PAPER ID-311148

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B.TECH
(SEM III) THEORY EXAMINATION 2020-21
SIGNALS AND SYSTEMS

Time: 3 Hours   *Total Marks: 70*

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1.   Attempt *all* questions in brief.   **2 x 7 = 14**

a.	Define the relationship between unit step, unit ramp and unit impulse function.
b.	Differentiate between periodic and Aperiodic signals. Find the fundamental period if the signal is periodic. $x(t) = e^{j\frac{2\pi}{3}t} + e^{j\frac{3\pi}{4}t}$
c.	What is stable system? Determine whether the system $y(n) = x(n) - x(n-1)$ is stable or not.
d.	Find the final value of $X(s) = \dfrac{3s+2}{s(s^2+3s+2)}$.
e.	Enlist the Dirichlet conditions of Fourier Transform.
f.	Write down the significance of ROC of Z- Transform.
g.	What is meant by aliasing? What is an Anti-aliasing filter?

SECTION B

2.   Attempt any *three* of the following: **7 x 3 = 21**

a.	What is Signal? Explain the classification of the signals in brief with examples.
b.	Find the signal $x(t)$ whose bilateral transform is as given below $$X(s) = \frac{2s}{(s+1)(s+3)}$$ for (a) $-1 < R_e(s) < -3$ (b) $R_e(s) < -3$ (c) $R_e(s) > -1$
c.	The input and the output of a causal LTI system are related by the differential equation $$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = x(t) .$$ a) Find the frequency and impulse response of the system. b) What is the response of this system if x (t) = te^{-4t}u(t)
d.	State and prove the time shifting property of Z Transform. Determine the Z-transform and find the ROC for $x(n) = a^{n-1}u(n-1)$
e.	Explain the system bandwidth and rise time for low pass filter and prove that $$t_r = \frac{0.35}{B}$$

SECTION C

3.   Attempt any *one* part of the following: **7 x 1 = 7**

(a)	Plot $x(t) = r(t) - 2r(t-1) + r(t-2)$. Find the even and odd parts of this signal.
(b)	(i) Determine the power of the signal $x(n) = \cos\left(\frac{\pi}{4}\right)n$. (ii) Show that the power of the signal $x(t) = \sum_{k=-n}^{n} c_k e^{j\Omega_k t}$ is

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$$P = \sum_{k=-n}^{n} |c_k|^2$$

Assuming all the frequencies to be distinct, that is $\Omega_i \neq \Omega_k$ for $i \neq k$.

4. **Attempt any *one* part of the following:** 7 x 1 = 7

(a)	Determine whether the following continuous time system $y(t) = x(t)x(t-1)$ is (i) static or dynamic (ii) linear or non-linear (iii) time variant or time invariant (iv) causal or non-causal
(b)	What is unit impulse function? Enlist the properties of the unit impulse function. Simplify the $y(t) = \int_{-2}^{\infty} 2Cos\,(2\pi t)\delta\left(t+\frac{1}{2}\right)dt$

5. **Attempt any *one* part of the following:** 7 x 1 = 7

(a)	Find the DTFT of (i) $x(n) = \sin\left(\frac{n\pi}{2}\right)u(n)$ and (ii) $x(n) = \left(\frac{1}{2}\right)^{n-1}u(n-1)$.
(b)	State and prove that $F[x_1(t) * x_2(t)] = X_1(w).X_2(w)$. Using Convolution Theorem of Fourier Transform to find $x(t)$. If the signals are $x_1(t) = te^{-t}u(t)$ and $x_2(t) = te^{-2t}u(t)$.

6. **Attempt any *one* part of the following:** 7 x 1 = 7

(a)	(i) State and prove the final theorem of the Laplace Transform. (ii) If the Laplace transform of $x(t)$ is $(s+4)\big/(s^2+12s+27)$. Determine the Laplace Transform of $y(t) = x(2t-1)u(2t-1)$
(b)	A causal LTI system is described by the difference equation $y(n) - 2y(n-1) + 3y(n-2) = x(n) + x(n-1)$. (i) Find the system function $H(z)$ for the system (ii) Plot the poles and zero of the system and indicate the ROC. (iii) Find the stability of the system.

7. **Attempt any *one* part of the following:** 7 x 1 = 7

(a)	What is power spectral density and auto-correlation? Determine the auto correlation of the given signal $x(t) = e^{-t}u(t)$.
(b)	State and prove the sampling theorem. Also discuss the effect of under sampling.