(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0324 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. IV) THEORY EXAMINATION 2010-11

SIGNALS AND SYSTEMS

Time : 3 Hours *Total Marks : 100*

Note :– (1) Attempt **ALL** questions. All questions carry equal marks.

(2) Be precise in your answer. No second answer book will be provided.

1. Attempt any **FOUR** parts of the following :— **5×4=20**

(a) Define a continuous-time signal and show that the product of two odd signals is an even signal.

(b) Determine and sketch the even and odd components of the continuous-time signal $x(t) = e^{-t}\, u(t)$.

(c) Consider $x(t) = \cos 2\pi f_0 t$. Is it a power signal or energy signal ?

(d) Write down the expression for and plot the sinusoidal discrete-time sequence whose peak amplitude is 10 and frequency is 100 Hz. The sampling frequency is 1000 samples per second.

(e) Define unit impulse function and also state at least three properties of it.

(f) Show whether $x(t) = \begin{cases} A; & 0 < t < T_0 \\ 0; & \text{otherwise} \end{cases}$ is an energy signal or power signal.

2. Attempt any **FOUR** parts of the following :— **5×4=20**

(a) State and prove the initial value theorem for a function f(t).

(b) Using partial fraction expansion, find f(t). If its unilateral Laplace Transfom F(s) is given by

$$\frac{2s-1}{s^2+2s+1}.$$

(c) Determine the energy contained in the signal

$$x(t) = 20 \sin 10t.$$

(d) Show that the Z-transform of any anti-symmetric sequence has a zero at $z = 1$.

(e) Find the unilateral Z-Transform of

$$x(n) = [a^n \cos \omega_0 n]\, u(n).$$

(f) If $X(z) = \frac{z}{3z^2 - 4z + 1}$, find x(n), $n \geq 0$, given that ROC of X(z) is $|z| > 1$.

3. Attempt any **FOUR** parts of the following :— **5×4=20**

(a) Determine and sketch spectrum of

$$x(t) = 10 \sin 2\pi f_0 t.$$

(b) Show that the convolution in time domain is same as product in frequency domain.

(c) Find the Fourier transform of $x(t) = \frac{1}{1+t^2}$.

(d) Compute the DTFT of

$$x(n) = (a^n \cos \omega_0 n)\, u(n);\ a < 1.$$

(e) If $X(e^{j\omega}) = 2\pi\delta(\omega)$; $-\pi < \omega < \pi$. Find x(n).

(f) State and prove the multiplication theorem for two discrete signals.

4. Attempt any **TWO** parts of the following :— **10×2=20**

(a) (i) A particular system has been modeled by an input-output relation

$$Y(t) = a_0 + a_1x(t) + a_2x^2(t)$$

(ii) Is the system static or dynamic ?

(iii) Is it linear ? Justify your answer.

(iv) Show that an ideal differentiator which input x(t) and output y(t) related by $y(t) = \frac{dx(t)}{dt}$ is a linear time invariant system.

(b) For the DT system described by the difference equation

$$y(n) = 0{\cdot}6y(n-1) - 0{\cdot}08y(n-2) + x(n),$$

determine :

(i) The unit-sample response sequence, h(n),

(ii) The step-response sequence g(n) and

(iii) Whether it is BIBO stable ?

(c) (i) Find the auto-correlation function and the Energy Spectral Density (ESD) of the signal $x(t) = e^{-t}\,u(t)$.

(ii) Given $x(t) = 5\cos t$ and $y(t) = 2e^{-|t|}$, find convolution $x(t) * y(t)$.

5. Attempt any **TWO** parts of the following :— **10×2=20**

(a) A second-order DT system is described by the difference equation :

$$y(n) - y(n-1) + 0{\cdot}5y(n-2) = x(n).$$

Determine :—

(i) H(z), the system function,

(ii) h(n), the unit-sample response sequence and

(iii) transfer function $H(e^{jw})$.

Also plot its magnitude response.

(b) Find the voltage transfer functions, H(S), of the following :—

(i) The L-section RC high pass filter.

(ii) The L-section LC low pass filter.

(c) Obtain canonical direct form, cascade and parallel realizations of the transfer function :

$$H(s) = \frac{5s^3}{s^3 + 6s^2 + 11s + 6}.$$