Code No: 07A4EC19 **R07** **Set No. 2**

II B.Tech II Semester Examinations,December 2010
SIGNALS AND SYSTEMS
Common to Instrumentation And Control Engineering, Electronics And Computer Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Find the Fourier Transform of the following waveforms shown in figure 1a.

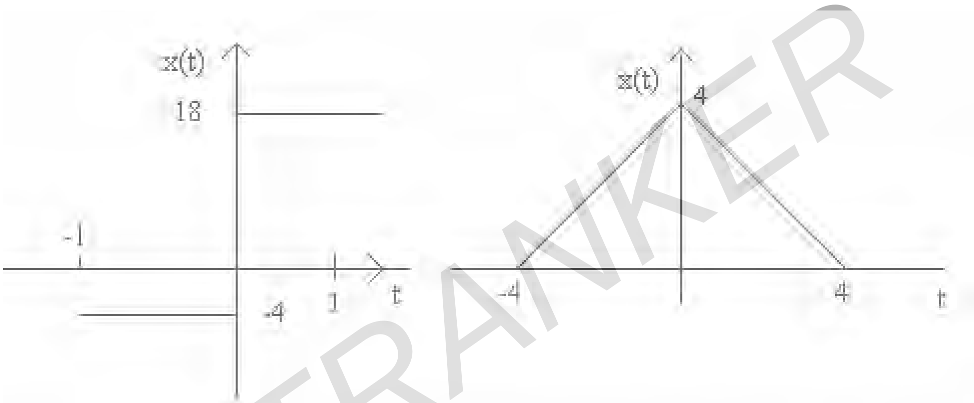

Figure 1a

(b) $If\ f(t)\ \leftrightarrow\ F(\omega)\ Show\ that$
$\frac{d^n t}{dt^n} \leftrightarrow (j\omega)^n F(\omega)$. [10+6]

2. (a) Explain the concept of generalized Fourier series representation of signal f(t).
(b) State the properties of Fourier series. [8+8]

3. (a) Determine the unilateral Z transform of the following signals, and specify the corresponding Regions of convergence:
i. $x_1[n] = \left(\frac{1}{4}\right)^n u\,(n+5)$
ii. $x_2[n] = \left(\frac{1}{2}\right)^{|n|}$
iii. $x_3[n] = \delta[n+3] + \delta[n] + 2^n u[-n]$
(b) Give the discrete time signal representation using complex exponential and sinusoidal components. [12+4]

4. (a) Obtain the Laplace transform of $e^{-at}\,Cos\,(\omega_c t + \theta)$
(b) Find the Inverse Laplace transform of
i. $\frac{s^3+1}{s(s+1)(s+2)}$
ii. $\frac{s-1}{(s+1)(s^2+2s+5)}$ [8+8]

5. (a) Derive Parseval's theorem from the frequency convolution property.
(b) Find the cross correlation between [u(t) + u(t- τ)] and e^{-t} u(t). [8+8]

6. (a) The transfer function of an ideal low pass filter is given by
$H(j\omega) = KG_w(\omega)e^{-j\omega t_0}$
Evaluate the unit step response of this filter.

(b) Find the output voltage V(t) of a network shown in figure 6b. when the voltage applied to the terminals ab is given by t e^{-t} u(t) [8+8]

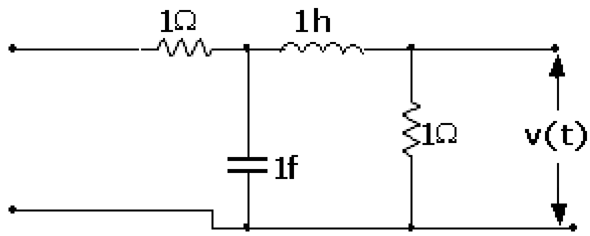

Figure 6b

7. (a) How we can reconstruct the original signal from sampled signal.

(b) What is an apecture effect? Explain why flat top samples get the aperture effect. [8+8]

8. (a) The two periodic functions $f_1(t)$ and $f_2(t)$ with zero dc components have arbitrary waveforms with periods T and $\sqrt{2T}$ respectively. Show that the component in $f_1(t)$ of waveform $f_2(t)$ is zero in the interval (-$\alpha < t <$ a).

(b) complex Sinusoidal signal x(t) has the following components.
$\mathrm{Re}\{x(t)\} = x_R(t) = A\mathrm{Cos}(\omega t+\theta)$
$I_m\{x(t)\} = x_I(t) = A\mathrm{Sin}(\omega t+\theta)$
The amplitude of x(t) is given by the square root of $x_R^2(t) + x_I^2(t)$. Show that this amplitude equals A and is therefore independent of the phase angle θ. [8+8]

⋆⋆⋆⋆⋆

Code No: 07A4EC19 **R07** **Set No. 4**

II B.Tech II Semester Examinations,December 2010
SIGNALS AND SYSTEMS
Common to Instrumentation And Control Engineering, Electronics And Computer Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆⋆⋆⋆⋆

1. (a) Given $x[n] = (-1)^n u[n] + \alpha^n u[-n - n_0]$, determine the constraints on the complex number ? and the integer n_0, given that the ROC of X(z) is $1 < |z| < 2$.
   (b) State the properties of convergence of Z transform. [8+8]

2. (a) Consider a continuous time LTI system with frequency response:
   $H(w) = \frac{a-j\omega}{a+j\omega}$ *where* $a > 0$
      i. What is the magnitude of H(ω)
      ii. What is 4H(ω)
      iii. What is the impulse response of this system?
   (b) Let the input to the system of part [a] be x(t) = e^{-bt} u(t) b > 0, What is the output y(t)
      i. When b $\neq$ a
      ii. when b = a. [8+8]

3. (a) Explain how Fourier Transform is developed from Fourier series.
   (b) Find the Fourier Transform of Cos ω_0t and draw the spectral density function. [8+8]

4. (a) Determine the inverse Laplace transform for the following Laplace transform and their associated ROC.
      i. $\frac{s+1}{(s^2+5s+6)}$ $\quad -3 < \mathrm{Re}\{s\} < -2$
      ii. $\frac{(s^2+5s+6)}{(s+1)^2}$ $\quad \mathrm{Re}\{s\} > -1$
   (b) Explain the constraints on ROC for various classes of signals, with an example. [10+6]

5. (a) Find the exponential Fourier series for the periodic waveform shown in figure 5a.

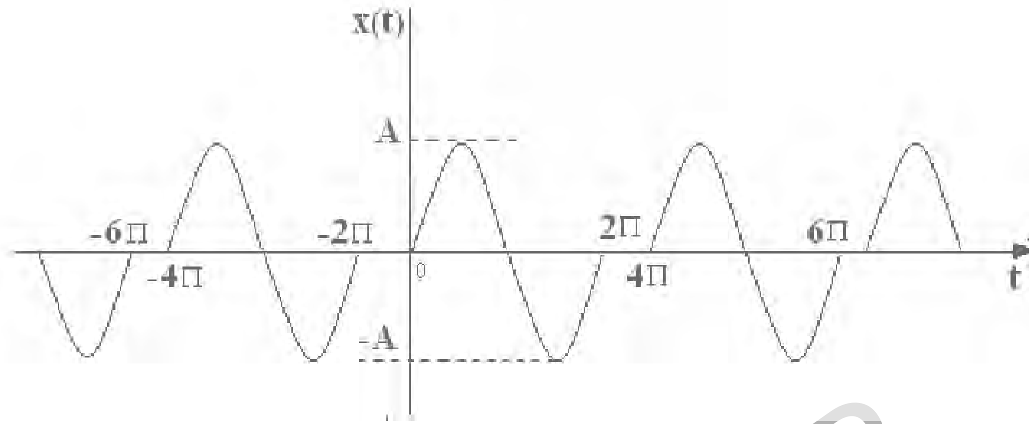

Figure 5a

(b) Find the average signal power of x(t)= Sin c(5t)$*\delta_3$(t). [10+6]

6. (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. [8+8]

7. (a) Let x(t) be a continuous time signal, and let $y_1(t) = x(2t)$, $y_2(t) = S\ x(t/2)$. Consider the following statements.

   i. If x(t) is periodic, then y_1(t) is periodic
   ii. If y_1(t) is periodic, then x(t) is periodic
   iii. If x(t) is periodic, then y_2(t) is periodic
   iv. if y_2(t) is periodic, then x(t) is periodic
   Determine if each of these statements is true, and if so, determine the relationships between the fundamental period of two signals considered.

   (b) Find the signal energy for the following signals:

   i. x(t) = 2 rect (-t)
   ii. x(t) = 2 Sin (300πt). [8+8]

8. (a) Explain the process of reconstruction of the signal from its samples. Obtain the impulse response of an ideal reconstruction filter.

   (b) In a system, two functions of time, x_1(t) and x_2(t) , are multiplied together, and the product w(t) is sampled by a periodic impulse train. x_1(t) is band limited to ω_1 , and x_2(t) is band limited to ω_2 ; that is,
   $X_1(j\omega) = 0, |\omega| \geq \omega_1$
   $X_2(j\omega) = 0, |\omega| \geq \omega_2$
   Determine the maximum sampling interval T such that w(t) is recoverable from wp(t) through the use of an ideal low pass filter. [8+8]

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A4EC19 **R07** **Set No. 1**

II B.Tech II Semester Examinations,December 2010
SIGNALS AND SYSTEMS
Common to Instrumentation And Control Engineering, Electronics And Computer Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. (a) State and prove the properties of Laplace transforms.
   (b) Derive the relation between Laplace transform and Fourier transform of signal. [8+8]

2. (a) A finite sequence x[n] is defined as x[n] = $[5, 3 \underset{\uparrow}{-2}, 0, 4, -3]$ Find X[Z] and its ROC.
   (b) Consider the sequence
   $x[n] = a^n \quad 0 \leq n \leq N-1, \; a > 0$
   $\quad = 0 \quad otherwise$
   Find X[Z].
   (c) Find the Z-transform of x(n) = cos($n\omega_0$)u(n). [6+5+5]

3. (a) A unit impulse voltage is applied to the RC circuit as shown in figure 3a.

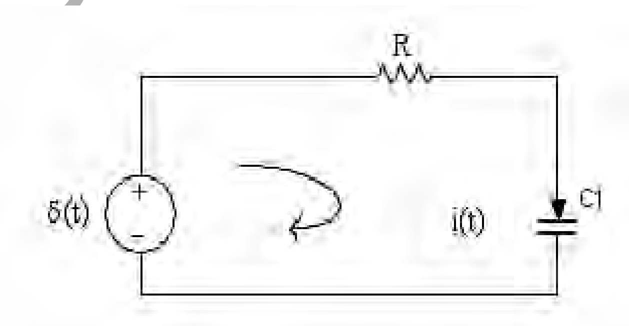

Figure 3a

   Find the current i(t) through the circuit.
   (b) Distinguish between the terms signal bandwidth and system bandwidth. [8+8]

4. A periodic waveform is formed by eliminating the alternate cycle of a Sinusoidal waveform as shown in figure 4.

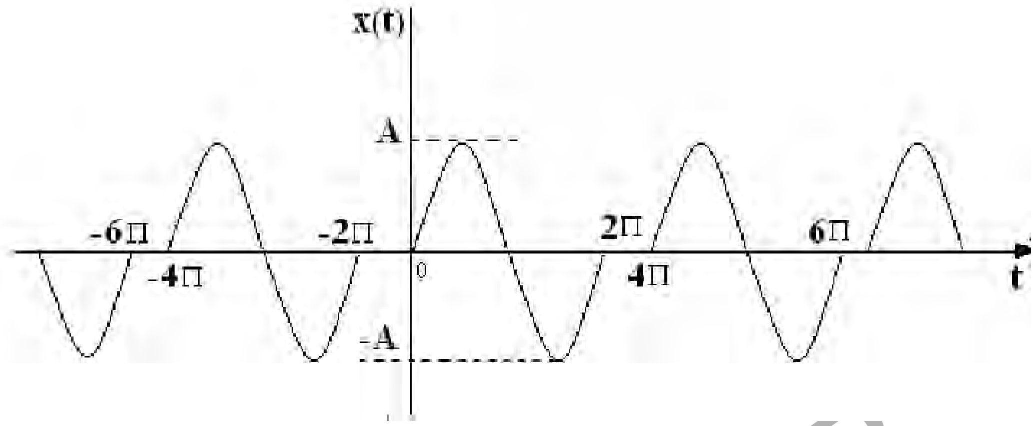

Figure 4

i. Find the Fourier series (exponential) by direct evaluation of the coefficients.

ii. If the waveform is shifted to the left by π seconds, the new waveform f(t+π) is odd function of the time whose Fourier series contains only sine terms. Find the Fourier series of f(t+π). From this series, write down the Fourier series for f(t). [8+8]

5. (a) Find the Fourier Transform for the following functions shown in figure 5a.

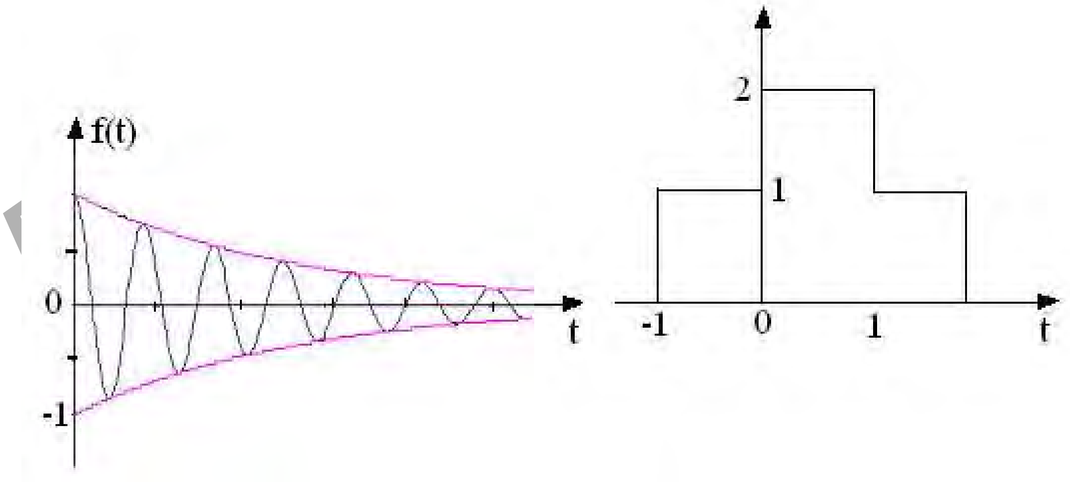

Figure 5a

(b) Find the total area under the function g(t) = 100 Sin c ((t-8)/30). [10+6]

6. (a) Approximate the rectangular function shown in figure 6a is orthogonal set of sinsoidal signals and show that mean square error is minimum..

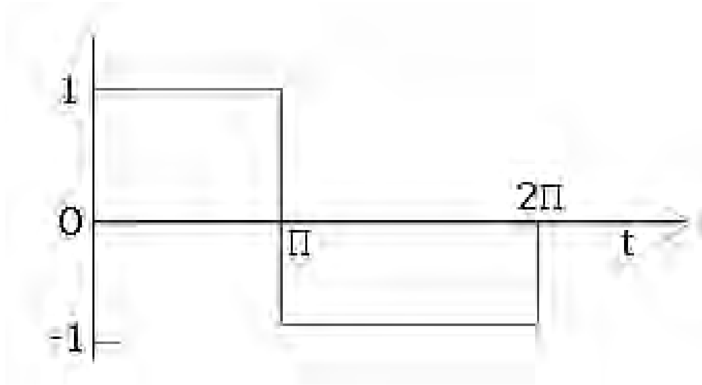

Figure 6a

(b) Prove that if $f_1(t)$ and $f_2(t)$ are complex functions of real variable t, then the component of $f_2(t)$ contained in $f_1(t)$ over the interval (t_1, t_2) is given by:

$$C_{12} = \frac{\int_{t_1}^{t_2} f_1(t) f_2^* dt}{\int_{t_1}^{t_2} f_2(t) f_2^* dt}.$$ [8+8]

7. (a) A signal x(t)= 2 cos 400 π t + 6 cos 640 π t. is ideally sampled at $f_s = 500$Hz. If the sampled signal is passed through an ideal low pass filter with a cut off frequency of 400 Hz, what frequency components will appear in the output.

(b) A rectangular pulse waveform shown in figure 7b below is sampled once every T_S seconds and reconstructed using an ideal LPF with a cutoff frequency of $f_s/2$. Sketch the reconstructed waveform for $T_s = 1/6$ sec and $T_s = 1/12$ sec. [8+8]

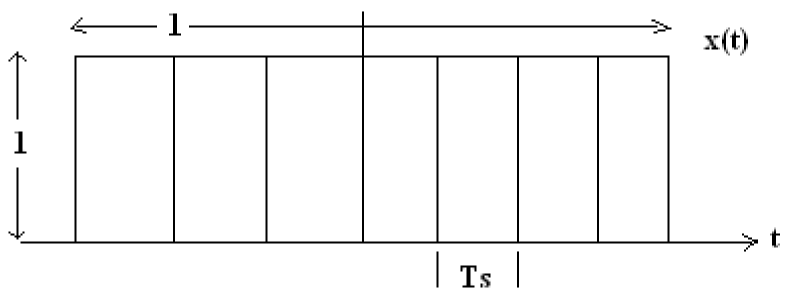

Figure 7b

8. (a) Derive the relation between auto correlation function and energy/power spectral density function

(b) Find the mean square value (or power) of the output voltage y(t) of the system shown in figure 8. If the input voltage PSD, $S_2(\omega) = \text{rect}(\omega/2)$. Calculate the power (mean square value) of input signal x(t). [8+8]

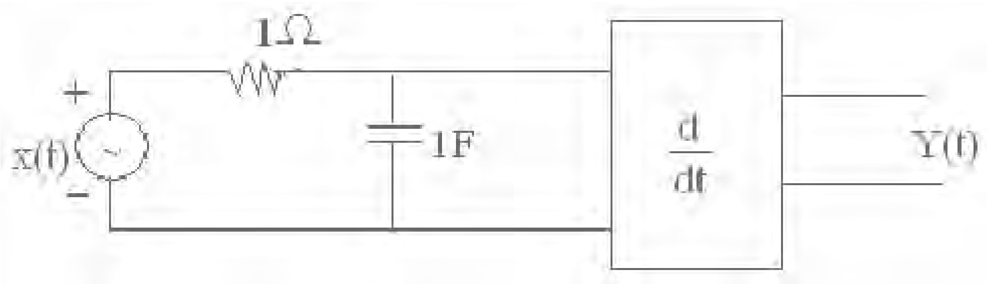

Figure 8

⋆ ⋆ ⋆ ⋆ ⋆

Code No: 07A4EC19 **R07** **Set No. 3**

II B.Tech II Semester Examinations,December 2010
SIGNALS AND SYSTEMS
Common to Instrumentation And Control Engineering, Electronics And Computer Engineering

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. (a) With the help of graphical example explain sampling theorem for Band limited signals.
   (b) Explain briefly Band pass sampling. [8+8]

2. (a) Explain about ideal filters.
   (b) Consider a linear system with the following response to δ(t-t):
   $h_\tau(t) = u(t-\tau) - u(t-2\tau)$
      i. Is this system time invariant
      ii. Is it causal. [8+8]

3. (a) State & Prove the properties of the z-transform.
   (b) Find the Z-transform of the following Sequence.
   $x[n] = a^n\, u[n]$ [8+8]

4. (a) Find the Fourier series of the wave shown in figure 4a.

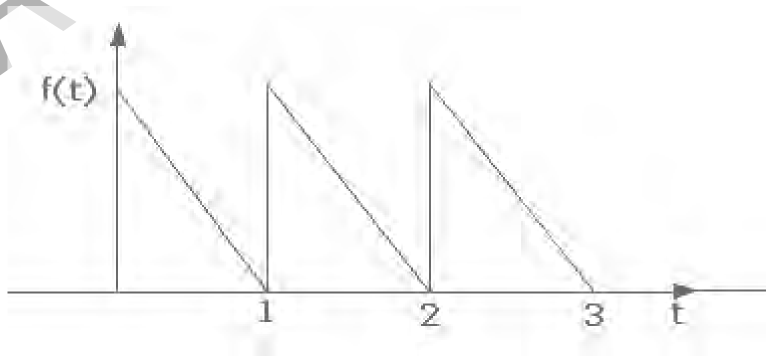

Figure 4a

   (b) Determine the Fourier series representation of
   $x(t) = 2\ \mathrm{Sin}\ (2\pi t\text{-}3) + \mathrm{Sin}\ (6\pi t)$. [8+8]

5. (a) An AM signal is given by
   $f(t) = 15\ \mathrm{Sin}\ (2\pi 10^6 t) + [5\ \mathrm{Cos}\ 2\pi 10^3 t + 3\ \mathrm{Sin} 2\pi\ 10^2 t]$
   $\mathrm{Sin}\ 2\pi\ 10^6 t$
   Find the Fourier Transform and draw its spectrum.
   (b) Signal x(t) has Fourier Transform $x(f) = \frac{j2\pi f}{3+j/10}$.
      i. What is total net area under the signal x(t).

ii. Let y(t) = $\int_{-\alpha}^{t} x(\lambda)d\lambda$ what is the total net area under y(t). [8+8]

6. Find the power of periodic signal g(t) shown in figure6. Find also the powers of

   (a) -g(t)

   (b) 2g(t)

   (c) g(-t)

   (d) g(t)/2. [4×4]

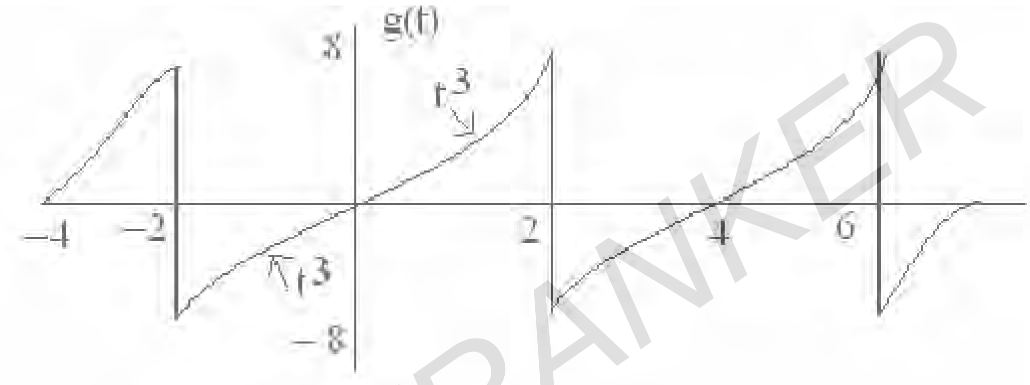

Figure 6

7. (a) Obtain the inverse laplace transform of F(s) = 1/s^2(s+2) by convolution integral.

   (b) Using convolution theorem find inverse laplace transform of s/(s^2+a^2)^2.

   (c) Define laplace transform of signal f(t) and its region of convergence. [6+6+4]

8. (a) The rectangular function f(t) in figure 8a is approximated by the signal 4π Sin t.

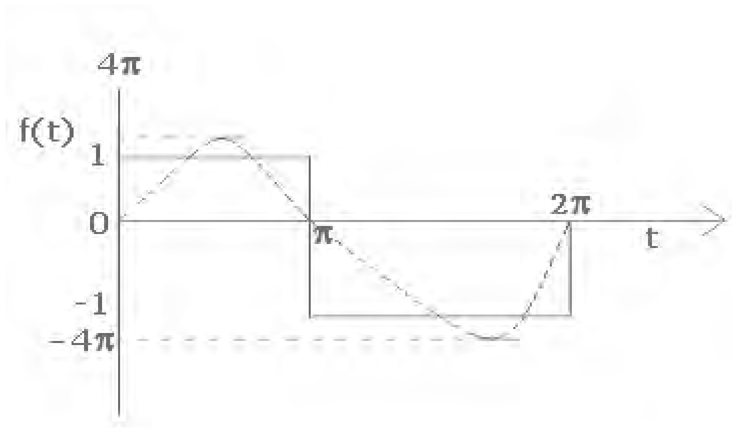

Figure 8a

show that the error function f$_e$(t) = f(t)-4/π Sin t is orthogonal to the function Sin t over the interval (0,2π).

   (b) Determine the given functions are periodic or non periodic.

i. a Sin 5t + b cos 8t
ii. a Sin (3t/2) + b cos (16t/15) + c Sin (t/29)
iii. a cos t + b Sin $\sqrt{2t}$
Where a, b, c are real integers. [10+6]

*****