Code No: R1921043 **R19** SET - 1

II B. Tech I Semester Regular Examinations, March – 2021
SIGNALAS AND SYSTEMS
(Electronic Communication Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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1 a) Give expressions for determining the total energy (E_∞) of a continuous time signal and a discrete time signal. Find the total energy in, [8M]
$x(t) = e^{at}u(t)$(ii) $x[n] = 0.5^n u[n]$, n- integer.

b) Consider the discrete –time signal $x[n] = 1 - \sum_{k=3}^{\infty} \delta[n-1-k]$. Analyze the signal to determine the values of the integers M and n_0 so that $x[n]$may be expressed as [7M]

$$x[n] = u[Mn - n_0].$$

Or

2 a) Check whether the following signals are Energy or power Signals. Justify your answer. a) $x(t)=e^{-2t}u(t)$ b) $x[n]= (0.5)^n u[n]$ [8M]

b) Describe different types of continuous-time and discrete-time Test signals. [7M]

Or

3 a) Find the Fourier transform of the aperiodic signals [8M]
(i) $x(t) = e^{-a|t|}, a > 0$and (ii) $y(t) = \begin{cases} 1 & ,|t| < T_1 \\ 0 & ,|t| > T_1 \end{cases}$

b) State and prove the Time shifting and Time scaling property of the Fourier transform. [7M]

Or

4 a) State and prove duality property and find the F.T $\{\frac{1}{\pi t}\}$ [8M]

b) The frequency response of an LTI system is given by $H(w) = \frac{2+jw}{12+7jw-w^2}$ [7M]
Find i) Impulse response of the system?
ii) Output of the system when input $x(t) = e^{-2t}u(t)$

Or

5 a) A discrete LTI system describe by difference equation is given by [8M]
y[n]+3y[n-1]+2y[n-2]=2x[n]-x[n-1] and given y(-1)=0 & y(-2)=1 , x(n)=u(n)
Find i) Zero input Response ii) Zero State Response iii) Total Response

b) Illustrate the ideal LPF, HPF and BPF characteristics [7M]

Or

6 a) Discuss on Causality and Poly-Wiener criterion for physical realization [8M]

b) Perform the convolution of $h(t)=e^{-at}u(t)$ and x(t)=u(t)-u(t-b) [7M]

Or

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7 a) Explain Natural sampling and Flat top sampling? [8M]

b) Consider the signal x(t) =6 cos5πt+3 cos10πt . Find the minimum sampling rate if . [7M]
i) x(t) is band limited ii) x(t) is band pass signal .

Or

8 a) Derive the relation between Convolution and correlation. [8M]

b) Discuss about the process of extraction of signal from noise by filtering. [7M]

Or

9 a) Find the bilateral Laplace transform of the following signals and specify the ROC. [8M]
(i) $x(t) = e^{2t}u(-t) + e^{-3t}u(t)$, (ii) $y(t) = e^{-at}\cos(\omega_0 t)u(t)$

b) Find the inverse Laplace transform of [7M]

$$X(s) = \frac{3+4s}{s^2+6s+8}; ROC: Re\{s\} > -2$$

Or

10 a) Find the inverse Z-Transform of $X(z) = \frac{3z^2-5z}{z^2-3z+2}$; $ROC: |z| < 1$. [8M]

b) Find the Z- Transform of the signals with the corresponding ROCs [7M]
(i) $x[n] = -a^n u[-n-1]$(ii) $x[n] = cos(\omega_0 n)$u[n].

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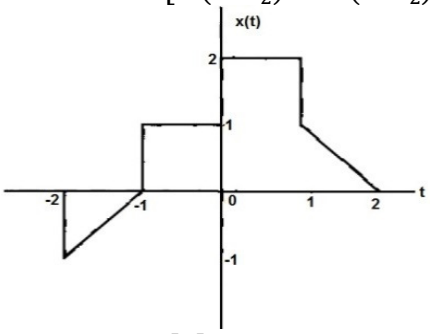
1 a) A continuous time signal $x(t)$ is shown in Fig. Apply transformations on the independent variables and sketch, label carefully each of the following signals. [8M]
i) $x(t-1)$ ii)$x(2t+1)$ iii) $x(t)\left[\delta\left(t+\frac{3}{2}\right)-\delta\left(t-\frac{3}{2}\right)\right]$



b) Comment on the (E_∞) of the signal $x[n]=u[n]$. Justify your answer using the relationship between (P_∞) and (E_∞). [7M]

Or

2 a) Analyze the following signals and find the periodicity of the signals and its fundamental period. [8M]
a) x(t)= sin 10πt+cos 15πt+20cos(20πt+π/4)
b) x[n]= sin (3π/5)n.

b) Illustrate Energy and power signals. [7M]

Or

3 a) Describe the following [8M]
a) Properties of Fourier series
b) Dirichlet's conditions

b) Find the complex exponential Fourier series coefficients $c_k$for the continuous time periodic signal $x(t)=2+\cos\left(\frac{2\pi}{3}t\right)+4\sin\left(\frac{5\pi}{3}t\right)$ [7M]

Or

4 a) Describe a) Fourier transform of arbitrary signal, b) Fourier transform of standard signals, c) Fourier transform of periodic signals. ``

b) Derive the Fourier transform from Fourier series. [7M]

Or

5 a) Describe about a) Linear time invariant (LTI) system, b) Linear time variant (LTV) system. [8M]

b) What is the purpose of Convolution? Represent the sequence $x[n]=\{1,2,-3,-1,2\}$ as a sum of weighted impulse sequences. [7M]

Or

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6	a)	Perform the convolution of the two sequences x[n]={3,2,1,2} and h[n]= {1,2,1,2}.	[8M]
	b)	Discuss about distortion less transmission through a system.	[7M]

Or

7	a)	Derive the expression for the reconstructed signal from samples taken with a sampling interval of Ts when interpolation is done using Sinc function.	[8M]
	b)	State and explain Parseval's theorem.	[7M]

Or

8	a)	Explain the process of detection of periodic signals in the presence of noise by correlation.	[8M]
	b)	What are the properties of correlation function?	[7M]

Or

9	a)	L.T $\{h(t)\}=\frac{1}{s^2-s-42}$, Find Inverse laplace Transform such that system is i) Causal ii)Stable iii) Anti-causal	[8M]
	b)	State and prove initial and final value theorem of Laplace Transform.	[7M]

Or

10	a)	Distinguish among Laplace, Fourier and Z transforms.	[8M]
	b)	Write down any six properties of ROC of Z-Transform.	[7M]

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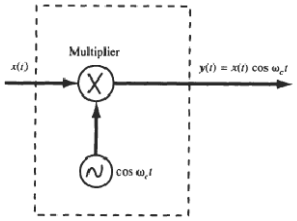
1 a) Determine whether or not each of the following signals is periodic. If a signal is periodic, determine its fundamental period. [8M]
(i)$x(t) = cos\frac{\pi}{4}t + sin\frac{\pi}{3}t$ (ii) $x(t) = \cos t + \sin\sqrt{2}\,t$

b) Explain how a function can be approximated by a set of orthogonal functions [7M]

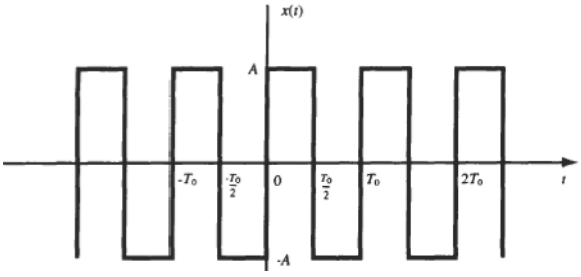
Or

2 a) Consider the system shown in Fig. Determine whether it is (a) memoryless, (b) causal, (c) linear, (d) time-invariant, or (e) stable. [8M]



b) Obtain the condition under which two signals f_1 (t) and f_2 (t) are said to be orthogonal to each other. Hence prove that cos $n\omega_0 t$ and cos $m\omega_0 t$ are orthogonal over any interval (t_0, $t_0 + 2\pi/\omega_0$) for integer values of n and m. [7M]

3 a) Consider the periodic square wave ***x (t)*** shown in Fig. [8M]
Determine the complex exponential Fourier series of x(t).



b) Obtain the Fourier Transform of the following functions [7M]
(a) DC signal (b) Unit step function

Or

4 a) Find the Fourier transform of the signal $x(t) = e^{-a|t|}, a > 0$ and plot its magnitude spectrum. [8M]

b) Discuss the concepts of Trigonometric Fourier series and derive the expression for coefficients. [7M]

5 a) The input ***x (t)*** and the impulse response ***h (t)*** of a continuous time LTI system are given by $x(t) = u(t), h(t) = e^{-\alpha t}u(t), \alpha > 0$. Compute the output y(t) [8M]

b) Consider the system described by differential equation $y'(t) + 2y(t) = x(t) + x'(t)$. Find the impulse response of the system [7M]

Or

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6 a) The input signal x(t) and impulse response h(t) of an LTI system is given by $x(t) = 2u(t), h(t) = 2e^{-t}u(t)$. Determine the output y(t) of the system. [8M]

b) Test the stability and causality of the following LTI system whose impulse response is [7M]

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

7 a) Explain briefly detection of periodic signals in the presence of noise by correlation. [8M]

b) Determine the Nyquist sampling rate and Nyquist sampling interval for the below signals. [7M]

i) x(t) =3cos4π500t cos2π1000t.

ii) x(t) =3 sinπ50t+9 cos2π10t+3 Sin8π50t.

Or

8 a) Determine the autocorrelation function and energy spectral density function of $X(t)=e^{-at}u(t)$ [8M]

b) What is aliasing and explain different methods to avoid aliasing effect? [7M]

9 a) Determine the Laplace Transform for the below signals and plot it's region of convergence. [8M]

i) $x(t)=e^{-4t}u(t)+e^{-2t}u(-t)$ (ii) $x(t)= te^{-at}u(t)$

b) Consider the transfer function $H(Z)= 3/ ((1-1/3z^{-1})(1+1/4z^{-1}))$, determine it's inverse Z- Transform. [7M]

Or

10 a) Determine the inverse Laplace transform of [8M]

$$X(s) = \frac{2s+4}{s^2+4s+3}, Re(s) > -1$$

b) Determine the Z- Transform for the below signals and plot it's region of convergence. [7M]

i) $x[n]= (1/4)^n u[-n-1]+ (2)^n u[-n-1]$ (ii) x[n]= nu[n]

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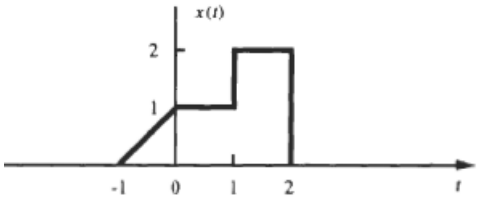
1 a) Determine whether the following signals are energy signals, power signals, or neither. [8M]
(i)$x(t) = e^{-at}u(t), a > 0$ (ii) $x(t) = tu(t)$

b) Obtain the condition under which two signals f1 (t) and f2 (t) are said to be orthogonal to each other. Hence prove that cos $n\omega_0 t$ and cos $m\omega_0 t$ are orthogonal over any interval (t_0, $t_0 + 2\pi/\omega_0$) for integer values of n and m. [7M]

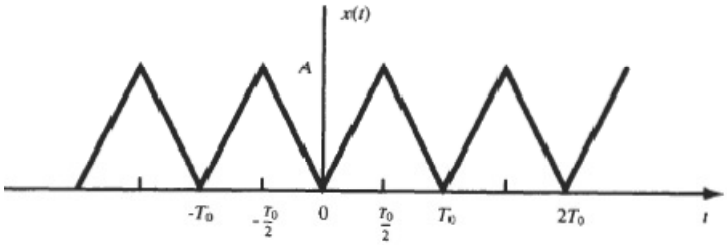
Or

2 a) A continuous-time signal *x(t)* is shown in Fig. 1-27. Sketch and label each of the following signals.(i)$x(t)u(1-t)$ (ii)$x(t)\delta(t-\frac{3}{2})$ [8M]



b) Define orthogonal functions. Give some examples of orthogonal functions [7M]

3 a) Consider the periodic wave ***x (t)*** shown in Fig. [8M]
Determine the complex exponential Fourier series of x(t).



b) Obtain the Fourier Transform of the following functions [7M]
(a) Impulse (b) Unit step function

Or

4 a) Find the Fourier transform of the signal$x(t) = \frac{1}{a^2+t^2}$ and plot its magnitude spectrum. [8M]

b) Define Fourier series and derive the relationship between Trigonometric Fourier series as Exponential Fourier series. [7M]

5 a) Compute the output *y(t)* for a continuous-time LTI system whose impulse response *h (t)* and the input *x (t)* are given by [8M]
$$h(t) = e^{-at}u(t), x(t) = e^{at}u(-t)$$

b) The step response ***s (t)*** of a continuous-time LTI system is given by $s(t) = [cosw_0 t]u(t)$. Find the impulse response of the system [7M]

Or

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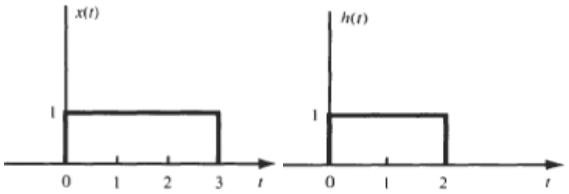
6 a) Determine convolution of the following continuous time signals [8M]



b) The following are the impulse responses of the LTI systems in continuous time. Determine whether each system is stable and/or causal. Justify your answer. [7M]

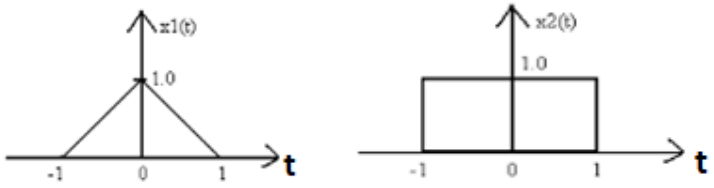
$$(i)\ h(t) = e^{-3t}u(t), (ii) h(t) = \log(t)$$

7 a) Prove that autocorrelation function and energy spectral density function forms a Fourier transforms pair. [8M]

b) Determine the Nyquist sampling rate and Nyquist sampling interval for the below signals. i) x(t) =3cos4π500t cos2π300t. [7M]
ii) x(t) =3 sinπ500t+9 cos2π100t+3 Sin8π500t.

Or

8 a) Find the Cross correlation between triangular and gate function as shown in below figure. [8M]



b) State and Prove sampling theorem for band limited signals. [7M]

9 a) A system described by a differential equation is given by $\frac{d^2y(t)}{dt^2} - \frac{dy(t)}{dt} + 12y(t) = x(t)$ and system is initially at rest. Determine it's output when input x(t)=4u(t)? [8M]

b) Determine the Z- Transform for the below signals and plot it's region of convergence. [7M]
i) $x[n]= (1/4)^n u[-n-1]+ (2)^n u[-n-1]$ (ii) $x[n]= n(5)^n u[n]$

Or

10 a) Calculate the Laplace transform of the signal $x(t) = e^{-a|t|}$ [8M]

b) A discrete LTI system describe by difference equation [7M]
y[n]+3y[n-1]+2y[n-2]=2x[n] and given y(-1)=0, y(-2)=1.
Determine the unit step response of the system.

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