Course Code: 19EC0403 **R19**

SIDDHARTH GROUP OF INSTITUTIONS:: PUTTUR (AUTONOMOUS) Siddharth Nagar, Narayanavanam Road – 517583 **QUESTION BANK (DESCRIPTIVE)** **Subject with Code: Signals, Systems and Random Processes (19EC0403)** **Course & Branch**: B.Tech - ECE **Year & Sem:** II-B.Tech & I-Sem **Regulation:** R19

UNIT –I

INTRODUCTION TO SIGNALS AND SYSTEMS

1	(a) Define various elementary signals and indicate them graphically (b) Find the Even and Odd Component of the signals below (i) $x(t)=e^{j2t}$ (ii) $x(n)=\{-3,1,2,-4,2\}$	[L1][CO1] [L3][CO1]	**[6M]** **[6M]**
2	What are the basic operations on signals? Illustrate with an example.	[L1][CO1]	**[12M]**
3	Explain the classification of signals in both continuous time and discrete time with suitable examples.	[L2][CO1]	**[12M]**
4	(a) Find which of the signals are causal or non-causal. (i) $x(t)= e^{2t} u(t-1)$ (ii) $x(n)=u(n+4)-u(n-2)$ (b) Sketch the following signals (i) $x(t)=2 u(t+2)- 2 u(t-3)$ (ii) $x(t)=r(t)-r(t-1)-r(t-3)+r(t-4)$	[L3][CO1] [L3][CO1]	**[6M]** **[6M]**
5	Find whether the following signals are periodic or not? If periodic, determine the fundamental Period. (a) $\sin 12\pi t$ (b) $\sin (10t+1)- 2\cos (5t-2)$ (c) $e^{j4\pi t}$	[L3][CO1]	**[12M]**
6	Determine whether the following signals are energy signals or power signals. Calculate their energy or power? (i) $x(t)=8 \cos 4t \cos 6t$ (ii) $x(t)= e^{j[3t+(\pi/2)]}$ (iii) $x(n)=(1/2)^n u(n)$	[L3][CO1]	**[12M]**
7	Define a system. How are systems classified? Define each one of them with examples	[L1][CO1]	**[12M]**
8	Check whether the following system is (a) Static or dynamic (b) Linear or Non- Linear (c) Time invariant or time variant $d^3y(t)/dt^3+2d^2y(t)/dt^2+4dy(t)/dt+3y^2(t)=x(t+1)$	[L2][CO1]	**[12M]**
9	Interpret whether the following systems are Static or dynamic, Linear or Non- Linear and Time invariant or time variant (a) $y(n) =\log_{10} \lvert x(n) \rvert$ (b) $y(t)=at^2 x(t)+bt\, x(t-4)$	[L2][CO1]	**[12M]**
10	(a) Discuss about Energy and Power signals. (b) Determine whether the following systems are stable or not. (i) $y(t)= (t+5) u(t)$ (ii) $h(n)=a^n$ for $0<n<11$	[L6][CO1] [L3][CO1]	**[6M]** **[6M]**

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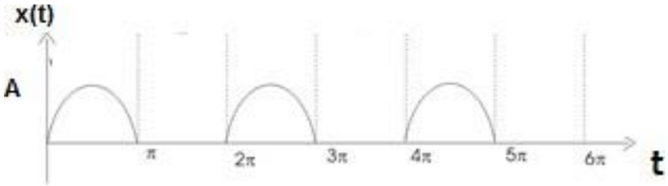
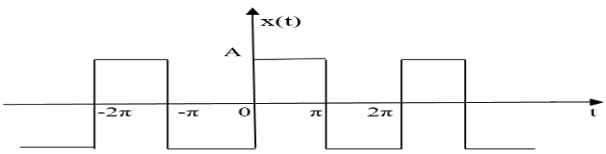
UNIT –II

FOURIER SERIES AND FOURIER TRANSFORM

1	Construct the Fourier series expansion of the Half wave rectified sine wave shown in figure.  	[L6][CO2]	**[12M]**
2	(a) State and Prove Linearity, Time Reversal Properties of Fourier Series. (b) State and Prove Time Shifting and Time Convolution Properties of Fourier Series	[L5][CO2] [L5][CO2]	**[6M]** **[6M]**
3	Develop the Exponential Fourier Series for the given signal below  	[L3][CO2]	**[12M]**
4	(a) Explain about representation of a signal in exponential Fourier series (b) Derive the Exponential Fourier series coefficient	[L2][CO2] [L3][CO2]	**[6M]** **[6M]**
5	(a) Demonstrate how Fourier Transform derived from Fourier Series. (b) Develop the Fourier transform of the following (i)impulse function (ii) $x(t)=e^{-at}u(t)$	[L3][CO2] [L6][CO2]	**[6M]** **[6M]**
6	(a) Find the Fourier transform of the following (i) $x(t)=sgn(t)$ (ii) $x(t)=u(t)$ (iii)$Cos\omega_0 t$ (b) Discuss about Dirichlet's Conditions.	[L1][CO2] [L6][CO2]	**[6M]** **[6M]**
7	State and Prove any four properties of Continuous time Fourier transform.	[L6][CO2]	**[12M]**
8	Find the Fourier transform of the following signals (i) $x(t)=e^{-3t}u(t)$ (ii) $x(t)=te^{-at}u(t)$ (iii) $x(t) = e^{-t}\cos 5t\, u(t)$	[L1][CO2]	**[12M]**
9	Find the inverse Fourier transform of the following signals (i) $X(\omega)=\frac{4(j\omega)+6}{(j\omega)^2+6(j\omega)+8}$ (ii) $X(\omega)=\frac{1+3(j\omega)}{(j\omega+3)^2}$	[L1][CO2]	**[12M]**
10	(a) Explain about Fourier Transform of Periodic Signals. (b) Find the Fourier Transform of the following signals using Properties (i) $e^{-at}u(t)$ (ii) $\delta(t+2)+\delta(t+1)+\delta(t-1+\delta(t-2)$	[L2][CO2] [L1][CO2]	**[6M]** **[6M]**

UNIT –III

SIGNAL TRANSMISSION THROUGH LINEAR SYSTESMS

1	(a) Explain the Filter characteristics of linear systems and explain with neat diagrams (b) Define the following (i)Impulse Response (ii)Step Response (iii) Response of the System	[L2][CO3] [L1][CO3]	**[6M]** **[6M]**	
2	(a) Derive the Transfer function and impulse response of an LTI system. (b) Define Linear time variant, Linear time-invariant, step response of the system.	[L3][CO3] [L1][CO3]	**[6M]** **[6M]**	
3	Discuss the properties of linear time invariant systems.	[L2][CO3]	**[12M]**	
4	(a) Consider a stable LTI System characterized by the differential equation dy(t)/dt+2y(t)=x(t), Find its impulse response. (b) Discuss the Flowing (i) Linear Shift Invariant systems (ii) Transfer Function	[L3][CO3] [L2][CO3]	**[6M]** **[6M]**	
5	Consider a causal LTI system with frequency response H(ω)=1/4+jω, for a input x(t), the system is observed to produce the output y(t)=e^{-2t}u(t)- e^{-4t}u(t). Find the input x(t).	[L4][CO3]	**[12M]**	
6	Consider a stable LTI system that is characterized by the differential equation $d^2y(t)/dt^2$+4dy(t)/dt+3y(t)= dx(t)/dt+2x(t) find the response for an input x(t)=e^{-t} u(t).	[L4][CO3]	**[12M]**	
7	(a) State and prove the time convolution theorem with Fourier transforms. (b) State and prove the frequency convolution theorem with Fourier transforms.	[L6][CO4] [L6][CO4]	**[6M]** **[6M]**	
8	(a) Explain the properties of convolution. (b) Find the convolution of the signals, $x_1(t)= e^{-2t}\ u(t)$, $x_2(t)=e^{-4t}\ u(t)$	[L2][CO4] [L3][CO4]	**[6M]** **[6M]**	
9	(a) Explain the procedure to perform convolution Graphically. (b) Examine the convolution of the following signals by graphical method x(t)=e^{-3t} u(t) and h(t)=u(t+3)	[L2][CO4] [L4][CO4]	**[6M]** **[6M]**	
10	(a) The impulse response of a continuous-time system is expressed as h(t)=e^{-2t} u(t). Find the Frequency response of the system (b) Define the Following Properties of LTI System (i) Distributive Property (ii) Associative Property	[L3][CO3] [L1][CO3]	**[6M]** **[6M]**	

UNIT –IV

LAPLACE TRANSFORMS AND INTRODUCTION TO PROBABILITY

1	State and prove the any four Properties Laplace Transform	[L6][CO5]	**[12M]**
2	(a) Determine the Laplace transform of the signal $x(t)= e^{-at}\, u(t) - e^{-bt}\, u(-t)$ and also find its ROC (b) Find the Laplace transforms and region for the following signals (i)$x(t)=e^{-5t}\, u(t-1)$ (ii) $x(t)=e^{-a\|t\|}$	[L5][CO5] [L1][CO5]	**[6M]** **[6M]**
3	Determine the Laplace transform of the following signals using properties of Laplace transform (i) $x(t)=t\, e^{-t}\, u(t)$ (ii) $x(t)=t\, e^{-2t}\sin 2t\, u(t)$	[L5][CO5]	**[12M]**
4	Illustrate the inverse Laplace transform of the following (i)$X(s) = 1/\, s(s+1)\,(s+2)\,(s+3)$ (ii) $X(s)=s/(s+3)(s^2+4s+5)$	[L3][CO5]	**[12M]**
5	(a) Discuss about the Linearity, Time Shifting and Time Reversal Properties of Laplace transform. (b) Explain the Laplace transform for any 3 standard signals.	[L2][CO5] [L5][CO5]	**[6M]** **[6M]**
6	Define the following with examples i. Sample space ii. Event iii. Mutually exclusive events. iv. Independent events	[L1][CO6]	**[12M]**
7	Explain about Joint and Conditional probability and also state the properties of Joint & Conditional Probability.	[L2][CO6]	**[12M]**
8	(a)Explain the concept of random variable (b) Examine the distribution function $F_{xx}(x,y)$ <table><tr><td>(X,Y)</td><td>(0,0)</td><td>(1,2)</td><td>(2,3)</td><td>(3,2)</td></tr><tr><td>P(x,y)</td><td>0.2</td><td>0.3</td><td>0.4</td><td>0.1</td></tr></table>	[L2][CO6] [L1][CO6]	**[6M]** **[6M]**
9	(a)Explain the probability distribution and density functions. (b)A random variable X has a pdf $f_x(x) = \begin{cases} C(1-x^4) & -1<x<1 \\ 0 & \text{Otherwise} \end{cases}$ Determine it 'C'	[L2][CO6] [L3][CO6]	**[6M]** **[6M]**
10	Let X is a continuous random variable with density function $f_X(x) = \begin{cases} x/9+k & 0<x<6 \\ 0 & \text{Otherwise} \end{cases}$ i) Find 'k' ii) Find $p[2<x<5]$	[L3][CO6]	**[12M]**

UNIT –V
RANDOM PROCESSES

1	Define Auto Correlation Function. State and explain any four properties of ACF.	[L2][CO6]	**[12M]**
2	Explain about first order, second, wide-sense and strict sense stationary process.	[L3][CO6]	**[12M]**
3	(a)Show that the autocorrelation function of a stationary random process is an even function of τ. (b) Explain the classification of Random Processes.	[L2][CO6] [L2][CO6]	**[6M]** **[6M]**
4	What is cross correlation function of a random process? State and explain any four properties of cross correlation function of a random process.	[L1][CO6]	**[12M]**
5	Prove the following (i) $\lvert R_{xx}(\tau)\rvert \leq R_{xx}(0)$ (ii) $R_{xx}(-\tau)= R_{xx}(\tau)$ (iii) $R_{xx}(0) = E[X^2(t)]$	[L6][CO6]	**[12M]**
6	Explain Distribution and Density function of a Random Process.	[L2][CO6]	**[12M]**
7	(a) Explain the concept of power spectral density. (b) Discuss the properties of power spectral density.	[L2][CO6] [L6][CO6]	**[6M]** **[6M]**
8	(a)Briefly explain the concept of cross power density spectrum. (b)Discuss the properties of cross power density spectrum.	[L2][CO6] [L2][CO6]	**[6M]** **[6M]**
9	(a) Briefly explain the concept of Random process. (b) Prove that the PSD of the derivative X(t) is equal to ω^2 times the PSD of Sxx(ω).	[L2][CO6] [L6][CO6]	**[6M]** **[6M]**
10	(a) If the PSD of x(t) is Sxx(ω). Find the PSD of dx(t)/dt. (b) The power spectral density of a stationary random process is given by $S_{xx}(\omega) = \begin{cases} A \; ; & -k < \omega < k \\ 0 \; ; & \text{otherwise} \end{cases}$ Find the auto correlation function.	[L3][CO6] [L3][CO6]	**[6M]** **[6M]**

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