Code No: R21044 **R10** SET - 1

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

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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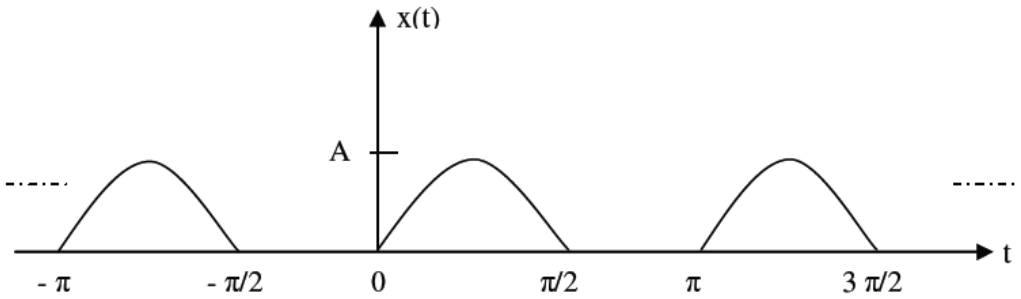
1. a)Define and sketch the following signals
   i) Signum Function
   ii) Impulse function
   iii) Unit step function
   b) Define mean square error and derive the expression for evaluating mean square error

2. a) Find the Fourier series expansion of the half wave rectified sine wave shown below.



   b) Find the even and odd components of the signal x(t)= sin t +cos t + cos t sint

3. a) Determine the fourier transform of the signal g(t)=A sinc2wt
   b) Write a short notes of the following
   i)Hilbert Transform ii)Modulation theorm

4. a) Find the impulse response of the system shown in figure 1 given below.Find the transfer function.What would be its frequency response .Sketch its response .

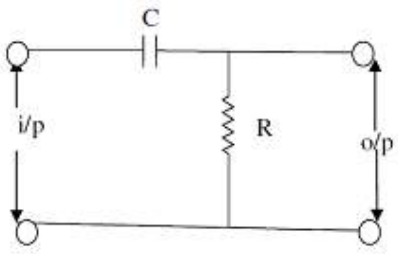


Figure 1

   b) List the properties of a LTI system and explain each property with an example.
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5. a) If y(t)= x(t)* h(t) then show that x(t-t1) * h(t-t2) = y (t-t1-t2)
   b) Derive an expression that relates energy spectral density and autocorrelation function.

6. a) The signal g(t)= 10 cos(20Πt)cos(200Πt) is sampled at the rate of 250 samples per second. What is the Nyquist rate for g(t) as a low pass signal and determine the lowest permissible sampling rate for this signal ?
   b) State and explain sampling theorem for continuous signals?

7. a) Define Laplace transform and state the necessary conditions for its existence. List out its advantages and disadvantages.
   b) Determine the inverse Laplace transform of the following

   i) $\frac{S^3+1}{S(S+1)(S+2)}$ ii) $\frac{S-1}{(S+1)(S^2+2S+5)}$

8. a) The z-transform of a particular discrete time signal x(n) is expressed as

   $X(Z)=\frac{1+0.5Z^{-1}}{1-0.5Z^{-1}}$ Determine the x(n) using the time shifting property1.
   b) Explain the differentiation property of Z-transform?

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1. a))A rectangular function f(t) is defined by

$$f(t)=\begin{cases}1, & 0<t<\pi\\ -1, & \pi<t<2\pi\end{cases}$$

Approximate this function by a wave form 'Sin t' over the interval (0,2Π)such that the mean square error is minimum.

b) Explain how a function can be approximated by a set of orthogonal functions.

2. a) Consider the periodic square wave x(t) as shown in figure 1 given below.Determine the complex exponential Fourier series of x(t).

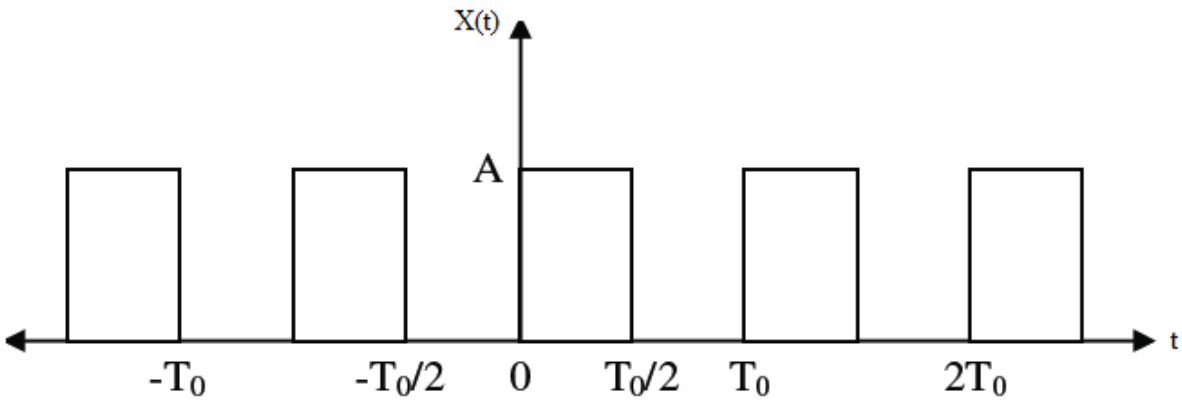

Figure 1

b) State and prove the following fourier series properties.
i) Time Shift ii) Frequency shift

3. a) Determine the Fourier transform of the signal g(t)= 2 Sinc2wt
b) Find the Fourier Transform of Impulse function and Signum function

4. a) How can you verify a system is distortion less and explain the same with required details?
b) List out the properties of a LTI system and explain each property with a relevant example.
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5. a) Compute the convolution sum y(n) to the following pair of sequences:

   i) x(n)=y(n),h(n)= 2^n u(-n) ii) x(n)=$(1/2)^n$ u(n), $h(n)=\frac{1}{2}\delta(n-1)$

   b) State and prove convolution property of Fourier transforms.

6. a) Discuss sampling of continuous time signals.
   b) Find the Nyquist rate and Nyquist interval for the signal
   x(t)=1/2 cos (4000Πt)cos(1000Πt)

7. a) Discuss various properties of ROC's for Laplace transform.
   b) Determine the inverse Laplace transform of the following

   i) $\frac{s^3+1}{s(s+1)(s+2)}$ ii) $\frac{s-1}{(s+1)(s^2+2s+5)}$

8. a) Determine the inverse Z-transform of the following X (z) by the partial fraction expansion method. $X(z)=\frac{z+2}{2z^2-7z+2}$ If the ROC's are

   i) |z|>3 ii) |z|<1/2 iii) 1/2<|z|<3

   b) Explain the differentiation property of Z-transform.

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1. a) Check whether the following signals are orthogonal or not
   $X_1(n)=e^{jk(\Pi/8)n}$ and $X_2(n)= e^{jm(2\Pi+/ \Pi /8)n}$
   b) A rectangular function f(t) is defined by
   $$f(t)=\begin{cases} 1, & 0<t<\pi \\ -1, & \pi<t<2\pi \end{cases}$$
   Approximate this function by a wave form Sin t over the interval (0,2Π) such that the mean square error is minimum.

2. a) State all the properties of Fourier series.
   b) Derive the relationship between trigonometric and exponential Fourier series coefficients.

3. a)Find the inverse Fourier transform of the following:
   i) $X(w)=\frac{1}{(a+jw)^2}$ ii) $X(w)=\frac{1}{a-jw}$
   b) Write a short notes of the following i)Hilbert Transform ii)Modulation theorem

4. a) Draw the ideal characteristics of Low pass, High pass, Band pass and Band stop filters.
   b) Test the linearity, causality, time variance, stability of the system governed by the equation.
   i)y(n)=ax(n)+b ii)y(n)=ncos[x(n)]
   iii)$y(n)=n[x(n)]^2$ iv)y(n)=x(n)+nx(n-1)

5. a) A system has an input x(t)= u(t) and $H(w)=\frac{1}{(1+jw)}$. Find energy spectral density of the output.
   b) Find the convolution of the following signals $x_1(t)=e^{-t}u(t)$, $x_2(t)=e^{2t}u(t.)$

6. a) Discuss different sampling techniques.
   b) Explain the effect of under sampling aliasing.
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7. a) Define Laplace transform. Distinguish between Laplace transform and continuous time Fourier transforms.
   b) Find the output response y(t) of the RC low pass network as shown in the figure 1 given below due to the input $x(t) = t\, e^{t/Rc} u(t)$ convolution.

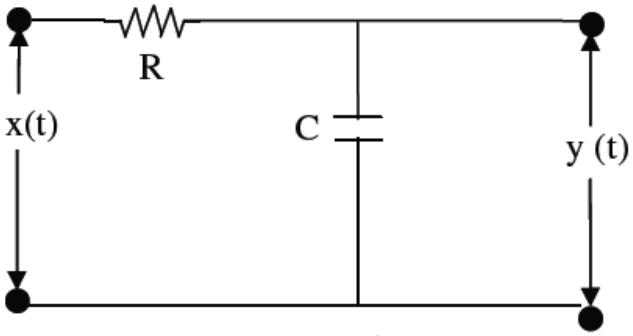

Figure 1

8. a) Determine the final value of the signal corresponding to the Z-transform

$$X(z) = \frac{2z}{1 - 1.8z^{-1} - 8z^{-2}}$$

   b) Explain different properties of ROC of Z transform.

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1. a) Derive the condition for the two signals $x_1(t)$ and $x_2(t)$ to be orthogonal to each other.
   b) Define mean square error and derive the expression for evaluating mean square error

2. a) Explain about Dirichlet's conditions?
   b) Explain the concept of complex Fourier spectrum with an example?

3. a) Find the Fourier transform of the triangular pulse

$$x(t) = \begin{cases} A\ (1-|t|/T); & |t| > T \\ 0 \qquad\qquad\ ; & |t| > T \end{cases}$$

   b) State and prove the following properties of Fourier transform:
   i) Multiplication in time domain ii) Convolution in time domain

4. a) What is an LTI system? Explain its properties.
   b) Find the impulse response of the system shown in the Figure 1 given below. Find the transfer function. What would be its frequency response? Sketch the response.

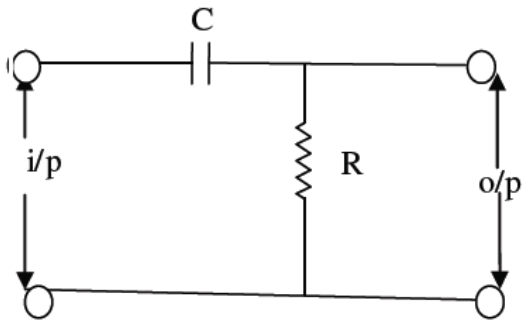

Figure 1

5. a) Write short notes on cross correlation and its properties.
   b) Find the power, rms value and sketch the PSD for the following signal.
   X(t) = (A+sin100t)cos200t
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6. a)Determine the Nyquist rate for a continuous time signal
   x(t)= 6 cos 50Π t+20 sin 300Π t+10 cos100Πt
   b) Explain the following terms:
   i) Natural sampling ii) Importance of sampling theorem

7. a)State and prove initial and final value theorem wrt Laplace transform
   b) Determine the Laplace transform of the following:
   i) x(t)=sin(at) cos (bt)
   ii) x(t)=Cos^3 3t
   iii) x(t)=t sinat

8. a) Determine the inverse Z-transform of the following X(z) by the partial fraction expansion method.

$$X(z)=\frac{z+2}{2z^2-7z+2}$$

   If the ROC's are
   i) |z|>3 ii) |z|<1/2 iii) 1/2<|z|<3
   b) Explain different properties of ROC of Z transform