**Seat No.: _____** **Enrolment No._____**

# GUJARAT TECHNOLOGICAL UNIVERSITY

## BE SEM-V Examination-Nov/Dec.-2011

**Subject code: 150303** **Date: 26/11/2011**

**Subject Name: Signal and Systems**

**Time: 2.30 pm -5.00 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) Explain Sampling Theorem. [7]

(b) State and explain the advantages of digital signals. [7]

Q.2

(a) If $f[k]u[k] \leftrightarrow F[z]$, then prove the following: [8]

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

(ii) $\gamma^k f[k]\, u[k] \leftrightarrow F[z/\gamma]$

(iii) $k\ f[k]\, u[k] \leftrightarrow -z\ d/dz\ \{F[z]\}$

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

(b) Using z-transform find y[z] of following linear difference equation with constant coefficient having causal input f[k], [6]

$$y[k] - 5y[k-1] + 6y[k-2] = 3f[k-1] + 5f[k-2]$$

Where $y[-1] = 11/6$, $y[-2] = 37/36$ and $f[k] = 2^{-k}u[k]$.

OR

(b) Using z-transform find y[z] of following linear difference equation with constant coefficient having causal input f[k], [6]

$$y[k+2] - 5/6y[k+1] + 1/6y[k] = 5f[k+1] - f[k]$$

Where $y[-1] = 2$, $y[-2] = 0$ and $f[k] = u[k]$.

Q.3

(a) Determine which of the systems are linear and which are non-linear. [8]

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

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

(b) Explain following: [6]

(i) Causal and Non-causal systems

(ii) Lumped and Distributed parameter systems.

OR

Q.3

(a) Explain following: [8]

(i) Time-invariant and Time-varying systems.

(ii) Invertible and Non-invertible systems.

(b) Show that an everlasting exponential $e^{-at}$ is neither energy nor a power signal for any real value a. However, if a is imaginary, it is power signal with power $P_f = 1$ regardless of the value a. [6]

Q.4

(a) Determine the unit impulse response h[k] for a system specified by [8]

$$y[k+2] - 5y[k+1] + 6y[k] = 8f[k+1] - 19f[k]$$

(b) A signal $f(t) = \text{sinc}(200\pi t)$ is sampled (using uniformly spaced impulses) at a rate of (a) 150 Hz (b) 200 Hz (c) 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 100 Hz , sketch the spectrum of the output signal. [6]

OR

Q.4

(a) Determine the unit impulse response h[k] for a system specified by [8]

$$y[k+2] - 0.6y[k+1] - 0.16y[k] = 5f[k+2]$$

Where $f[k] = \delta[k]$ and $y[k] = h[k]$.

(b) A compact disc records audio signals digitally by using PCM. Assume the audio signal bandwidth to be 15 kHz. [6]

(a) What is the Nyquist rate?

(b) If the Nyquist samples are quantized into 65536 levels (L=65536) and then binary coded, what number of binary digits is required to encode a sample.

(c) Determine the number of binary digit/s (bit/s) required to encode the audio signal.

(d) Practical CDs use 44100 samples/s. if L=65536, determine the number of pulses/s required to encode the signal.

Q.5

(a) Explain generation and demodulation of angle modulated signal. [6]

(b) For an LTIC system with transfer function [4]

$$H(s)=1/(s+1)$$

Find the zero-state response if the input f(t) is (i) $e^{-2t}u(t)$ (ii) $e^{t}u(-t)$

(c) Explain the types of stability of systems. Investigate the stability of following LTIC systems: [4]

(i) $(D+1)(D^2+4D+8)\,y(t) = (D-3)\,f(t)$

(ii) $(D+1)(D^2+4)^2\,y(t) = (D^2+2D+8)\,f(t)$

OR

Q.5

(a) Write a note on correlation and its application in signal detection. [8]

(b) Explain following Fourier Transform properties: [6]

(i) symmetry (ii) Time shifting (iii) Scaling