T 8223

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 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. Find the fundamental period of the signal $x(n) = \frac{3e^{j3\pi(n+\frac{1}{2})}}{5}$.

2. Consider the discrete time signal $x(n) = 1 - \sum_{k=+3}^{\infty} \delta(n-1-k)$.

   Determine the value of the integers M and n_0 so that $x(n)$ may be expressed as, $x(n) = u(Mn - n_0)$.

3. Define Parseval's relation for continuous-time periodic signals.

4. Find the Laplace transform for the signal $x(t) = -te^{-2t}u(t)$.

5. Write the properties of the Roc for the Z-transform.

6. Write the analysis and synthesis equation of DTFT.

7. Draw the radix-2 Basic Butterfly diagram.

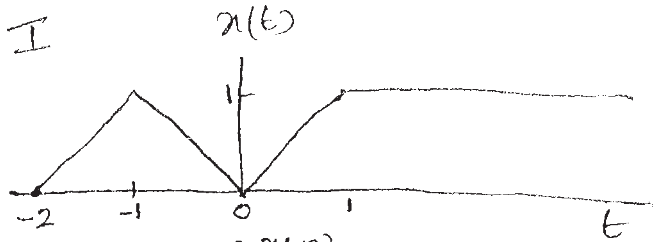
8. Find the Fourier transform of $h(n) = \delta(n - n_0)$.

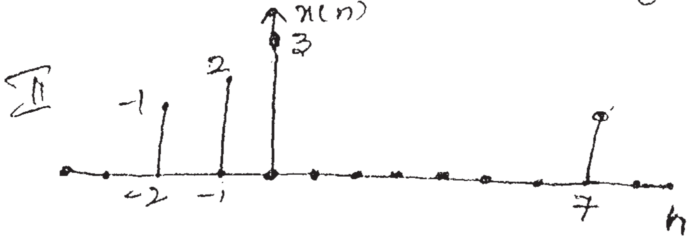
9. Draw the block diagram for $H(z) = \frac{1 + 2z^{-1} + 4z^{-4}}{1 - z^{-1} + z^{-2}}$ using Direct form-I.

10. Write the differentiation and integration property of Fourier transform.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Determine and sketch the even and odd part of the signals. ($2 \times 6 = 12$)





(ii) Consider a continuous time signal $x(t) = \delta(t+2) - \delta(t-2)$. Calculate the value of E_{α} for the signals, $y(t) = \int_{-\infty}^{t} x(\tau)d\tau$. (4)

Or

(b) (i) What are the classification of signals? Define and sketch all the signals. (11)

(ii) Determine whether the given system $y(t) = \begin{cases} 0 & t < 0 \\ x(t) + x(t-2) & t \geq 0 \end{cases}$, Satisfies the following properties. (5)

(1) Memoryless (2) Time invariant (3) Linear (4) Causal and (5) Stable.

12. (a) (i) Consider the following discrete time signals with a fundamental period of 6. $x(n) = 1 + \cos\left(\frac{2\pi}{6}n\right)$, $y(n) = \sin\left(\frac{2\pi}{6}n + \frac{\pi}{4}\right)$ and $z(n) = x(n)\,y(n)$. Compute Fourier series coefficients for $z(n)$. (8)

(ii) Let $x(t)$ be a periodic signal whose Fourier series coefficients are,

$$a_k = \begin{cases} 2 & k = 0 \\ j\left(\frac{1}{2}\right)^{|k|}, & \text{otherwise} \end{cases}$$

Using Fourier series properties find,

Is $x(t)$ real?

Is $x(t)$ even?

Is $\frac{dx(t)}{dt}$ even? (8)

Or

(b) (i) $x_1(t) = e^{-2t}u(t)$, $x_2(t) = e^{-3t}u(t)$ determine $Y(s)$, where $y(t) = x_1(t-2) * x_2(-t+3)$. (14)

(ii) Find the laplace transform for $x(t) = \delta(t) + u(t)$. (2)

13. (a) Convolve $x(t)$ and $h(t)$ as shown in Fig. 13(a)

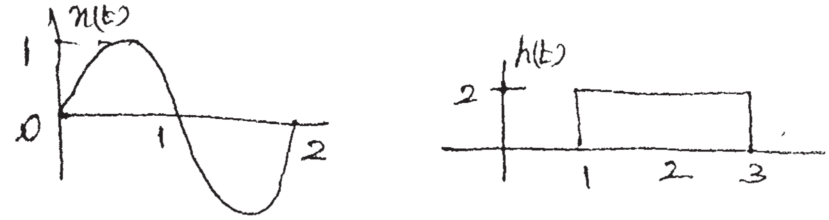


Fig. 13(a)

Or

(b) (i) Consider an LTI system whose input $x(t)$ and output $y(t)$ are related by the differential equation $\frac{d}{dt}y(t) + 4y(t) = x(t)$. The system also satisfies the condition at initial rest, if $x(t) = e^{-(1+3j)t}u(t)$ find $y(t)$. (10)

(ii) Find $y(t)$ for the differential equation $\frac{d}{dt}y(t) + 5y(t) = x(t)$, where $x(t) = 3e^{-2t}u(t)$ and $y(0^+) = -2$. (6)

14. (a) (i) Consider a discrete time LTI system with impulse response

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

Using Fourier transform determine the response for the input $x(n) = (n+1)\left(\frac{1}{4}\right)^n u(n)$. (10)

(ii) Determine the signal corresponds to this Fourier transform $x(w) = \sum_{k=-\infty}^{\infty} (-1)^k \delta\left(w - \frac{\pi}{2}k\right)$. (6)

Or

(b) (i) Find the DFT of the signal

$$x(n) = \begin{cases} 1 & 0 \le n \le l-1 \\ 0 & \text{otherwise.} \end{cases}$$ (8)

(ii) Write any two properties of discrete Fourier transform and prove them. (8)