. Write a C++ program to read two marks, Name, roll_no of 'n' students and find average of 2 marks of all 'n' students and display the avg_marks, Name and roll_no of all 'n' students. Using class and object array of objects. **(06 Marks)**

b. Define Friend Function. Write a C++ program to swap 2 numbers. One is present in XYZ class and another number is present in ABC class. Consider a Friend Function to swap the numbers. **(04 Marks)**

c. Explain pointers to members with examples. **(06 Marks)**

5 a. Define constructor. List out characteristics of constructor give an example. **(05 Marks)**

b. Explain copy constructor with example. **(05 Marks)**

c. Define operator overloading. Write a C++ program to overload Binary '+' operator to add two complex numbers. **(06 Marks)**

6 a. What is operator over loading? Explain overloading of unary operator with an example. **(05 Marks)**

b. Define Destructor. Explain the use of Destructor with example. **(05 Marks)**

c. Write a C++ program to illustrate overloading of insertion (<<) and Extraction (>>) operator to perform Read and Write operations. **(06 Marks)**

7 a. What is Inheritance? Explain various types of inheritance. How inheritance is done using multiple base classes? Demonstrate. **(10 Marks)**

b. Explain the use of "this" pointer with example. **(04 Marks)**

c. Define base class and derived class. **(02 Marks)**

8 a. Define Inheritance. Compare and differentiate different types of inheritance. **(06 Marks)**

b. What is Virtual Function? Explain with an example. **(05 Marks)**

c. Explain pure virtual Function with example. **(05 Marks)**

9 a. List and explain the classes used for file stream operations. **(08 Marks)**

b. Explain the working of formatted and unformatted functions used in C++. **(08 Marks)**

10 a. Write a program to copy content of one file into another file until end of file is reached. Display the copied content on the output screen. **(08 Marks)**

b. How file opening and closing is done? What are the functions required for reading and writing data in a file. Explain in brief EOF. **(08 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

15EC563

Fifth Semester B.E. Degree Examination, July/August 2021
8051 Microcontroller

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Compare between microprocessor and microcontroller. **(06 Marks)**

b. Explain internal block diagram of 8051. **(10 Marks)**

2 a. Explain internal RAM organization of 8051. **(08 Marks)**

b. Explain External RAM (8K Bytes) interfacing with block diagram and timing. **(08 Marks)**

3 a. Explain any four addressing modes of 8051 with examples. Write a program to copy value of 65H into RAM location 50 to 53H using direct addressing mode without loop. **(10 Marks)**

b. Explain the following instruction with examples: i) XCHD ii) ADDC iii) XRL. **(06 Marks)**

4 a. Explain the following instructions with examples: i) CJNE ii) SETB iii) SJMP iv) JC. **(08 Marks)**

b. Write the instructions to do following:
i) Setting bit1 of internal RAM location 20H.
ii) Reading the content of external RAM location.
iii) Moving a data byte into location of 40H.
iv) Setting carry flag and clearing parity flag without altering other flags. **(04 Marks)**

c. Analyze the following program and write the result after executing each instruction:

```
ORG 00H
MOV R0, #21h
MOV R7, #78h
MOV A, 07h
MOV 21H, A
SETB 0Ah
MOV A, @21h
XRL A, R7
MOVX @R0, A
END
```

(04 Marks)

5 a. Explain working of PUSH and CALL instructions with examples. **(10 Marks)**

b. Develop an assembly language program to count number of 1's in a given byte which is in internal RAM location 50H. Display the result on port P1. **(06 Marks)**

6 a. Develop an assembly language program to find largest in the given N numbers, which are stored in internal RAM location 40H onwards. Store the result in external RAM location 40H, write algorithm. **(10 Marks)**

b. Interface a simple switch and Led to 8051 system and develop the program to read switch status continuously and switch on/off LED accordingly. Draw the block diagram. **(06 Marks)**

7 a. Explain 8051 timer mode-1 programming with steps. **(06 Marks)**

b. Develop an assembly language program to generate square wave of 2000Hz a P1-1 using timer mode-2. Assume crystal frequency of 11.0592MHz. Show the calculations. **(10 Marks)**

8 a. Briefly explain serial communication basics. **(04 Marks)**

b. Draw the Bit pattern of SCON register and explain each bit in it. **(06 Marks)**

c. Develop a program in C/assembly to transmit "VES" serially at 9600 baudrate 1 start and 1 stop bit. Assume crystal frequency of 11.0592MHz. **(06 Marks)**

9 a. Explain 8051 interrupts with their vector address and priority. **(08 Marks)**

b. Develop a 'C' program to generate a square wave of 1kHz using timer interrupt on P1.2. Assume crystal frequency of 12MHz. **(08 Marks)**

10 a. With a block diagram, explain LCD interfacing to 8051. Develop a program in assembly language to display "MC1" on LCD panel. **(10 Marks)**

b. Explain stepper motor interfacing to 8051 with a block diagram and explain how to rotate it 180° clockwise. **(06 Marks)**

* * * * *