B.Tech. / B.E. Electronics & Communication/Telecommunication Engineering (Model Curriculum)
Semester-III

104 / 004 - Signals and Systems

P. Pages : 3 **GUG/W/23/13909**

Time : Three Hours * 7 4 9 6 * Max. Marks : 80

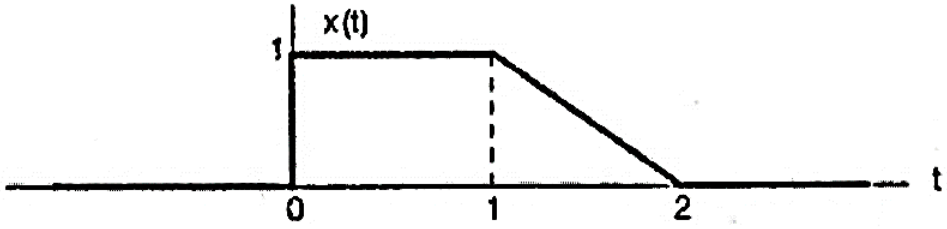
Notes : 1. All questions carry marks as indicated.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Determine whether the following signals are periodic or aperiodic, If periodic, determine its fundamental period. **8**

i) $x(t) = 4\cos \pi t + 3\sin 2\pi t + 2\sin 3\pi t$

ii) $x(t) = 4\cos 2\pi t + 3\sin 6t + 5\cos 6\pi t$

b) Given the signal x(t), draw the following signals. **8**



i) $X(t+1)$

ii) $X(-t+1)$

iii) $X\left(\frac{3}{2}t\right)$

iv) $X\left(-\frac{3}{2}t+1\right)$

OR

2. a) Define even and odd signals. Find the even and odd component of the following signals. **8**

i) $x(t) = \cos t + \sin t + \cos t \sin t$

ii) $x(t) = u(t)$

b) Define a system. How the systems are classified. Check whether the system $y(n) = x(n)\, x(n-1)$ is (Give Reasons). **8**

i) Linear or Non linear.
ii) Causal or Non causal.
iii) Time invariant or time variant.
iv) Static or dynamic.

3. a) Explain the concept of stability and causality in LTI systems. **8**
Check whether the following systems whose impulse response is given below are stable and causal.

i) $h(t) = te^{-t}u(t)$ $\quad h(n) = 2^n u(-n)$

b) Given **8**

$x(t) = e^{-at}u(t), a > 0$

$h(t) = u(t)$

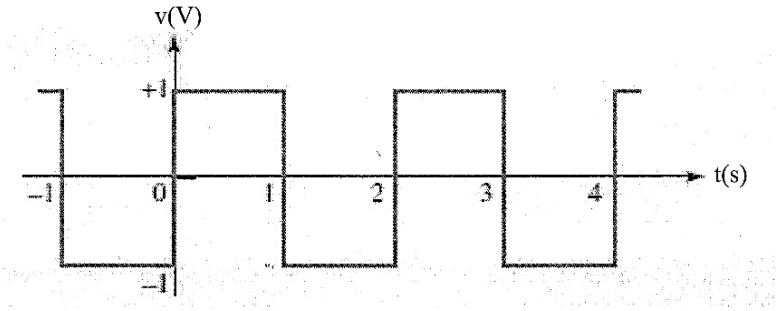
Find y(t) which denotes the convolution of x(t) and h(t).

OR

4. a) Find the output of an LTI system with impulse response $h(t) = u(t-3) - u(t-5)$ and input to the system is $x(t) = e^{-3t}u(t)$. **8**

b) Explain the properties of LTI system. Find the overall impulse response of the LTI systems if. **8**
i) Two LTI systems are connected in parallel.
ii) Two LTI systems are connected in cascade.

5. a) Find the Fourier series representation of the following signal. **8**



b) Prove time shifting property of Fourier transform. Using the property find Fourier transform of $e^{-t}u(t-2)$. **8**

OR

6. a) What are the conditions for the existence of Fourier series. Show that **8**

$$\frac{e^{j\theta} + e^{-j\theta}}{2} = \cos\theta$$

b) Find the Fourier transform of the signal shown in figure 2. **8**

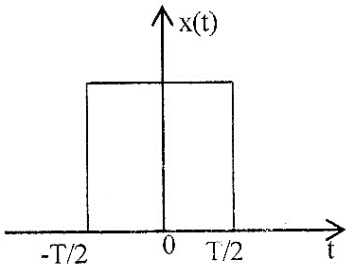


Figure 2

7. a) Obtain the z-transform of the following. **8**

i) $x(n) = \sin(\omega_0 n)u(n)$

ii) $x(n) = \cos(\omega_0 n)u(n)$

b) Consider the first order difference equation- **8**

$y(n) + 5y(n-1) + 6y(n-2) = x(n)$.

Assuming the initial conditions $y(-1) = 1, y(-2) = -1$, find the impulse response of the system.

OR

8. a) Find the inverse Laplace transform of the function given by $X(s) = \frac{2s+5}{(s+2)(s+3)}$ **8**

In the following cases.

i) $RoC: Re\{s\} > -2$

ii) $RoC: Re\{s\} < -3$

iii) $RoC: -3 < Re\{s\} < -2$

b) Prove the time shifting property of Laplace transform. Using the property find the Laplace transform of $x(t) = e^{-5t}\lfloor u(t) - u(t-5)$ and its RoC. **8**

9. a) An analog signal is given as $x_a(t) = \sin(100\pi t) + 2\sin(200\pi t) + 3\cos(300\pi t)$ **8**

i) What is the Nyquist rate of this signal.

ii) If the signal is sampled with Fs = 200 Hz, what is the discrete time signal obtained after sampling?

b) What is aliasing? Explain the concept with an example. **8**

OR

c) a) Draw and explain the reconstruction of signal from its samples using zero-order hold. **8**

b) State the sampling theorem. Explain impulse train sampling. **8**

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