Code No. 3306

FACULTY OF INFORMATICS

B.E. 2/4 (IT) II-Semester (Supplementary) Examination, January 2011

SIGNALS AND SYSTEMS

Time : Three Hours] [Maximum Marks : 75

Note :—Answer ALL questions of Part A. Answer any FIVE questions from Part B.

PART—A (Marks : 25)

1. Define the sequence $\tilde{a} = \{a_1\ a_2\ a_3\} = \{0.2\ \ 0.8\ \ 0.5\}$. Using this sequence, define the signal :

$$x(t) = \sum_{k=1}^{3} a_k \pi(t-k).$$ 2

Sketch the signal. 1

2. Find the Fourier transform of the signal

$x(t) = Sgn(t)$. 3

3. Find the Laplace transform of the signal

$$x(t) = \frac{d^2}{dt^2}[\delta(t)].$$ 3

4. Draw the pole-zero diagram of the system from its transfer function :

$$\ddot{y}(t) + 2\zeta w_n\ \dot{y}(t) + w_n^2\ y(t) = b_0 x(t).$$ 3

5. What is a multivariable system ? Give an example. 2

6. Find the output signal of the system when the input signal is given by $x(t) = \cos(wt)$, using convolution integral. 3

7. Define Bibostable system with an example. 2

8. What is Nyquist frequency and Aliasing. 2

9. Give an example of a signal which is neither energy nor power signal. 2

10. Give the relationship of the Fourier Transform to the DTFT. 2

PART—B (Marks : 5×10=50)

11. (a) Find the trigonometric and exponential representations of the following cosine Fourier Series :

$$x(t)=\sum_{m=1}^{\infty}\frac{3}{4m^2}\cos\left(2mt-\frac{\pi m}{4}\right).$$

5

(b) State and prove modulation property of Fourier Transform. 5

12. (a) Find the Energy Spectral Density of the signal :

$$x(t) = [Sa\ (3t)]\ \cos\ (7t).$$

5

(b) Solve the following differential equation using Laplace transform :

$$\ddot{y}(t)-\dot{y}(t)-6y(t)=e^{-t}u_s(t)$$

where $\dot{y}(0) = 5;\ y(0) = 0.$ 4

(c) Give the relationship between Laplace transform and Fourier transform. 1

13. (a) For the system below, draw an all-integrator block diagram and find the transfer function using (i) block diagram reduction (ii) Formula :

$$\dot{q}=\begin{bmatrix}1 & 0\\ 0 & -1\end{bmatrix}q+\begin{bmatrix}3\\ 5\end{bmatrix}x;$$

$$y = [2\quad 1]\ q.$$

5

(b) Suppose the impulse response of a system is given by $h(t) = u_s(t) - u_s(t) - u_s(t - 3)$. Find $y(t) = h(t) * x(t)$ if the input signal is

$$x(t) = [u_s\ (t + 1) - u_s\ (k)] - [u_s\ (t) - u_s(t - 1)].$$

5

14. (a) For what values of K is the following system BIBO stable ?

$$\frac{Y(s)}{X(s)}=\frac{s+3}{s^2+10\,ks+25}\ ;\ -1\le k\le 1.$$

5

(b) Find the inverse Z-transform of

$$X(z)=\frac{z}{(z+2)(z-3)}$$

when the ROC is ROC = $\{|\ z\ | > 3\}$ 5

15. (a) Consider the signal :

$$x(t) = w_c\, e^{-\alpha t} \sin(w_c t),\ w_c = 8;\ \alpha = 0.2.$$

Suppose that this signal is sampled with a sampling frequency of $f_s = 50$ Hz. Before sampling this signal is passed through an anti-aliasing filter. Design this filter so that the amplitude spectrum of this signal is reduced by 30dB at the Nyquist frequency of the sampling frequency. State your filter type, bandwidth, order etc. 5

(b) Find the DFT of the following signal. Also plot the twiddle factors W^k in the z-plane :

$$\tilde{x}(n) = \{1, 2, -1, -3, 1, 0, 0, 0\}.$$ 5

16. (a) Find the energy spectral density of the following signal using auto-correlation function :

$$x(n) = A\, a^n u_s(n).$$ 5

(b) Find the discrete convolution of the signal

$$h(n) = (2 - n)\,(u_s(n) - u_s(n - 2)).$$ 5

17. (a) State and Prove Perseval's theorem using DFT. 5

(b) Give the properties of correlations integrals. 3

(c) Explain Digital filters. 3

4