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National Institute of Technology, Delhi

Name of the Examination: B. Tech. [redacted]

Branch	: ECE , CSE, EEE	Semester	:3rd
Title of the Course	:Signals and Systems	Course Code	:ECB-204

Time: 3 Hours **Maximum Marks: 50**

SECTION-A (Attempt all, Each question carry 1 mark) **10×1=10marks**

1. (a)Determine whether the following signals are periodic or not. If a signals is periodic, determine its fundamental period. (i) $x(t)=\cos t+\sin\sqrt{2t}$ (ii) $x(n)=\sin(n/8)$

(b) Determine whether the following signals are energy signals, power signals or neither.
(i) $x(t)=tu(t)$ (ii) $x[n]=2e^{j3n}$

(c) If the continuous time signal $x(t)=\cos(1250\pi t)$ is sampled at sampling frequency $Fs=10Hz$, then the discrete time sequence x(n) is ?

(d) Determine the Z transform and ROC of $x(n)=(1/2)^n u(-n)$

(e) Obtain the fourier transform of $x(t)=te^{-at}u(t)$

(f) State the Parseval's Theorem for the discrete time signals.

(g) Check the following systems for linearity (i) $y(t)=5\sin x(t)$ (ii) $y(n)=[x(n)]^2$

(h) Consider a discrete time LTI system whose input x(n) and output y(n) are related by $y(n)=\sum_{k=-\infty}^{n}2^{k-n}x(k+1)$

Is the system Causal ?

(i) Determine the Nyquist rate for a continuous time signal $x(t)=6\cos 50\pi t+20\sin 300\pi t-10\cos 100\pi t$.

(j) A discrete time system is characterized by the following difference equation $y(n)=x(n)+e^{\alpha}y(n-1)$
Check this system for BIBO stability.

SECTION-B (Attempt any four, Each Question carry 5 marks) **4×5=20marks**

2. Determine Z transform of x(n) and draw its ROC. Also find the causality and stability of the system.

$$x(n)=[(0.5)^n\sin\frac{\pi n}{4}]u(n)$$

3. The output y(t) of a continuous time LTI system is found to be $2e^{-3t}u(t)$ when the input x(t) is u(t).
(a) Find the impulse response h(t) of the system.
(b) Find the output y(t) when the input x(t) is $e^{-t}u(t)$.

4. Determine the fourier series representation of the signal x(n) and plot its magnitude and phase spectrum.

$$x(n)=1+\sin(\frac{2\pi}{N}n)+3\cos(\frac{2\pi}{N}n)+\cos(\frac{4\pi}{N}n+\frac{\pi}{2})$$

5. A continuous time signal x(t) is shown in figure 1. Sketch and Label each of the following signals.

(i) $x(1-\frac{t}{2})$ (ii) $x(t)[u(t)-u(t-1)]$

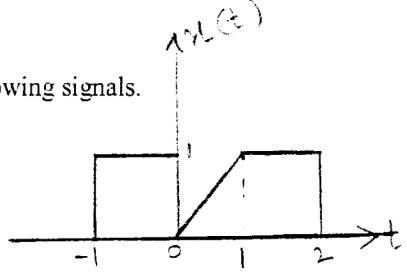

Fig 1.

6. (a) Prove the time convolution theorem that is $x_1(t)*x_2(t)\leftrightarrow X_1(\omega)+X_2(\omega)$

(b) Using the time convolution theorem, find the inverse fourier transform of $X(\omega)=\frac{1}{(a+j\omega)^2}$

SECTION-C (Attempt any two, Each Question carry 10 marks) **$2 \times 10 = 20$marks**

7. Consider a continuous time LTI system for which the input x(t) and output y(t) are related by

$$y''(t) + y'(t) - 2y(t) = x(t)$$

(a) Find the system function H(s)

(b) Determine the impulse response h(t) for each of the following three cases (i) the system is causal (ii) the system is stable (iii) the system is neither causal nor stable.

8. Consider the signal $x(t) = e^{-5t}u(t-1)$ and denote its Laplace transform by X(s).

(a) Evaluate X(s) and find its ROC.

(b) Determine the values of the finite numbers A and t_0 such that the Laplace transform G(s) of

$$g(t) = Ae^{-5t}u(-t-t_0)$$

has as the same algebric form as X(s). What is the ROC corresponding to G(s) ?

9. A signal $x(t)$ having frequency domain representation $X(j\omega)$ is sampled in every T_S seconds and is denoted by $x(nT_S)$. Find the fourier transform of the sampled signal in terms of $X_{nT_S}(j\omega)$.