G 385 (Pages : 3) Reg. No..............................

Name..................................

B.TECH. DEGREE EXAMINATION, MAY 2014

Sixth Semester

Branch : Electrical and Electronics Engineering

EE 010 604—DIGITAL SIGNAL PROCESSING

(New Scheme—2010 Admission onwards)

[Regular/Improvement/Supplementary]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 3 *marks.*

1. Check whether the following system is linear or not ?

$$y(n) = \frac{x(n-5)+x(n-7)}{x(n-2)\,x(n-3)}.$$

2. Explain the circular shift property of DFT.

3. Draw the direct form I structure of a filter whose difference equation is

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{2}x(n-1).$$

4. Write the equations specifying any *three* windows used in FIR filter design.

5. What is truncation ? What is the error that arises due to truncation in floating point numbers ?

(5 × 3 = 15 marks)

Part B

Answer **all** *questions.*
Each question carries 5 *marks.*

6. Find Z-transform of $x(n) = a^n \cos(\Omega_0 n)\, u(n)$.

7. Find the circular convolution of the sequences $x_1(n) = \{\underset{\uparrow}{2}, 1, 2, 1\}$, $x_2(n) = \{1, 2, 3, 4\}$.

8. Explain the forward difference method of converting analog to digital filters.

Turn over

9. Obtain the direct form realisation with minimum number of multipliers :

$$H(z) = \frac{1}{2} + \frac{1}{4}z^{-1} + \frac{1}{4}z^{-2} + \frac{1}{2}z^{-3}.$$

10. Draw and explain the quantizer characteristics with : (a) Round off ; and (b) Truncation.

(5 × 5 = 25 marks)

Part C

Answer **all** *questions.*
Each question carries 12 *marks.*

11. (a) Solve the difference equation $y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$, given $y(-1) = 2,\ y(-2) = -1,\ \ x(n) = 2^n\, u(n)$.

(8 marks)

(b) Specify the Nyquist rate for the following :

(i) $g_1(t) = \sin(200\, k)$.

(ii) $g_2(t) = \sin(200\, t) + \sin^2(200\, t)$.

(2 + 2 = 4 marks)

Or

12. (a) Find the inverse Z-transform of $X(Z) = \frac{z^3 - 10z^2 - 4z + 4}{2z^2 - 2z - 4}$, $|z| < 1$. (8 marks)

(b) Find the Fourier Transform of $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - n\tau)$, where τ is the fundamental period.

(4 marks)

13. Let $X\left(e^{jw}\right)$ denote the Fourier Transform of the sequence $x(n) = \left(\frac{1}{2}\right)^n u(n)$. Let $y(n)$ denote a finite duration sequence of length 10. ie, $y(n) = 0, n < 0$ and $y(n) = 0, n \geq 10$. The 10-point DFT of $y(n)$ denoted by Y(k) corresponds to 10 equally spaced samples of $X\left(e^{jw}\right)$ *ie,* $Y[K] = X\left(e^{j2\pi k/10}\right)$. Determine $y(n)$.

Or

14. Compute the 8-point DFT of the sequence $x(n) = \begin{cases} 1, & 0 \leq n \leq 7 \\ 0, & \text{otherwise} \end{cases}$

using DIT and DIF algorithms.

15. Realise the following system function in parallel form :

$$H(z) = \frac{1 - \frac{2}{3} z^{-1}}{1 - \frac{7}{8} z^{-1} + \frac{3}{32} z^{-2}} + \frac{1 + \frac{7}{4} z^{-1} - \frac{1}{2} z^{-2}}{1 - z^{-1} + \frac{1}{2} z^{-2}}$$

Or

16. Design a second order Butterworth digital filter with cut-off frequency 1.2 kHz and sampling frequency of 10^4 samples/sec by Bilinear Transformation.

17. Determine the impulse response $h(n)$ of a filter having desired frequency response

$$H_d\left(e^{jw}\right) = \begin{cases} e^{-j(N-1)fz}, & 0 \le |w| < \frac{\pi}{2} \\ 0 \text{ for } \frac{\pi}{2} \le w \le \pi \end{cases}$$

where N = 7. Use frequency sampling.

Or

18. Design an ideal band pass filter with frequency response $H_d\left(e^{jw}\right) = 1$ for $\frac{\pi}{4} \le |w| \le \frac{3\pi}{4}$. Use **rectangular window with N = 11 in the design.**

19. Realise the first order transfer function $H(z) = \frac{1}{1 - 0.5 z^{-1}}$ and draw its quantization noise model.

Also find the steady-state noise power due to round off. Take number of bits = 4.

Or

20. Discuss the applications of DSP in :
    (i) Channel vocoder.
    (ii) Homomorphic vocoder.
    (iii) Speech processing.

(3 × 4 = 12 marks)

[5 × 12 = 60 marks]