Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- Vth SEMESTER–EXAMINATION – MAY/JUNE - 2012

Subject code: 150303 **Date: 04/06/2012**

Subject Name: Signals & Systems

Time: 02:30 pm – 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1

(a) Give the classification of signals with necessary illustration. [8]

(b) Explain following: [6]

(i) Signal Energy

(ii) Signal Power

Q.2

(a) Justify that PCM is an application of Sampling Theorem. [8]

(b) Determine the power and rms value for following signals: [6]

(i) 10 cos 5t cos10t

(ii) 10 sin5t cos 10t

OR

(b) If f[k] u[k] $\leftrightarrow$ F[z], then prove the following: [6]

(i) f[k-1] u[k-1] $\leftrightarrow$ 1/z F[z]

(ii) $f_1[k] * f_2[k] \leftrightarrow F_1[z]\, F_2[z]$

Q.3

(a) Determine which of the systems with input f(t) and output y(t) are linear and which are non-linear. [8]

(i) $dy/dt + 3t\, y(t) = t^2 f(t)$

(ii) $dy/dt + y^2 = f(t)$

(b) Find $y_0(t)$, the zero-input component of the response for an LTI system described by the following differential equation: [6]

$$(D^2 + 3D + 2)\, y(t) = D\, f(t)$$

When initial conditions are $y_0(t) = 0$ and $\mathring{y}_0(t) = -5$.

OR

Q.3

(a) The unit impulse response of an LTIC system is [8]

$$h(t) = [2e^{-t} - e^{-2t}]$$

and if the input f(t) is

(a) u(t)

(b) e^{-t} u(t)

(b) Sketch the following signals: [6]

(i) $u(t-5) - u(t-7)$
(ii) $u(t-5) + u(t-7)$
(iii) $t^2 [u(t-1) - u(t-2)]$

Q.4

(a) State advantage of FFT over DFT and explain Decimation in Time FFT algorithm. [8]

(b) A signal $f(t) = \text{sinc}(300\pi t)$ is sampled (using uniformly spaced impulses) at a rate of (a) 200 Hz (b) 300 Hz . For each of the three cases (i) sketch the spectrum of the sampled signal, (ii) explain if you can recover the signal f(t) from the sampled signal, (iii) if the sampled signal is passed through an ideal lowpass filter of bandwidth 150 Hz , sketch the spectrum of the output signal. [6]

OR

Q.4

(a) Prove that Z-transform can be considered as a Laplace transform with a change of variable $z = e^{sT}$. [8]

(b) Find the response y[k] of an LTID system described by the difference equation: [6]

$$y[k+2] + y[k+1] + 0.16y[k] = f[k+1] + 0.32f[k]$$

for the input $f[k]= (-2)^{-k} u[k]$ and with all initial conditions zero.

Q.5

(a) Distinguish the unilateral and bilateral Z-transform. Determine Z-transform of [8]

$$f[k] = (0.8)^k u[k] + (1.4)^k u[-(k+1)]$$

(b) Determine whether the systems specified by the following equations are asymptotically stable, marginally stable, or unstable. In each case plot the characteristic roots in the complex plane. [6]

(i) $y[k] - y[k-1] + 0.21y[k-2] = 2f[k-1] + 3f[k-2]$
(ii) $y[k+3] + 2y[k+2] + 1.5y[k+1] + 0.5y[k] = f[k+1]$

OR

Q.5

(a) Write the side effects of truncation and its remedies. [8]

(b) Derive the transfer function and necessary condition for distortionless transmission. [6]

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