INDIAN INSTITUTE OF TECHNOLOGY

Date: **Mid-Semester** Time: 2Hrs. Full Marks: 60 No. of students: 120
Spring Semester 2011-2012 Dept. Electronics & ECE Sub. No. EC21004
2nd Year B.Tech.. Sub. Name: Signals and Systems

Answer all questions. Answers should be brief, ***to the point and legible****. Sketches wherever appear should be neat and* ***properly labeled****. All parts of a question to be answered at one place.* ***All steps*** *towards a solution must be* ***unambiguously presented.***

Q1. (a) Define and explain the significance of aliasing.

(b) Discuss accumulation and differencing properties of Discrete Time Fourier Transform and comment on their High Pass or Low Pass nature.

(c) Explain various differences between FIR and IIR systems in discrete time domain. How do they compare with impulse response of continuous time system.

5 + 5 + 5

Q2. (a) Find if the discrete time system defined by $y[n] = \sqrt{x[n]}$ is linear, causal, stable, invertible.

(b) Find impulse response of the system defined by $3y[n] + 4y[n-1] + y[n-2] = x[n] + x[n-1]$

(c) Find output $y[n]$ of the system defined below if input $x[n] = 4^{-n}u[n]$

$$y[n+2] - 0.6y[n+1] - 0.16y[n] = 5x[n+2] \text{ where } y[-1]=0, y[-2]=25/4$$

4 + 5 + 6

Q3. (a) Define DTFS and inverse DTFS. Show how it can be expressed in terms of matrix multiplication.

(b) Prove Parseval's Theorem : $\frac{1}{N_0}\sum_{n=\langle N_0\rangle}|x[n]|^2 = \sum_{k=\langle N_0\rangle}|X[k]|^2$

(c) Consider a discreet time system defined by $1.25\,y[n] - y[n] = x[n]$

(i) Find $y_1[n]$ if $x[n] = x_1[n] = \delta_4[n]$ and plot $y[n]$ for $n = 0$ to 7.

(ii) Find $y_2[n]$ if $x[n] = x_2[n] = \delta_4[n]u[n]$ and plot $y[n]$ for $n = 0$ to 7.

(iii) Comment on the difference between $y_1[n]$ and $y_2[n]$ 3 + 4 + 8

Q4. (a) Compare Continuous Time Fourier Transform and Discrete Time Fourier Transform.

(b) State and prove the time scaling property of Discrete Time Fourier Transform. How upscaling and downscaling are different in terms of uniqueness?

(c) Consider following discreet time systems

(i) $y[n] = \{x[n] + x[n-1] + x[n-2]\}/3$

(ii) $y[n] = x[n] - 0.6\,x[n-1] + 0.4x[n-2]$

Find their Discrete Time Fourier Transform; plot magnitude and phase response; calculate their 3-dB cut-off frequency and comment on their utilities. 2 + 4 + 9

---------- All The Best ----------