M 2056

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2006.

Third Semester

Information Technology

IT 1201 — SIGNALS AND SYSTEMS

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define signal. What are the classifications of signals?

2. Determine the fundamental period of the signal $x(n) = 1 + e^{j4\pi n/7} - e^{j2\pi n/5}$.

3. Find the Fourier series coefficient of $x(t) = \sin \omega_0 t$.

4. Find the Laplace transform of the signal $u(t)$.

5. Find the Fourier transform of the impulse response.

6. Draw direct form II representation of $H(z) = \frac{1 + z^{-1} + 3z^{-2}}{1 + z^{-2} + z^{-3}}$.

7. Define Initial value theorem and Differentiation theorem of Z-transfer.

8. Find the condition for signal $a^n u(n)$ is stable.

9. Find the convolution sum for $x(n) = \{1,1,1,1\}$ and $h(n) = \{1,2,2,1\}$.

10. Define Parsavel's relation.

PART B — (5 × 16 = 80 marks)

11. (i) Determine whether or not each of the following signals is periodic. If the signal is periodic, determine the fundamental period.

(1) $x(t) = [\cos(2t - \pi/3)]^2$

(2) $x(n) = \Sigma\delta(n) - 4k - \delta(n - 1 - 4k)$

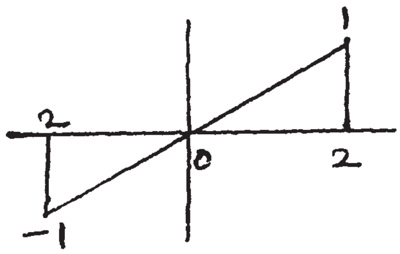
(ii) Determine whether the systems are linear, time in variant causal and stable.

(1) $y(n) = n\ x(n)$

(2) $y(t) = x(t) + x(t-2) \quad t \geq 0$
$\quad = 0 \quad t < 0$

12. (a) (i) A discrete time periodic signal $x(n)$ is real valued and has a fundamental period $N = 5$. The non-zero Fourier series coefficient are $a_0 = 1$, $a_2 = a_{-2}{}^* = e^{j\pi/4}$, $a_4 = a_{-4}{}^* = 2\ e^{j\pi/3}$. Express $x(n)$ in the form of $x(n) = A_0 + \sum_{k=1}^{\infty} A_k \sin(\omega_k n + \phi_k)$.

(ii) Compute Fourier transform for



Or

(b) (i) Determine the Fourier transform of $x(t) = e^{-4t} + e^{-5t}\sin 5^t u(t)$.

(ii) Suppose the following facts are given about the signal $x(t)$ with Laplace transform, $x(s)$

(1) $x(t)$ is real and even

(2) $x(s)$ has four poles and no zeros infinite s-plane

(3) $x(s)$ has a pole at $S = \frac{1}{2} e^{j\pi/4}$

(4) $\int_{-\infty}^{\infty} x(t)\,dt = 4$.

Determine $x(s)$ and its ROC.

13. (a) Find the convolution integral for

$x(t) = e^{-\alpha t}u(t)$

$h(t) = e^{-\beta t}u(t)$

(i) when $\alpha = \beta$ (ii) $\alpha \neq \beta$.

Or

(b) (i) Consider a stable LTI system that characterize by the differential equation.

$$d^2y(t)/dt^2 + 4d\,y(t)/dt + 3\,y(t) = d\,x(t)/dt + 2\,x(t)$$

where $x(t) = e^{-t}\ u(t)$. Find the output response.

(ii) Draw the direct form I and II block diagram representation for the following transfer function.

$$H(z) = \frac{1 + 2z^{-1} + 3z^{-2} + 4z^{-6} + z^{-7}}{1 + 2z^{-2} + 4z^{-5} + z^{-8}}.$$

14. (a) (i) Find the Fourier transform for

(1) $x(n) = (1/3)^{|n|}\ u(-n-2)$

(2) $x(n) = u(n-2) - u(n-6)$.

(ii) Find the inverse Fourier transform

(1) $$x(\omega) = \frac{1 - \frac{1}{3}e^{-jw}}{1 - \frac{1}{4}e^{-jw} - \frac{1}{8}e^{-j2w}}$$

(2) $$x(\omega) \begin{matrix} = e^{-jw/2} & \text{for } -\pi \leq w \leq \pi \\ = 0 & \text{for elsewhere} \end{matrix}$$

Or

(b) (i) Find the DFT for $x(n) = \{1, 2, 3, -2, -3\}$

(ii) Find the Z-transform and plot its poles and zeros.

(1) $x(n) = a^n \cos \omega n\ u(n)$

(2) $x(n) = 2^n\ u(n-2)$.

15. (a) Find the FFT for $x(n) = \{1,2,3,4,4,3,2,1\}$.

Or

(b) (i) Find the convolution of $x(n) = (3/4)^n\, u(n)$

$$h(n) = (1/2)^n\, u(n)$$

(ii) Determine the impulse response for the following difference equation.

$$4y(n-2) + 5y(n-1) + 2y(n) = 4x(n) + 2x(n-1) + 3x(n-3).$$

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