8. (a) A lowpass filter is to be designed with the following desired frequency response :

$$Hd(e^{j\omega}) = \begin{cases} e^{-j2\omega} & , -\pi/4 \le \omega \le \pi/4 \\ 0 & , \pi/4 \le |\omega| \le \pi \end{cases}$$

Define the filter coefficients hd(n) if the window function is defined as

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

Also determine the frequency response $H(e^{j\omega})$ of designed filter. 10

(b) What are different types of windows used for FIR filter design. 4

9. (a) Find circular convolution of the following signals using DFT-IDFT method

$x_1(n) = \{1, 2, 3, 4\}$, $x_2(n) = \{1, 0, 0, 1\}$. 7

(b) Find the response y(n) to the input

$$x(n) = \{2, -1, 0, 0, 1, 1, 1, 1, -3, -2\}$$

when the impulse response of the system is $h(n) = \{1, 0, 1\}$ using overlap save method. 6

10. Compute 8-point FFT of the sequence :

$x(n) = (-1)^n \quad 0 \le n \le 7$

Using DIF-FFT algorithm. 13

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Faculty of Engineering & Technology
Eighth Semester B.E. (Electrical Engg.) / Eighth Semester B.E.P.T (Electric) Examination
DIGITAL SIGNAL PROCESSING
Elective—II
Sections—A & B

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Answer **THREE** questions from Section A and **THREE** questions from Section B.

(3) Assume suitable data wherever necessary.

(4) Illustrate your answers wherever necessary with the help of neat sketches.

SECTION—A

1. (a) Explain the advantages and limitations of Digital Signal Processing System. State its applications. 6

(b) Explain the following system with examples :

(i) Stable or unstable

(ii) Causal or non causal

(iii) Linear or non linear

(iv) Time variant or time invariant. 8

2. (a) Consider the following analog signals :

$x_1(t) = 2 \cos 100 \pi t,\ x_2(t) = 2 \cos 500 \pi t.$

Find the sample signals $x_1(n)$ and $x_2(n)$ if sampling rate is 200 samples/sec. Is it possible to distinguish $x_1(n)$ and $x_2(n)$ at sampling rate of 200 Hz ? Explain. If not, explain how the sampled signals can be distinguished. 6

(b) Compute the convolution of the following using graphical method :

$x_1(n) = a^n u(n),\ \ x_2(n) = u(n-3)$ 7

3. (a) Find z-transform of the following signals. Also draw RoC :

(i) $x(n) = 9^n \cos \omega_{on} 4(n)$

(ii) $x(n) = \left(-\frac{1}{3}\right)^n u(n) - \left(\frac{1}{2}\right)^n u(-n-1)$. 6

(b) Find the Diverse z-transform of following :

$$X(z) = \left(1 + 2z^{-1} + z^{-2}\right)/\left(1 - 1.5z^{-1} + 0.5z^{-2}\right)$$

using partial fraction method. 7

4. (a) State and move differentiation and convolution property of z-transform. 6

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(b) Give the z-transform of h(n) :

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

Find the impulse response h(n) such that is corresponds to a stable system. 5

(c) Why is it necessary to indicate RoC for z-transform of any signal ? 2

5. (a) Determine energy density spectrum $S_{xx}(\omega)$ of the signal $x(n) = a^n u(n)$, $a < 1$, sketch $S_{xx}(\omega)$ for $a = 0.5$ and $a = -0.5$. 8

(b) Find Fourier transform of the signal $x(n) = z^n u(-n)$. 5

SECTION—B

6. Obtain DF – I, DF – II, cascade and parallel form validation for the system :

$$H(z) = \frac{1 + 2z^{-1} + z^{-2}}{1 - 0.75z^{-1} + 0.125z^{-2}}$$ 13

7. (a) Explain Bilinear transformation method of design of digital IIR filter. 7

(b) An analog filter has transfer function :

$$H(s) = \frac{10}{s^2 + 7s + 10}$$

Design a digital filter equivalent to this using impulse variant method. 6