Reg.	No	*************

Maximum: 100 Marks

# B.TECH. DEGREE EXAMINATION, MAY 2014

## Sixth Semester

Branches: Applied Electronics and Instrumentation/Electronics and Communication/ Electronics and Instrumentation Engineering

AI 010 602/EC 010 602/EI 010 602—DIGITAL SIGNAL PROCESSING (AI, EC, EI)

(New Scheme -2010 Admission onwards)

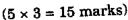
[Regular/Improvement/Supplementary]

Time : Three Hours

## Part A

Answer all questions briefly. Each question carries 3 marks.

- Determine if the system  $y(n) = e^{x(n)}$  is time invariant or not?
- 2. Find the transfer function description of the system difference equation  $y(n) = x(n) - b_1 y(n-1) - b_2 y(n-2)$ , where x(n) is input and y(n) is the output.
- Draw the frequency response characteristics for the ideal low-pass, band-pass and high-pass fifte
- Write the equations specifying Barlett and Hamming windows.
- Obtain the linear convolution of the sequences  $x(n) = \{1, 2, 3\}, h(n) = \{-1, -2\}$  using circular convolution.



#### Part B

Answer all questions. Each question carries 5 marks.

- 6. Find the z-transform of  $x(n) = n2^n \sin(\pi/2 n) u(n)$ .
- 7. Solve the difference equation, where input sequence is  $x(n) = 3^{n-2}$ ,  $n \ge 0$ , using z-transform, where 2y(n-2)-3y(n-1)+y(n)=x(n) with the initial conditions:  $y(-2)=\frac{-4}{9}$ ,  $y(-1)=-\frac{1}{3}$ .
- 8. Draw the cascade and parallel form realisations of  $\frac{(4s+28)}{(s+1)(s+5)}$



9. In a band-pass filter, the desired frequency response is:

$$\mathbf{H_d}\left(e^{jw}\right) = \begin{cases} e^{-jw\tau} &, \ w_{c_1} \le |w| \le w_{c_2} < \pi \\ 0 &, \ \text{otherwise} \end{cases}$$

Obtain the filter coefficients for a rectangular window for

N = 7, 
$$w_{c_1} = 1 \text{ rad/s}$$
,  $w_{c_2} = 2 \text{ rad/s}$ ,  $\tau = \frac{(N-1)}{2}$ .

10. Compute the DFT of the sequence whose values for one period is given by  $\tilde{x}(n) = \{1, 1, -2, -2\}$ .

(5 × 5 = 25 marks)

### Part C

Answer all questions.

Each question carries 12 marks.

11. Calculate the frequency response for the LTI system representation below:

(a) 
$$h(n) = \left(\frac{1}{2}\right)^n u(n)$$
.

(b) 
$$h(n) = \delta(n) - \delta(n-1)$$
.

(c) 
$$h(n) = (0.9)^n (e^{j\pi/2})^n u(n)$$
.

Or

- 12. A causal LTI system is described by the difference equation y(n) ay(n-1) = bx(n) + x(n-1) where 'a' is real and less than 1 in magnitude. Find a value of 'b'  $(a \neq b)$  such that the frequency response of the system satisfies  $|H(e^{jw})| = 1$  for all w.
- 13. For the LSIV system  $H(s) = \frac{z a^{-1}}{z a}$ , where 'a' is real.
  - (a) For what range of values of 'a' is the system stable?
  - (b) If 0 < a < 1, plot the pole-zero diagram and shade the ROC.
  - (c) Show graphically in the z-plane that this system is an all pass system.



14. Find H(z), and the frequency response of  $h(n) = \left(\frac{1}{2}\right) \left[\left(\frac{1}{2}\right)^n + \left(\frac{-1}{4}\right)^n\right] u(n)$  substituting  $z = e^{jw}$ .

Locate the zeros and poles in the z-plane.

15. (a) Determine the direct form realisation of the system function

$$H(z) = 1 + 2z^{-1} - 3z^{-2} - 4z^{-3} + 5z^{-4}$$

(b) Obtain the cascade realisation of the system function  $H(z) = 1 + \frac{5}{2}z^{-1} + 2z^{-2} + 2z^{-3}$ .

Or

16. Design an ideal low-pass filter with frequency response

$$\begin{aligned} \mathbf{H}_d\left(e^{jw}\right) &= 1 \quad \text{for } -\frac{\pi}{2} \leq w \leq \frac{\pi}{2} \\ &= 0 \quad \text{for } -\frac{\pi}{2} \leq |w| \leq \pi. \end{aligned}$$



Find the values of h(n) for N = 11.

17. Design a filter with  $H_d\left(e^{-jw}\right)=e^{-j3w}, \ \frac{-\pi}{4}\leq w\leq \frac{\pi}{4}$   $=0, \ \frac{\pi}{4}<|w|\leq \pi.$ 

Use Hanning window with N = 7.

Or

18. Using Bilinear Transformation design a digital band-pass Butterworth filter with the following specifications:

Sampling frequency f = 8 kHz

 $\alpha_{\rm p}$  = 2 dB in the pass-band 800 Hz  $\leq f \leq$  1000 Hz

 $\alpha_s = 20 \text{ dB}$  in the stopband,  $0 \le f \le 400 \text{ Hz}$  and  $2000 \le f \le \infty$ .

19. Find the output of y(n) of a filter whose impulse response in  $h(n) = \{1, 1, 1\}$  and input signal  $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$  using (a) overlap-save method; and (b) overlap-add method.

Or

20. Find the DFT of a sequence  $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$  using DIT algorithm.

 $(5 \times 12 = 60 \text{ marks})$