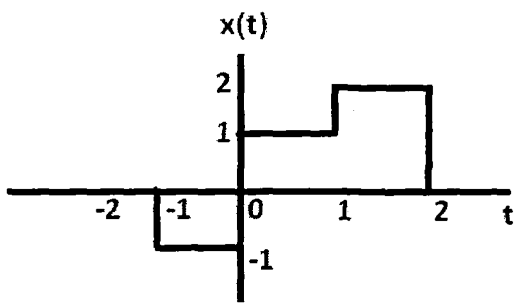
B.E. (ECE) (FT) DEGREE END SEMESTER EXAMINATIONS, NOV/DEC 2011
THIRD SEMESTER
EC 9203 Signals and Systems

Time: 3 Hours **Max.marks: 100**

Answer ALL questions

PART-A **(10X2=20 Marks)**

1. Determine if the signal x[n] given below is periodic. If yes, give its fundamental period. If no state why it is not periodic.
   $x[n]=\sin(\frac{5\pi n}{7})$
2. Consider a continuous time CT signal x(t) given in the below figure. Sketch the signal y(t) given by $y(t)= x(t+1)[\delta(t-3/2)-\delta(t+1/2)]$



3. A continuous time signal x(t) has a fundamental period T=4. The Fourier coefficients of x(t) are given by
   $$a_k = \begin{cases} jk, & |k| < 3 \\ 0, & otherwise \end{cases}$$
   Determine the signal x(t).
4. Let $X(j\omega)$ represent the Fourier transform of x(t). Determine the Fourier transform of x(4t+2).
5. Determine whether the system described by the impulse response $h(t)=e^{3t}u(-2-t)$ is causal and/or stable. Justify.
6. Consider an LTI system with transfer function H(s) given by $H(s)=\frac{1}{(s+1)(s+3)}$, Re{s}>3; Determine h(t).
7. Determine the inverse fourier transform of $X(j\omega)=2\pi\delta(\omega) + 2\pi\delta\left(\omega - \frac{\pi}{4}\right) + 2\pi\delta\left(\omega + \frac{\pi}{4}\right)$
8. Plot the spectrum of the periodic signal $x[n] = 4 + \cos(\frac{\pi}{3}n + \frac{\pi}{4})$.
9. Determine the DTFT of the signal x[n] given by $x[n]= \delta[n] + \frac{1}{2}\delta[n-1]$.
10. Determine h[n] for an LTI system whose transfer function is given by $H[z]=\frac{z^2}{(z+3)}$;$|z| > 3$.

PART-B **(5X16=80 Marks)**

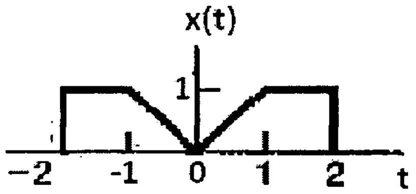
11. A continuous time system is described by its input output relation given by the following expression.

$$Y(t)=\begin{cases}0, & t<0\\ x(t)+x(t-4), & t\geq 0\end{cases}$$

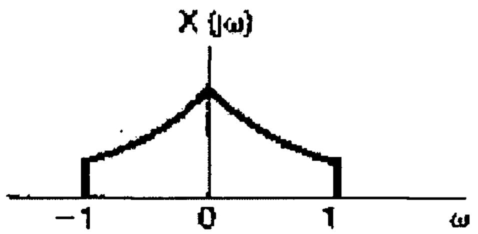
Determine whether the system possess the following characteristics or not. State with proof.

(i)Linearity , (ii) Time invariant (iii) Causal (iv) Stable (v) Inverse (vi) If inverse exists, derive the inverse system. (16)

12. (a) (i). Determine the Fourier transform of the signal x(t) given in the figure below. (8)



(ii).Consider a CT signal x(t) whose spectrum X(jω) is given in the figure below. Let m(t) be a CT signal expressed as m(t)=$\sum_{n=-\infty}^{\infty}\delta(t-4\pi n)$ Derive and plot the spectrum of the signal y(t)=x(t)m(t) (8)

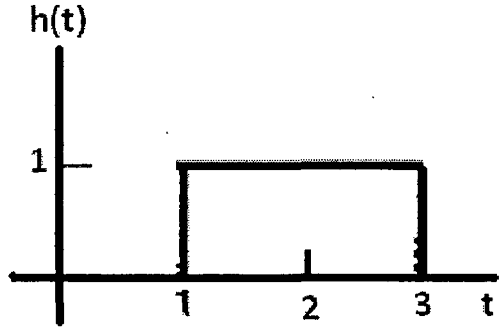


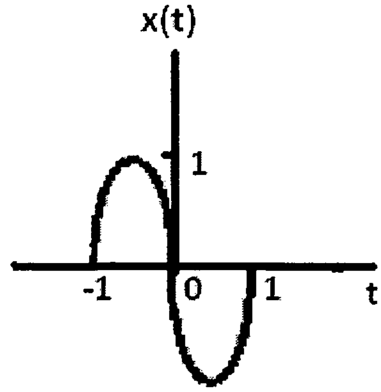
(OR)

(b) i. Determine the Laplace transform for the signal x(t) given by x(t)=$e^{-a|t|}$. Indicate ROC in the s- plane for (i) a<0 and (ii) a>0 (8)

ii. Consider the Laplace transform X(s) given by X(s)=$\frac{s+1}{s^2+6s+8}$. For the possible ROC's of X(s), derive the corresponding x(t). (8)

13. (a)(i). Consider an LTI system with impulse response h(t) shown below. If the signal x(t) shown below is given as input to this system, using convolution evaluate the expression the output y(t). (8)





(ii). The input and output of an LTI system is described by the following differential equation

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6 = 2x(t)$$

Determine the impulse response of the LTI system. What is the response of the system if the input to the system is given by $x(t)=te^{-3t}u(t)$. (8)

(OR)

(b) (i) Consider a causal LTI system with transfer function $H(s)=\frac{1}{s^2+2s+2}$. Let the input x(t) to the LTI system is given by $x(t)= e^{-3t}u(t)$. Determine the response y(t) and impulse response h(t). (8)

(ii) Consider an LTI system with an impulse response $h(t)=te^{-3t}u(t)$ and an input x(t) defined by $x(t)=te^{-4t}\,u(t)$. Use fourier transform to determine the frequency response Y(jω) and the response y(t). (8)

14. (a) (i).The spectrum X(jω) of a bandlimited signal x(t) is shown in the figure below. Determine and plot the spectrum of sampled signal if the signal is sampled at the rates (1) $\omega_s = 4\omega_m$ and (2) $\omega_s = 0.5\omega_m$. (8)

(ii). Determine the signal corresponding to the Fourier transform given by

$$X(e^{j\omega})=\sum_{k=-\infty}^{\infty}(-1)^k\delta(\omega - \tfrac{\pi}{4}k)$$ (8)

(OR)

(b) (i).Consider the signal x[n] given below. Determine its z-transform X(z), draw the ROC and mark the poles. (8)

$$x[n]=\begin{cases} \left(\frac{1}{5}\right)^n \cos\left(\frac{\pi}{8}n\right), & n \le 0 \\ 0 & , n > 0 \end{cases}$$

(ii). Determine the Fourier transform of the signal x[n] given by (8)

$$x[n]=\begin{cases} n, & -4 \le 0 \le 4 \\ 0, & otherwise \end{cases}$$

Q15. (a)(i).Consider an LTI system with impulse response $h[n]=\frac{\sin(\frac{\pi n}{4})}{\pi n}$. Determine the response y[n] for the input x[n] defined by $x[n]=\delta[n+2] + \delta[n-1]$ by computing the Fourier transform. (8)

(ii). Consider a discrete time LTI system with impulse response h[n]=$\left(\frac{1}{4}\right)^n u[n]$. Use Fourier transform to determine the response y[n] for the input signal x[n]=$(-1)^n$. (8)

(OR)

(b)(i). Determine whether an LTI system described by the transfer function H(z)=$\frac{z-\frac{1}{4}}{z^2+\frac{2}{3}z+\frac{1}{9}}$ is causal and/or stable without computing z transform. State with proof. (8)

(ii). Consider a causal LTI system whose input x[n] and output y[n] are related by

3y[n-2] + 4y[n-1] + 4y[n]=x[n]. Determine system transfer function H(z). Using H(z), determine the step response of the given causal LTI system. (8)