**MUTHAYAMMAL ENGINEERING COLLEGE, RASIPURAM.**

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**QUESTION BANK**

| | | | |
|---|---|---|---|
| **Subject name** | **: SIGNALS AND SYSTEMS** | **Branch** | **: ECE** |
| **Subject Code** | **: 19ECC02** | **Year/Sem** | **: II/III** |

## UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS

**Part-A (2 marks)**

1. Define Signal.
2. Define System.
3. Define CT signals.
4. Define DT signal.
5. Define unit step, ramp and delta functions for CT.
6. State the relation between step, ramp and delta functions (CT).
7. State the classification of CT signals.
8. Define deterministic and random signals.
9. Define Random signal. [ Madras University, April – 96, May/June 2013 ]
10. Define power and energy signals.
11. Compare power and energy signals.

12. Define odd and even signal. [A.U Nov/Dec 2006]

13. Define periodic and aperiodic signals.

14. State the classification or characteristics of CT and DT systems.

15. Define linear and non-linear systems.
16. Is the system $y(t) = y(t-1) + 2t\, y(t-2)$ time invariant ? [A.U May/June 2009]

17. Check whether the given system is causal and stable..

18. Is diode a linear device? Give your reason. [May/June 2006]

19. Define stable and unstable systems.

20. Define Causal and non-Causal systems. [ Madras University, April – 95,99, Oct.-95]

**Part-B**

1. Explain in detail about the classifications of continuous time signals and discrete time signals. **[Madras Universtiy, April -96]**
2. Determine whether the following signals are periodic or nonperiodic. If the sequence is periodic determine its fundamental period.
   a. $\cos(0.01\pi n)$
   b. $\cos(3\pi n)$
   c. $\sin(3n)$
   d. $\cos\left(\frac{n}{8}\right)\cos\left(\frac{n\pi}{8}\right)$
3. Determine the following signals are energy signals or power signals and evaluate their normalized energy or power. **[April/May-2003]**
   a. $x(t) = e^{-3t}u(t)$
   b. $x(t) = \cos t$
   c. $x(n) = \left(\frac{1}{2}\right)^n u(n)$
   d. $x(n) = e^{-j\left(\frac{n\pi}{2}+\frac{\pi}{8}\right)}$
4. Find the even and odd components of the following signals.
   a. $x(t) = \cos t + \sin t + \cos t \sin t$
   b. $x(n) = \{-2, 1, 2, -1, 3\}$
5. With and example explain in detail about the classifications of continuous time and discrete time systems.
6. Determine whether the given system is time invariant and linear
   a. $y(t) = x(t) + x(t-100)$
   b. $y(n) - 4y(n-1) + 3y(n-2) = x(n)$
7. Verify the linearity and causality of the following systems.
   c. $y(t) = x(t^2)$
   d. $\frac{dy(t)}{dt} + 10y(t) = x(t)$ **[April/May-2003]**
   e. $y(n) = nx(n)$
8. State whether the following systems are 1)static 2)linear 3)shift invariant 4)causal 5)stable
   f. $y(n) = x(n) + 3u(n+1)$ $y(n) = g(n)x(n)$ here g(n) is another sequence.

## UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS

### PART-A(2 marks)

1. **What do the Fourier series coefficients represent?**

2. **State Dirichlet conditions for Fourier series. [Nov/Dec 2009]**

3. **What are the difference between Fourier series and Fourier transform? [Oct. Nov.-2002, Nov/Dec-2004]**

4. **What is the relationship between Fourier transform and Laplace transform? [April/May-2002]**

5. **State the modulation property and convolution (time) property of Fourier transform. [April/May-2003]**

6. **Determine Laplace transform of x(t) = sin(ωt) u(t). [April/May-2004]**

7. **Define the Fourier transform pair for continuous time signal.**

8. **Find the Laplace transform of $x(t) = t\, e^{-at}\, u(t)$, where a > 0. [April/May – 2005]**

9. **Define Parseval's relation for continuous time periodic signals. [Nov./Dec. – 2006]**

10. **List some properties of continuous-time Fourier transform.**

11. **Determine the Fourier transform of the unit impulse**

12. **How the Laplace Transform can be represented ? (Or) What are the the representations of Laplace transform? (or) Define Unilateral & Bilateral Laplace transforms.**

13. **Obtain the Fourier transform of $x(t) = e^{-at}u(t)$, a> 0. [Nov./Dec.-2005]**

14. **nal value theorem of Laplace transforms. [April/May 2011,Nov./Dec.-**

**15. Find the Laplace transform of signal u(t).** **[May/June – 2006**

**16. Define Parseval's relation for continuous time periodic signals.**

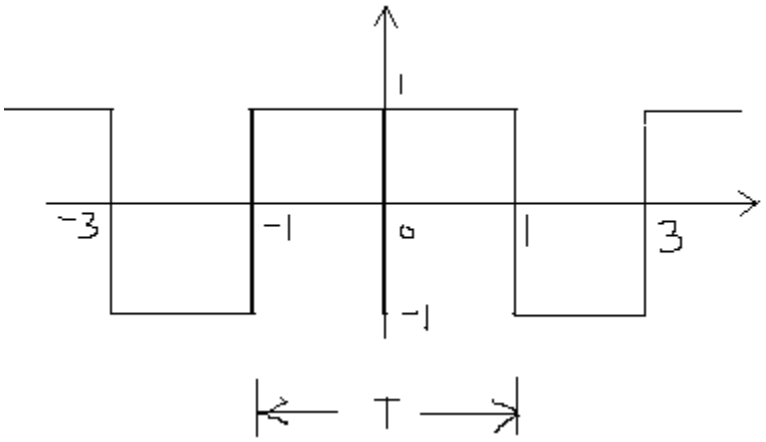
**[Nov./Dec. – 2006]**

**17. Find the Laplace transform of the signal.** **[Nov./Dec.-2006]**

$$x(t) = -te^{-2t}\,u(t)$$

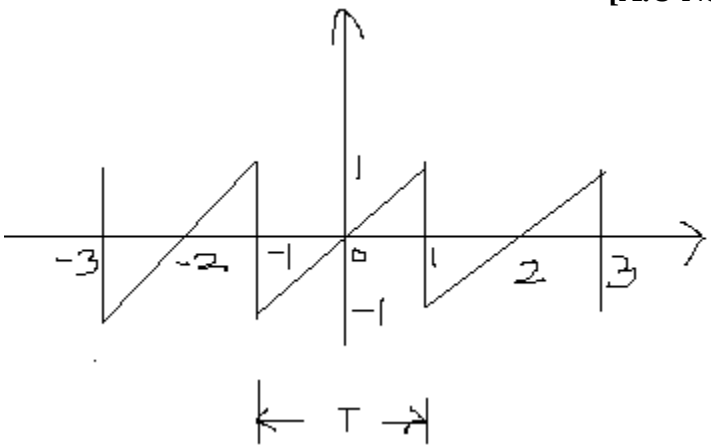
**Part-B**

**1.** a.Find the trigonometric Fourier series for the periodic signal x(t) in Figure.



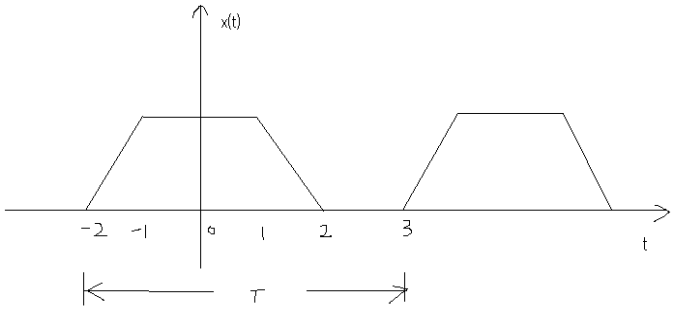

c. Find the trigonometric Fourier series for the periodic signal x(t) in Figure.

**[A.U Nov/Dec- 2003]**




**2.** State and prove the properties of CT Fourier Series.

**3.** a. Find the cosine representation FS for the given signal.




b. Find the cosine Fourier series of a half rectified sine wave function.

4. State and prove the properties of Fourier Transform. **[April/May-2012]**
5. Find the Fourier transform of the following and sketch the magnitude and phase spectrum.

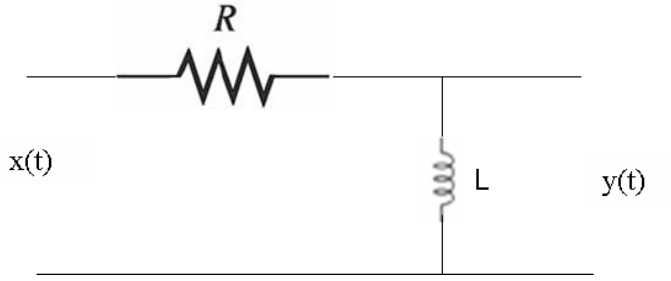
   $(i)\ x(t) = \delta(t)$

   $(ii)\ x(t) = e^{-at}u(t)$

   $(iii)\ e^{-|t|}$

   $(iv)\ e^{2t}u(t)$

6. (a) Find the Laplace transform of the signal.
   $x(t) = e^{-3t}u(t) + e^{-2t}u(t)$ and hence find ROC.
   (b)Find whether the system as shown in Figure is BIBO stable or not?




7. State and prove the properties of Laplace Transform.

## UNIT III LINEAR TIME INVARIANT –CONTINUOUS TIME SYSTEMS

### PART A (2 marks)

**1. Write Convolution integral of x(t).**

**2. What are the properties of convolution?**

**3. Define impulse response of continuous system**

**4. Find the unit step response of the system given by h (t)= $\frac{1}{R} e^{-t/RC} \cdot u(t)$**

**5. What is the impulse response of the system y(t)= x(t-to)**

**6. Define eigenvalue and eigenfunction of LTI-CT system.**

**7. The impulse response of the LTI-CT system is given as h(t) = $e^{-t}u(t)$. Determine transfer function and check whether the system is causal and stable.**

**8. What is the overall impulse response h (t) when two systems with impulse response h1 (t) and h2(t) are in parallel and in series?**

Or

**9. Define impulse response of a linear time invariant system.**

**10. Write down the input-output relation of LTI system in time and frequency domain**

**11. Define transfer function in CT systems.**

**12. What is the relationship between input and output of an LTI system?**

**[A.U May/June 2013]**

**13. What is the transfer function of a system whose poles are at -0.3±j 0.4 and a zero at -0.2?**

**14. Find the impulse response of the system given by H(S) = 1/(s+9)**

**$e^{-at}u(t) \leftrightarrow 1/(s+a)$**

**15. Find the Fourier Transform of impulse response.**

**16. What is the impulse response of an identity system?**

## PART-B

1. By using Laplace transform ,solve the following differential equation.

   $(i)\ \frac{d^2y(t)}{dt^2}+3\frac{dy(t)}{dt}+2y(t)=\frac{d}{dx}x(t)\ if\ \ y(0^-)=2;\ \frac{dy(0^-)}{dt}=1\ \ and\ \ x(t)=e^{-t}u(t)$

   $(ii)\ \frac{d^3y(t)}{dt^3}+7\frac{d^2y(t)}{dt^2}+16\frac{dy(t)}{dt}+12y(t)=x(t)\ if\ \ \frac{dy(0^-)}{dt}=0\ ;\ \frac{d^2y(0^-)}{dt^2}=0$

   $y(0^-)=0\ \ and\ \ x(t)=\delta(t)$

2. Find the impulse and the step response of the following systems.

$(i)\quad H(s)=\dfrac{10}{s^2+6s+10}$

$(ii)\quad H(s)=\dfrac{s+2}{s^2+5s+4}$

**[A.U Nov/Dec-2003]**

3. Realize the system described by following differential equation in direct form I and direct form II

   $(i)\ \dfrac{d^3y(t)}{dt^3}+4\dfrac{d^2y(t)}{dt^2}+7\dfrac{dy(t)}{dt}+8y(t)=\dfrac{5d^2x(t}{dt^2}+\dfrac{4dx(t)}{dt}+7x(t)$

   (ii) Realize the following system in Cascade form

   $$H(s)=\frac{5(s^2+3s+2)}{(s^2+8s+15)(s+0.5)}$$

   (iii) ) Realize the following system in Parellel form

   $$H(s)=\frac{s(s+2)}{(s+1)(s+3)(s+4)}$$

4. Find the convolution of the following signals. **[April/May 2008]**

   $(i)\ \ x(t)=e^{-2t}u(t)\ ;\ h(t)=u(t+2)$

   $(ii)\ x(t)=e^{-|t|}\ ;\ h(t)=e^{-2(t+1)}u(t+1)$

5. (a). Find the state space representation of the following system whose differential equation representation is

   $$\frac{d^3y(t)}{dt^3}+\frac{3d^2y(t)}{dt^2}+\frac{5dy(t)}{dt}+6y(t)=\frac{d^2x(t)}{dt^2}+\frac{6dx(t)}{dt}+5x(t)$$

   (b) .For the given transfer function of a system, obtain state space representation

   $$H(s)=\frac{s^2+3s+4}{s^2+7s+13}$$

6. (a) .Find the transfer function of the system which is represented in the state space representation as follows.

   $$\begin{bmatrix}\dot{q}_1\\ \dot{q}_2\end{bmatrix}=\begin{bmatrix}2 & -1\\ -1 & 2\end{bmatrix}\begin{bmatrix}q_1\\ q_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}x(t)$$

   $$y=\begin{bmatrix}0 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

   (b). Find the inverse Laplace of the following

   i. $X(s)=\dfrac{s}{s^2+5s+6}$

   ii. $X(s)=\dfrac{3s^2+8s+6}{(s+2)(s^2+2s+1)}$

7. Use the convolution theorem of Laplace transform to find $y(t) = x_1(t) * x_2(t)$ where $x_1(t)$ and $x_2(t)$ are given below. **[April/May 2008]**
   a. $x_1(t) = e^{-3t}u(t)$ *and* $x_2(t) = u(t-2)$
   b. $x_1(t) = \cos(4t)u(t)$ *and* $x_2(t) = \sin(2t)u(t)$
8. Find inverse Fourier transform of
   c. $X(j\Omega) = \dfrac{j\Omega}{(3+j\Omega)^2}$
   d. $X(j\Omega) = e^{-|\Omega|}$
   e. Find the Fourier transform of $x(t) = 1 - e^{-|t|}\cos\Omega_0 t$

## UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS

### PART A(2 marks)

1. **How unit sample response of discrete time system is defined ?**
2. **A causal discrete time system is BIBO stable only if its transfer function has…**
3. **Determine the system function of the discrete time system described by the difference equation.**

   Y(n)-1/2y(n-1) + 1/4y(n-2) = x(n) – x(n-1)

4. **Define sampling process.**
5. **Mention the types of sampling.**
6. **What is meant by quantizer?**
7. **List out the types of quantization process.**
8. **Define truncation.**
9. **State sampling theorem.**
10. **Define nyquist rate.**
11. **Define aliasing or folding.** **[A.U May/June 2013]**
12. **What is the condition for avoid the aliasing effect?**
12. **What is meant by ROC?**
13. **Explain about the roc of causal and anti-causal infinite sequences?**

**14. Explain about the roc of causal and anti causal finite sequences**

**15. What are the properties of ROC?**

**16. Explain the linearity property of the z transform**
**17. What are the different methods of evaluating inverse z-transform?**
**18. Define DTFT and IDTFT of a sequence?**

**19. Give the Existence of DTFT**

**20. Define zeroes and poles.**

## PART-B

1. Find the Discrete Time Fourier Transform of the following
   i. $x(n) = \{1, -1, 2, 2\}$
   *ii.* $x(n) = 2^n u(n)$
2. Find the Fourier Transform of $x(n) = \sin\left(\frac{\pi n}{2}\right) u(n)$
3. State and prove the properties of DTFT.
4. Find the convolution of the signals given below using Fourier transform
   $x_1(n) = \left(\frac{1}{2}\right)^n u(n)$ ; $x_2(n) = \left(\frac{1}{3}\right)^n u(n)$
5. Find the z-transform and ROC of the following signal.
   a. $x(n) = a^n u(n)$
   b. $x(n) = -b^n u(-n-1)$
6. State and prove the properties of z-transform.
7. (a). By using long division ,determine the inverse z-transform of
   $$X(z) = \frac{1 + 2z^{-1}}{1 - 2z^{-1} + z^{-2}}$$

   (b). By using partial fraction , determine the inverse z-transform of

$$X(z) = \frac{\frac{1}{4} z^{-1}}{(1-\frac{1}{2} z^{-1})(1-\frac{1}{4} z^{-1})} \quad , ROC : |z| > \frac{1}{2}$$

8. Find the Z-transform of $X(n) = (a^n \sin w_0 n) u(n)$

# UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

## PART-A (2 marks)

**1. What is meant by step response of the DT system?**
**2. Define Transfer function of the DT system.**
**3. Define impulse response of a DT system.**
**4. State the significance of difference equations.**
**5. Write the difference equation for Discrete time system.**
**6. Define frequency response (or) transfer function of the DT system.**
**7. What are the blocks used for block diagram representation?**
**8. State the significance of block diagram representation.**
**9.What are the properties of convolution?**
**10.State the Commutative properties of convolution?**
**11.State the Associative properties of convolution**
**12. State Distributive properties of convolution**
**13. Define causal LTI DT system.**
**15. How the discrete time system is represented?**
**16. What are the classification of the system based on unit sample response?**
**17. What is meant by FIR system?**
**18. What is meant by IIR system?**
**19. What is recursive system?**
**20. What is Non recursive system?**
**21.What is the difference between recursive and non recursive system**
**22. Define realization structure.**
**23.What are the different types of structure realization.**
**24. What is natural response?**
**25. What is zero input Response?**
**26. What is forced response?**
**27. What is complete response?**
**28. What are the steps involved in calculating convolution sum?**
**28. Give the state equations for LTI DT systems.**

### Part-B

1. Find the response of the system with difference equation $y(n)+2y(n-1)+y(n-2)=x(n)+x(n-1)$ for the input $x(n)=\left(\frac{1}{2}\right)^n u(n)$ with initial conditions y(-1)=y(-2)=1.
2. a. Find the response of the system with difference equation $y(n)-4y(n-1)+3y(n-2)=x(n)$ for $x(n)=n$.

   b. Determine the convolution sum of two sequences $x(n)=\{1,\mathbf{4},3,2\}$ and $h(n)=\{1,3,2,1\}$.
3. Obtain the direct form I,II, cascade and parallel form realization for the following system y(n) = -0.1y(n-1)+0.2y(n-2)+3x(n)+3.6x(n-1)+0.6x(n-2)

**[May/June-2007]**

4. Find the state variable matrices A,B,C and D for the I/O relation given by the equations y(n)=6y(n-1)+4y(n-2)+x(n)+10x(n-1)+12x(n-2)
5. Find the output of the system whose input and output are related by y(n)=7y(n-1)-12y(n-2)+2x(n)-x(n-2) for the input x(n)=u(n).
6. Find the impulse response and step response of the system y(n)-3/4y(n-1)+1/8y(n-2)=x(n). **[April/May-2003]**

7. Find the inverse z-transform of $X(z)=(1+3z^{-1})/(1+3z^{-1}+2z^{-2}),|z|>2$
   Using long division method, partial fraction method, Residue method and convolution method.