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

II B. Tech I Semester Supplementary Examinations, June - 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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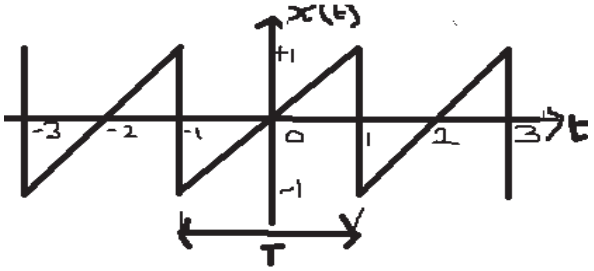
PART-A

1. a) Obtain the Fourier series coefficient 'b_n' for x[n]=sin w_0n ?
   b) Define Hilbert transform?
   c) Define System and signal bandwidth.
   d) Define Energy Spectral Density (ESD) and give the relation between ESD and auto correlation?
   e) Find the Laplace transform of the signal and its ROC of $x(t)=e^{-at}\,u(t)$.
   f) Find the Z-transform and its ROC of $\delta[n+k]$. (4M+3M+4M+3M+4M+4M)

PART-B

2. a) Find the trigonometric Fourier series for the periodic signal x(t) shown below.



   b) Find the complex exponential Fourier series coefficient of the signal x(t)=sin $3\pi\, t + 2\, cos 4\pi$t

3. a) Determine the Nyquist sampling rate and Nyquist sampling interval for The signal x(t) = $\text{sinc}^2\,(200\pi t)$.
   b) State and prove time convolution and time differentiation properties of Fourier Transform.

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4. a) A causal LTI system is described by $y[n]-\frac{5}{6}y[n-1]+\frac{1}{6}y[n-2]=x[n]$, where x[n] is the input to the system h[n] is the impulse response of the system. Find
   System function H(z)
   Impulse response h(n).
   b) Derive the relation between bandwidth and rise time.

5. a) Prove that the correlation and convolution functions are identical for even signals.
   b) Find the convolution of the following signals using graphical analysis:
   $x(t) = e^{-2t}\,u(t)$ and $h(t) = u(t + 2)$.

6. a) Find the Laplace transform of the signal $x(t) = e^{-at}\,u(t) + e^{-bt}\,u(-t)$
   b) Explain quantitatively how the signal is reconstructed from its samples

7. a) Find the signal corresponding to the z-transform $X(z)=\frac{1}{(1+0.2z^{-1})(1+0.2z^{-1})^2}$.
   b) Find the inverse z transform of X (z) using power series method, given $X(z)=\frac{1}{(1-az^{-1})}, |z| < |a|$.

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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 convergence of Fourier series.
   b) State and prove duality property of Fourier transform?
   c) Define Impulse response of a system and write the expression for transfer function in terms of input signal and output signal.
   d) List the steps involved in linear convolution.
   e) State the time scaling property of Laplace transform.
   f) Mention any two properties of ROC of Z-transform. (4M+3M+4M+3M+4M+4M)

PART-B

2. a) Given $x(t) = \begin{cases} \frac{1}{6}(t+2), & -2 \le t \le 4 \\ 0 & otherwise \end{cases}$. Then Sketch (i) x (t) (ii) x (t+1) (iii) x (2t) (iv) x($\frac{t}{2}$)
   b) Explain the classification of various signals.

3. a) A signal g(t) = $Cos(200\pi t) + 2Cos(280\pi t)$ is sampled at a sampling frequency of 300Hz. If the sampled signal is transmitted through an ideal LPF with cut-off frequency of 250Hz. What frequency component will present in the output?
   b) Determine the Fourier transform of a two sided exponential pulse $x(t) = e^{-|t|}$.

4. a) Define an LTI system. List the properties of LTI system and Explain.
   b) Prove that the Transmission of a pulse through a Low Pass Filter causes the dispersion of the pulse.
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5. a) Determine the output of an LTI system whose input and unit sample response are given as follows: $x(n) = b^n u(n)$ and $h(n) = a^n u(n)$.
   b) Derive the relation between PSDs of input and output for an LTI system.

6. a) Prove the scaling and time shifting properties of Laplace transform.
   b) Determine the Laplace transform of $x(t) = e^{-at} \cos wt \; u(t)$.

7. a) Determine the Z-transform and sketch the pole-zero plot with the ROC for each of the following signals: (i) $x[n] = (0.5)^n u(n) - (\frac{1}{3})^n u(n)$ (ii) $x[n] = (0.5)^n u(n) + (\frac{1}{3})^n u(n-1)$.
   b) State and prove initial and final value theorems of z-transform.

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2. Answer **ALL** the question in **Part-A**
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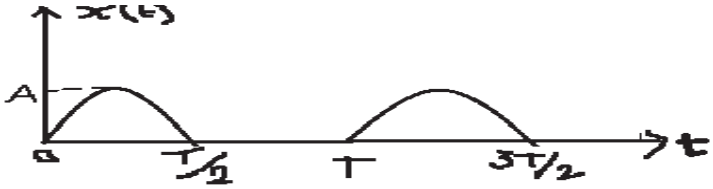
PART-A

1. a) State the Drichlet's conditions.
   b) State differentiation and integration properties of Fourier Transform both time and frequency domains.
   c) List the filter characteristics of linear systems.
   d) Determine the convolution of the signals x[n]={2, -1, 3, 2} and h[n]={1, -1, 1, 1}.
   e) Give the relationship between Fourier Transform and Laplace Transform.
   f) State the initial and final value theorems of Z-transform. (4M+3M+4M+3M+4M+4M)

PART-B

2. a) Obtain the trigonometric Fourier series for the half wave rectified sine wave as given below.



   b) Explain about complex Fourier spectrum.

3. a) Find the Fourier transform of a gate pulse of unit height, unit width and centered at t=0.
   b) Find the Fourier Transform of $f(t) = t\ Cos(2t)$.

4. a) Obtain the conditions for the distortion less transmission through a system.
   b) Let the transfer function of an LTI system be $\frac{1}{jw+2}$. What is the output of the system for an input $(0.8)^t u(t)$.

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5. a) Show that the cross correlation of $f(t)$ with $\delta(t - t_0)$ is equal to $f(t - t_0)$. Where $\delta(t-t_0)$ is delayed unit impulse function.
   b) Show that the auto-correlation function at the origin is equal to the energy of the function.

6. a) Find the inverse Laplace transform of X(s) $=\frac{1}{(s+5)(s-3)}$ for the ROCs.
   (i). $-5<\mathrm{Re}\{s\}<3$. (ii). $\mathrm{Re}\{s\} < 3$
   b) State and prove the initial and final value theorem of Laplace transform.

7. a) Find the Z-transform of the given signal x(n) and find ROC: X(n) = [sin(w_0n] u(n)
   b) Find the Inverse Z-transform using Residue method of the following:

$$X(z) = \frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}, |z| > 2.$$

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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) Explain about unit impulse and unit step signals.
   b) Define Nyquist rate.
   c) Define stability and causality of an LTI system.
   d) Define the convolution integral.
   e) How is Z-transform obtained from Laplace transform?
   f) Using Z-transform, check whether the following system is stable or not.

$$X(z)=\frac{z}{z-\frac{1}{2}}+\frac{2z}{z-3},\ \frac{1}{2}<|z|<3.$$

(4M+3M+4M+3M+4M+4M)

PART-B

2. a) Sketch the following signals: where r(t) is a unit ramp signal.
   (i).x(t) =r(-t+2) (ii). x(t) =-2r(t) (iii).x(t) =r(2t-4)
   b) Find the Fourier series coefficients of the signal x(t)=Sin(w_0t).

3. a) State and prove the sampling theorem for a band limited signals
   b) State and prove differentiation and integration properties of Fourier transform.

4. a) Find the response of an ideal low pass filter when unit step signal is applied as an input.
   b) What are the requirements of a system to allow the distortion less transmission of a signal?

5. a) Define auto-correlation and cross-correlation. Prove any two properties of correlation function.
   b) Find the Fourier transform of cross-correlation of $f_1(t)$ and $f_2(t)$.
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6. a Find the inverse Laplace transform of $X(s) = \frac{5s+13}{s(s^2+4s+13)}, \text{Re}(s) > 0.$

   b. Find the signal x(t) that corresponds to the Laplace transform

   $X(s) = \frac{3s^2+22s+27}{(s^2+3s+2)(s^2+2s+5)}.$

7. a) Find the Z-transform and ROC of the discrete signal $x[n] = [3(2^n) - 4.(3^n)]u[n].$

   b) Given $H(z) = \frac{z^2}{(z-0.5-j0.5)(z-0.5+j0.5)}$. Find *h[n]*.