Code No: RT21044 **R13** SET - 1

II B. Tech I Semester Regular Examinations, Jan - 2015
SIGNALS AND SYSTEMS
(Com. to ECE, EIE, ECC)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**
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PART – A

1. a) Define and sketch sinusoidal signal.
   b) Explain the Concept of Negative Frequency.
   c) What is the condition to be satisfied for the existence of Laplace transform?
   d) Define line spectrum.
   e) What is the effect of half wave symmetry on Fourier coefficients of a signal?
   f) Define linear system. When the system is said to be LTI system.
. g) Give the condition for Poly – Wiener criterion.
   h) Define signal bandwidth and system bandwidth.
   i) Find the energy of the signal $x(t)= e^{-at} u(t)$.

(2M+3M+2M+2M+3M+3M+2M+2M+3M)

PART – B

2. a) Explain how a function can be approximated by a set of orthogonal functions.
   b) Discuss the concept of trigonometric Fourier series and derive the expressions for coefficients. (6M+10M)

3. a) Find the Fourier transform of the signum function and plot its amplitude and phase spectra.
   b) State and prove the following properties of Fourier Transform
      i) Time shifting ii) Convolution in time domain (6M+10M)
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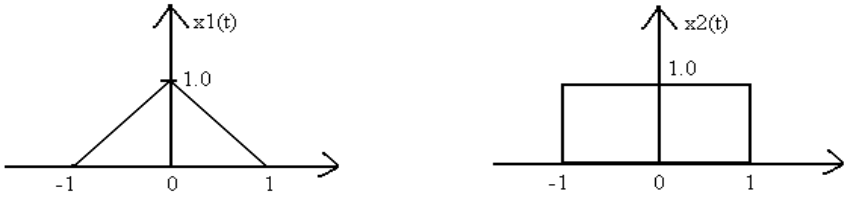
4. a) What is an LTI system? Explain its properties. Derive an expression for the transfer function of an LTI system.
   b) Obtain conditions for the distortion less transmission through a system. (10M+6M)

5. a) State the properties of convolution.
   b) Find the Cross correlation between triangular and gate function as shown in below figure. (6M+10M)



6. a) State the properties of ROC of Laplace Transform.
   b) Find the Laplace transform of the following signals
   i) Impulse function ii) unit step function iii) A sin w_0t u(t) (4M+12M)

7. a) Distinguish between Fourier transform, Laplace transform and z transforms.
   b) Prove that the sequences $x_1(n)=a^n$ u(n) and $x_2(n)= -a^n$ u(-n-1) have the same X(z) and differ only in ROC's. Plot their ROC's. (4M+12M)

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3. Answer any **THREE** Questions from **Part-B**

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PART – A

1. a) Define and sketch real exponential signal in different cases.
   b) Define complex frequency.
   c) List any three properties of impulse function.
   d) Define the transfer function of an LTI system.
   e) Write the Parseval's relation for continuous time periodic signals.
   f) What is impulse invariant transformation?
   g) What is aliasing, how to eliminate aliasing effect.
   h) Give the relation between autocorrelation and ESD.
   i) Obtain Fourier transform of signum function. (3M+2M+3M+2M+2M+2M+3M+2M+3M)

PART – B

2. a) Define orthogonal functions. Give some examples of orthogonal functions.
   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 $(t_0, t_0+\frac{2\pi}{\omega_0})$ for integer values of n and m. (4M+12M)

3. a) Explain how Fourier transform is developed from Fourier series.
   b) Obtain the Fourier transform of the following functions.
   i) Impulse function ii) DC signal iii) Unit step function. (4M+12M)
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4. a) Explain the characteristics of an ideal LPF. All ideal filters are physically not realizable: justify.
   b) Explain how Impulse Response and Transfer Function of a LTI system are related.
   c) Let the system function of a LTI system be 1/jw+2. What is the output of the system for an input (0.8)t u(t). (6M+4M+6M)

5. a) State and prove the relation between convolution and correlation.
   b) State the properties of auto correlation function.
   c) A signal x(t) has energy E, calculate the energy of the signal x(3t). (5M+4M+7M)

6. a) Define Laplace transform of signal x(t) and its region of convergence.
   b) When a function x(t) is said to be Laplace transformable?
   c) Find the Laplace transform of the following signal and its ROC.
   $x(t) = e^{-5t}\ [u(t) - u(t-5)]$ (4M+2M+10M)

7. a) Distinguish between one-sided and two sided z-transforms and its region of convergence.
   b) Find the inverse z- transform of $X(z) = \frac{z}{(z+2)(z-3)}$ when the ROC is
   i) ROC: |z| < 2 ii) ROC: 2 < |z| < 3 (4M+12M)

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**
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PART – A

1. a) Define causal and non causal signal. Give some examples.
   b) Write the expression for mean square error.
   c) List the properties of convolution.
   d) Give the importance of convolution and deconvolution operations using z-transform.
   e) State sampling theorem.
   f) What is the condition for stability of an LTI system?
   g) Give the relation between autocorrelation and PSD.
   h) What is impulse invariant transformation?
   i) Define signal bandwidth and system bandwidth. (3M+2M+3M+3M+2M+2M+2M+2M+3M)

PART – B

2. A rectangular function defined by f(t)= 1; $0 < t < -1$; $\pi < t < 2\pi$
   approximate the above function by a single sinusoid sin t, Evaluate mean square error in this approximation. Also show what happens when more number of sinusoidal are used for approximations. (16M)

3. a) State and prove sampling theorem for band limited signals using graphical approach.
   b) What is aliasing? Explain its effect on sampling. (10M+6M)
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4. a) Define the following properties for a continuous time system
   i) Causal or non causal ii) Time variant or time invariant
   iii) Linear or non linear iv) Stable or unstable.
   b) Examine the following systems with respect to the above properties
   i) $y(t)= \cos[x(t)]$ ii) $y(t)= \log_{10}|x(t)|$ (8M+8M)

5. a) Explain briefly detection of periodic signals in the presence of noise by correlation.
   b) Explain briefly extraction of a signal from noise by filtering. (8M+8M)

6. a) Define Laplace transform of signal x(t) and its region of convergence.
   b) State and prove initial value and final value theorems of Laplace transform.
   c) List the advantages and Limitations of Laplace transform. (4M+8M+4M)

7. a) What are the fundamental differences between continuous and discrete time signals?
   b) Explain the properties of the region of convergence of X (z).
   c) What are the methods by which inverse z-transform can be found out? (4M+6M+6M)

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART – A

1. a) State the condition for orthoganality of two complex functions.
   b) Write the expressions for trigonometric Fourier series coefficients a_0, a_n and b_n.
   c) List the properties of convolution.
   d) Write any two properties of Laplace transform.
   e) Find the Fourier transform of impulse function.
   f) Define transfer function of a system.
   g) Define correlation of a signal; give the expression for Auto and cross correlation.
   h) When a function x(t) is said to be Laplace transformable?
   i) Define periodic signal. Give the condition for periodicity of a discrete time periodic signal.
   (2M+3M+3M+3M+2M+2M+3M+2M+2M)

PART – B

2. a) Define and sketch the following elementary continuous time signals.
   i) Unit impulse signal ii) Signum function iii) unit step function
   b) Evaluate the following integrals
   i) $\int_{-\infty}^{\infty} \delta(t)\sin 2\pi t\, dt$ ii) $\int_{-\infty}^{\infty} [\delta(t)\cos t + \delta(t-1)\sin t]\, dt$
   c) Determine the power and rms value of the signal x(t)= u(t). (6M+6M+4M)

3. a) Define Fourier series and derive the relationship between trigonometric Fourier series and exponential Fourier series.
   b) Find the Fourier transform of the following functions.
   i) A single symmetrical triangular pulse. ii) A single symmetrical gate pulse.
   c) State the conditions for the existence of Fourier transform of a signal. (4M+10M+2M)
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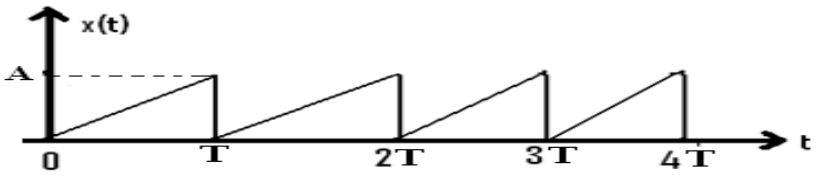
4. a) What is an ideal filter and Find impulse response of an ideal Low Pass Filter?
   b) Obtain the relationship between the bandwidth and rise time of ideal low pass filter.
   (8M+8M)

5. a) Prove that autocorrelation function and energy spectral density function forms a Fourier transforms pair.
   b) Determine the autocorrelation function and energy spectral density function of $x(t) = e^{-at}u(t)$ (8M+8M)

6. a) Define Laplace transform of signal x(t) and its region of convergence
   b) Find out the Laplace transform of the signal shown in below figure.



   c) List the advantages and Limitations of Laplace transform. (4M+8M+4M)

7. a) State and prove time shifting and time convolution properties of z- transform.
   b) Find the inverse Z-transform of (8M+8M)

$$X(Z) = \frac{z}{z(z-1)(z-2)^2} \qquad |Z| > 2$$