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

II B. Tech I Semester Supplementary Examinations, September - 2014
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 signal. Classify signals with examples.
   b) Determine energy and power of the following signals
   i)10sin(10t)cos(30t) ii) 20cos(100t+60°)

2. a) Define continuous time Fourier series. List out some of its properties.
   b) Determine the Fourier series representation of the signal show in Figure 1. Sketch its magnitude and phase spectra.

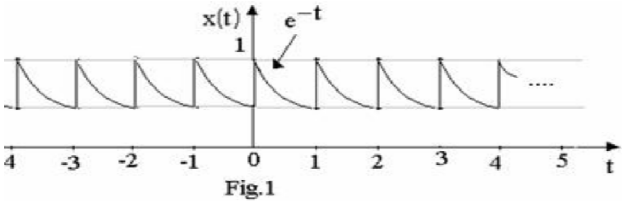

Fig.1

3. a) State and prove following properties of a Fourier transform
   i) Symmetry Property ii) Scaling property iii) Time-shifting property
   b) Discuss about the relationship between Fourier series and Fourier transform.

4. a) Show that the product of *bandwidth* and *rise time* is constant.
   b) Using graphical technique find the convolution of $x(t) = e^{-t}\,u(t)$ and $y(t) = \text{rect}(t/2)$

5. a) Explain filter characteristics of linear systems. What are the conditions to obtain distortion less transmission through the linear systems?
   b) Obtain relationship between rise time and bandwidth of a low pass filter when unit step signal is applied.

6. a) State and prove the sampling theorem.
   b) With necessary derivation explain the operation of a reconstruction filter.

7. a) Find the Laplace transform of the following signals i) $e^{-2t}\cos 3t$ ii) sinh(at)
   b) Find the inverse Laplace transform of the transfer function $H(s) = \dfrac{(s+1)(s+3)}{(s+2)(s+4)}$

8. a) A causal system is described by $H(z) = \dfrac{1+z^{-1}}{(1-az^{-1})(1-bz^{-1})}$. For what values of a and b will the system be i) unstable, ii) non causal?
   b) State and prove initial and final value theorems of z-transform.
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Code No: R21044 **R10** SET - 2

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1. a) What is the relationship between unit step and unit impulse functions? Prove it.
   b) Derive an expression for mean square error.

2. a) Find the Fourier series of the periodic impulse train shown in Figure 1.

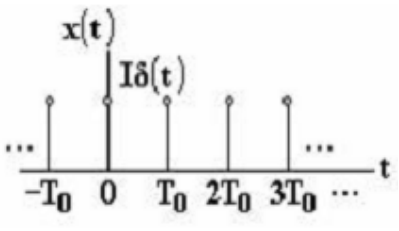

Figure 1

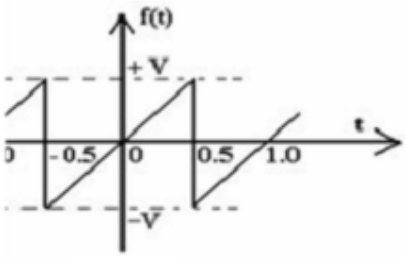

Figure 2

   b) Find the trigonometric Fourier series of the wave form shown in Figure 2.

3. a) State and prove the following properties of Fourier Transform:
      i) Time-shifting property ii) Differentiation in frequency-domain

   b) Consider $x(t) = e^{-2t}\,u(t)$ and $h(t) = u(t-1)$ corresponding to an LTI system. Determine y(t) using Fourier transform.

4. a) Define filter and give classification filters. Discuss about the ideal characteristics of filters.
   b) If $h_1(t)=\delta(t)$, $h_2(t)=\delta(t-1)+2\delta(t-2)$, $h_3(t)=\delta(t+1)+2\delta(t+2)$ are impulse responses of three LTI systems, determine the impulse response of the system shown in Figure 3.

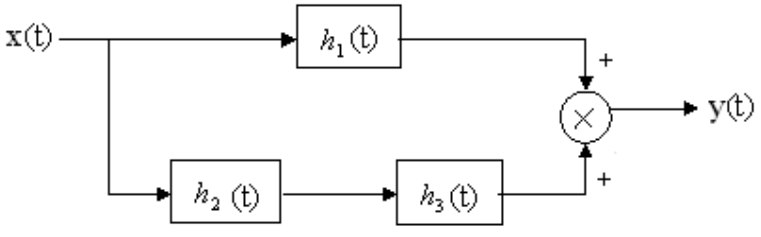

Figure 3
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5. a) Define convolution integral. State and prove convolution theorem for two continuous time signals.
   b) Define cross correlation and auto correlation. List out the properties of correlation functions.

6. a) What are the disadvantages of under-sampling? For a signal x(t), calculate Nyquist rate and Nyquist interval. x (t) = 3cos 25πt - 10 sin200πt + cos300πt.
   b) A continuous time signal is given as $x(t) = 8 \cos 200\pi t$ .Determine
      i) Minimum sampling rate
      ii) If f_s=400Hz, what is discrete time signal obtained after sampling.
      iii) If f_s=150Hz, what is discrete time signal obtained after sampling.

7. a) State and prove the initial and final value theorems of Laplace transform.
   b) If $F_1 = \frac{1}{s+2}$ and $F_2 = \frac{1}{s+3}$. Find the inverse Laplace transform of F(s) = F_1(s) F_2(s) using convolution property.

8. a) Obtain z-transform for
      i) $x(n) = a^n u(n)$
      ii) $x(n) = -a^n u(-n-1)$.
   b) Using partial fraction expansion find the inverse z-transform of $H(z) = \frac{z}{(z-1)(z-2)(z-3)}$
      with ROC i) |z| > 3 ii) |z| < 2.

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1. a) Define orthogonality of signals.
   b) Show that $\cos(\omega_0 nt)$ and $\cos(\omega_0 mt)$ are orthogonal over the interval $(t_0, t_0 + T_0)$, where $T_0 = \frac{2\pi}{\omega_0}$.
   c) Compute the integral: $\int_{-\infty}^{\infty} \delta(t-1)e^{-t}dt$.

2. a) Find the cosine Fourier series of an half wave rectified sine function
   b) State and explain Dirchlet's conditions.

3. a) State and prove the following properties of Fourier series i) Time differentiation property ii) Scaling property
   b) Find the line spectrum of half-wave rectified rise wave with period $2\prod$.

4. a) Describe the time and frequency domain criterion for physical realizability of LTI systems.
   b) State and explain the significance of Poly-Wiener criterion for causality.

5. a) Determine the auto correlation of sequence {1,1,2,3}.
   b) Determine the cross correlation of the following two signals $x_1(t) = A\cos(2\pi f_c t + \theta)$ and $x_2(t) = B\cos(2\pi f_c t + \theta)$ where θ is ranging from 0 to 2π.

6. a) Explain about natural and flat top sampling.
   b) Explain reconstruction of signal from its sample values using interpolation technique.

7. a) Find the Laplace transform of the following signals i) f(t)=10sin100πtu(t) ii) f(t)= cos20(t-2) u(t-2)
   b) Find the Inverse Laplace transform of $F(s) = \frac{3s+6}{(s+4)^2\,(s+1)}$

8. a) i) If $X(z) = 1+2z^{-1}+4z^{-2}$. Find the initial and final values of the corresponding sequence x (n).
      ii) Find the z transform of $x(n) = (1/3)^n u(n) - 3(1/2)^n u(n)$
   b) Using partial fraction expansion method determine the inverse z- transform of

$$X(z) = \frac{3 - \frac{5z^{-1}}{6}}{\left(1-\frac{z^{-1}}{4}\right)\left(1-\frac{z^{-1}}{3}\right)} \quad |z| > 1/3$$
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1. a) Show that the derivative of unit-step function is an impulse function.
   b) Find odd and even components of the following signals i) cost+sint cost ii) 1+tcost

2. a) State and explain any three properties of continuous time Fourier series.
   b) Find the FS of the signal $x(t) = e^{-t}; 0 \le t \le T_o = 1$, where T_o is the time-period of $x(t)$.

3. a) Find the continuous Fourier transform of a Rectangular pulse. Plot its magnitude and phase responses.
   b) State and prove time-integration and time-differentiation properties of Fourier transform.

4. a) Determine the following systems are linear time invariant or not
   i) $y(t) = t^2x(t-1)$ ii) $y[n] = x[n+1]-x[n-1]$ iii) $y[n] = x^2[n-2]$
   b) Explain different ways of realizing an LTI System.

5. a) What is an energy density spectrum and power density spectrum? Derive the relation between autocorrelation and power spectral density.
   b) Find the convolution of rect(t) with itself using graphic convolution.

6. Write short notes on:
   a) Aliasing effect
   b) Nyquist Sampling theorem

7. a) State and prove time differentiation and s-domain differentiation properties of Laplace transform.
   b) Find the Inverse Laplace transform of $F(s) = \dfrac{5s+4}{s^3+3s^2+5}$

8. a) Using z transforms find the convolution of x[n] = {1,2,-1,0,3} and y[n] = {1,2,-1}
   b) Using power series expansion method, determine the inverse z - transform of

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