B.E. (Electronics Engineering / Electronics Telecommunication / Electronics Communication Engineering) Sixth Semester (C.B.S.)

Digital Signal Processing

P. Pages : 2 **NRJ/KW/17/4519/4524**

Time : Three Hours * 0 1 1 8 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

1. a) Explain following system properties with example. **10**

i) Static system ii) Time Variant system
iii) Linear system iv) Causal system
v) Stable system

b) What do you mean by periodic signal? Determine whether the sequence $x(n)=\cos\left(\frac{n\pi}{17}\right)$ is periodic or not? **4**

OR

2. a) Consider the analog signal $x_a(t)=3\cos 2000\pi t+5\sin 6000\pi t+10\cos 12000\pi t$ **8**

i) What is the Nyquist rate for this signal?
ii) If sampling frequency used to sample this analog signal is 5KHz. What is the discrete time signal x (n) obtained after sampling?
iii) What is the analog signal $y_a(t)$ that can be reconstructed from the samples if we use ideal interpolation.

b) Determine response of system to input $x(n)=\{1,2,3,1\}$ if the impulse response is given as $h(n)=\{1, \underset{\uparrow}{2}, 1, -1\}$. **6**

3. a) Determine Z-transform of the signal and sketch the ROC **6**

$$x(n)= (1/2)^n \;;\; n \geq 0$$
$$= (1/2)^{-n} \quad n < 0$$

b) Determine Z-transform of $x(n)=\left[3\left(2^n\right)-4\left(3^n\right)\right]u(n)$. Also comment on ROC. **7**

OR

4. a) Determine inverse Z-transform of $x(z) = \frac{1}{1-4z^{-1}+3z^{-2}}$ if ROC is **6**

i) $|Z|>1$ ii) $|Z|<1$

b) Find the unit step response of the following system using Z-transform **7**
$y(n)+3y(n-1)+2y(n-2)=x(n)-x(n-1)$.

5. a) Determine DFT of **5**

$$x(n) = 1/2 \quad ; \quad 0 \le n \le 2$$
$$= 0 \quad ; \quad \text{otherwise}$$

b) Find IDFT of x (k) = {2, 0, 0, 1}. **5**

c) Write short note on Twiddle factor. **3**

OR

6. Compute the circular convolution of following sequence using DFT-IDFT method. **13**

$$x(n) = \{1, 2, 3, 4\};$$
$$h(n) = \{1, 2, 2, 1\}.$$

7. Design Butterworth digital filter using bilinear transformation method satisfying the conditions. **13**

$$0 \cdot 707 \le |H(\omega)| \le 1 \; ; \; 0 \le \omega \le 0.2\pi$$
$$|H(\omega)| \le 0.2 \; ; \; 0.6\pi \le \omega \le \pi$$

OR

8. Implement the following transfer function using DF-I, DF-II, cascade & parallel form of filter **13**

$$y(n) + y(n-1) + 4y(n-2) - 2y(n-3) = x(n) - 2x(n-2).$$

9. An FIR filter is to be designed with specifications as follows. **13**

$$H_d\left(e^{j\omega}\right) = 0; -\frac{\pi}{4} \le \omega \le \pi/4$$
$$= e^{-2j\omega}; \frac{\pi}{4} < |\omega| \le \pi$$

using rectangular window function for m = 5.

OR

10. Design a filter with **13**

$$H_d\left(e^{-j\omega}\right) = e^{-j\omega}; -\frac{\pi}{4} \le \omega \le \frac{\pi}{4}$$
$$= 0 \; ; \; \frac{\pi}{4} < |\omega| \le \pi$$

using Hamming window, plot magnitude and phase response.

11. a) For a given sequence x (n) **7**

x (n) = {1, 2, 1, -1, 3, 2, -1, 0, 1} find the output sequence y (n) for the system given below.

$$x(n) \longrightarrow \boxed{\uparrow I=2} \longrightarrow \boxed{\downarrow D=3} \longrightarrow y(n)$$

b) Explain Interpolation & decimation process in brief. What is anti-aliasing and anti imaging filters. **6+1**

OR

12. a) Explain sub-band coding of speech signals with the help of block diagram. **8**

b) Explain sampling rate conversion by rational factor I/D with block diagram. **6**

****