B.E./ COMP/ Sem VIII
Digital Signal Processing

Con. 5163–09. SP–6572

(3 Hours) [Total Marks : 100

9/12/09
10·30 to 1·30

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** out of remaining **six** questions.
(3) Assume **suitable** data wherever **necessary**, justify the **same**.

1. (a) Find the even and odd parts of the signal $x(n) = u(n)$. **5**
   (b) Determine whether following signals are periodic, if periodic detemine the fundamental period. **5**
   (i) $x(n) = \text{Re}\{e^{jn\pi/12}\} + \text{Im}\{e^{jn\pi/18}\}$ (ii) $x(n) = e^{j\pi/6n}\cos(n\pi/17)$
   (c) Determine the response of the relaxed system characterized by the impulse response $h(n) = \left(\frac{1}{2}\right)^2 u(n)$ to the input signal $x(n) = 2^n u(n)$. **5**
   (d) Find the Natural response of the system described by the difference equation $y(n) + 2y(n-1) + y(n-2) = x(n) + x(n-1)$ with initial condition $y(-1) = y(-2) = 1$. **5**

2. (a) Define z-transform and explain the importance of ROC. State and prove initial value theorem and final value theorem. **10**
   (b) Find the z-transform of the following sequences : **10**
   (i) $x(n) = \left(\frac{1}{2}\right)^n u(n+2) + (3)^n u(-n-1)$ (ii) $x(n) = \left(\frac{1}{3}\right)^n \cos(nw_0)\, u(n)$.

3. (a) Explain and draw the basic network structures for IIR system. **10**
   (b) A causal linear shift invariant system is characterized by the difference equation **10**
   $y(n) = \frac{1}{4}y(n-1) + \frac{1}{8}y(n-2) + x(n) - x(n-1)$. Find the system function, H(z) and the unit sample response, h(n).

4. (a) Compare between circular convolution and linear convolution. Determine the output response y(n) if $h(n) = \{1, 1, 1\}$: $x(n) = \{1, 2, 3, 1\}$ by using : **12**
   (i) Linear convolution
   (ii) Circular convolution
   (iii) Circular convolution with zero padding.
   (b) A linear phase FIR filter has $H_1(w) = \cos\frac{w}{2} + \frac{1}{2}\cos\frac{3w}{2}$. Determine the impulse response h(n). **8**

5. (a) Explain the Decimation in time FFT and Decimation in Frequency FFT. Draw the Butterfly Diagram for N = 8. **15**
   (b) State and prove Parseval's Power Relation and Energy Relation. **5**

6. (a) Design a low pass Butterworth filter that has a 3-dB cut-off frequency of 1·5 KHz and attenuation of 49 dB at 3 KHz. **10**
   (b) Explain the procedure to design Digital filters from Analog Filters using : **10**
   (i) Impulse Invariance
   (ii) Based on Differential Equation
   (iii) Bilinear Transformation.

7. Explain the following :– **20**

(a) DSP Techniques Applied in Audit Signal Processing
(b) Different Generations of Digital Signal Processor
(c) Filter Design using Frequency Transformations
(d) Hilbert Transform Relations for the DFT
(e) Chirp z-Transform Algorithms.
