TUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis (*EX 651*)

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What is periodic and aperiodic signal? Find the necessary condition for the signal x[n] = cos $(2\pi f_0 n + \theta)$ to be periodic. [2+2]
   b) Determine whether the given signal is energy signal or power signal. $x(t) = e^{-a|t|}$, $a > 0$ [4]
2. a) Derive an analysis equation of continuous time Fourier series representation of any signal x(t). [5]
   b) Describe the time shifting and frequency shifting properties of continuous time Fourier series. Find Fourier series coefficient of signal x(t) = A cos(wot). [6]
   c) State and prove Parseval's relation for continuous time periodic signals. [4]
3. a) Find the Fourier transform of the signal $x(t) = e^{-a|t|}$, $a > 0$ and also plot the frequency spectrum. [5]
   b) Find the Fourier transform of the given signal. [4]

$$x[n] = 1 \text{ for } -N_1 \le n \le N_1$$
$$= 0 \text{ elsewhere}$$

   c) Show that the convolution in the time domain results multiplication in frequency domain using discrete time Fourier transform. [4]
4. a) State and prove conjugate and frequency shifting properties of discrete time Fourier transform. [4]
   b) Derive the convolution integral for continuous time system signal. [6]
5. a) Define linear time invariant system. Explain causality and time variance properties of continuous time system. [4]
   b) Find the output of the LTI system with impulse response $h[n] = 2^n\{u[n]-u[n-3]\}$ and $x[n] = \delta[n] + \delta[n-1] + \delta[n-3]$. Also verify the answer. [6]
6. a) Define frequency response of the discrete LTI system. Derive Formula to calculate the impulse response of continuous time ideal low pass filter. [2+4]
   b) Find the convolution between signals $x[n] = \{1, 2, 2, 1\}$ *and* $h[n] = \{1, 2, 2, -1\}.\}$. Choose your own origin. [6]
7. a) Define sampling theorem. Determine the Nyquist rate and Nyquist interval for the given continuous time signal. [2+4]

$$x(t) = \frac{1}{2\pi}\cos\,(4000\pi t)\cos\,(1000\pi t)$$

   b) Find impulse response for the DT system given by the following linear constant coefficient difference equation. $y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = 2x[n]$ [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis (*EX 651*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. a) Define even and odd signal with necessary diagram. Check whether the following signal is energy or power signal. (i) x(t) = 5A cos($\omega t + \phi$) (ii) $x[n] = \sin(\frac{n}{4})$ [3+4]

   b) Prove that discrete time complex exponential is periodic if its frequency is rational. [4]

2. a) Derive the exponential form of the Fourier series of a continuous-time signal. [6]

   b) Find and plot the Fourier series coefficients for the following signal with period N. [5]
   $x[n] = 1 + Sin\left(\frac{2\pi}{N}\right)n + 3Cos\left(\frac{2\pi}{N}\right)n + \cos(\frac{4\pi}{N}n + \frac{\pi}{2})$

   c) State and prove Parseval's relation for Discrete Time Fourier Series. [3]

3. a) Find the Fourier transform of signal $x[n] = a^n u(n), \quad 0 < a < 1$ [6]

   b) Derive and explain the expression of energy density spectrum for a continuous time aperiodic signal. [6]

4. a) Derive Fourier transform pair equations of a discrete-time signal. [6]

   b) List out the properties of Discrete Time Fourier Transform. State and prove the convolution property of Discrete Time Fourier Transform. [6]

5. a) State and prove the sampling theorem. Find the Nyquist rate and Nyquist interval for the signal [3+3]
   x(t) = (1/2π) cos(4000πt) cos(1000πt)

   b) Derive the transfer function of a RC low pass filter and plot the magnitude and phase. [5]

6. a) Find the output $y(t)$ of LTI system if the impulse response $h(t) = e^{-t}u(t-3)$ and input $x(t) = u(t-2)$. [5]

   b) Describe the frequency response of a continuous time LTI system. [5]

7. a) Derive convolution sum of a discrete time signal. [5]

   b) Find out the frequency response of the following signal
   $y[n] = 0.5\,x[n] - 0.5x[n-1]$
   $h[n] = \frac{1}{2}\ for\ n = 0\ and\ -\frac{1}{2}\ for\ n = 1$ [5]

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TRIBHUVAN UNIVERSITY
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Examination Control Division
2081 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
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Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis (*EX 651*)

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define energy signal and power signal. Determine whether the signal $x(t) = e^{-3t}$ is a power signal or energy signal or neither energy nor power signal. [3+3]
   b) Define continuous time unit step signal. Derive the necessary condition for the signal $x(t) = e^{j\omega t}$ to be periodic. [1+3]
2. a) Derive the trigonometric fourier series expansion of a continuous-time periodic signal x(t). [5]
   b) State and prove the time-scaling property for continuous-time fourier series pair. [5]
   c) State and prove frequency shifting property of discrete time fourier series. [3]
3. a) Find the fourier transform of the signal $x(t) = e^{-a|t|}$; $a > 0$ and also plot the frequency spectrum. [5]
   b) Show that the convolution in time domain results multiplication in frequency domain using continuous time fourier transform. [5]
4. Determine the discrete time fourier transform of signum function (sgn[n]) and use it to find the DTFT of unit-step signal u[n]. [6+6]
5. a) State and prove the linearity and time shifting properties of DTFT [6]
   b) Define sampling theorem and Nyquist criteria for sampling. Find the Nyquist rate for the signal: $x(t) = 20\sin(500\pi t) + 10\cos(300\pi t) - 50\cos(1000\pi t)$ [3+3]
6. a) Derive convolution integral for continuous LTI system. [5]
   b) Find convolution between the signals $x[n] = \{3,5,6,9\}$ *and* $h[n] = \{-1,3,5\}$. Choose your appropriate origin. Show the output signal. [6]
7. a) Derive the expression for impulse response of RC filter and plot the magnitude and phase response. [6]
   b) Find the frequency response ($e^{j\omega}$), plot the magnitude and impulse response h[n] for a system characterized by linear constant coefficient difference equation

$$y[n] = 0.5y[n-1] + x[n]$$ [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis (*EX 651*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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- ✓ *Assume suitable data if necessary.*

1. a) Define energy and power signal. State whether the given signal is periodic or not? If signal is periodic, find its fundamental period. $x[n] = \cos(\frac{\pi n}{5})\sin(\frac{\pi n}{3})$ [6]
   b) Explain time shifting, time scaling and time inversion of a continuous time signal with example. [3]
2. a) What is Fourier series representation of a signal? Derive an expression for analysis and synthesis equation of the Fourier Series for a CT periodic signal x(t). [6]
   b) Consider a Signal $x[n] = \sin(w_0 n)$ with period N = 6. Find the Fourier series coefficient of the given signal x[n]. Plot spectra. Also find the average power. [6]
3. a) Derive Fourier Transform of discrete time aperiodic signal. Also, prove that DTFT is periodic with 2π. [4+2]
   b) State and prove that convolution in time domain is equivalent to multiplication in frequency domain. [5]
4. a) Explain duality property of continuous time Fourier transform with derivation. [1.5+3.5]
   b) Find the Fourier transform of the signal $(t) = e^{-\alpha t}\cos\omega_0(t)$, $\alpha > 0$. [5]
5. Find: a) Inverse Fourier Transform of CT unit impulse signal $\delta(\omega)$ [2]
   b) Fourier Transform of DT signal $\cos\omega_0(n)$ [4]
   c) Show that the multiplication of a signal x(t) by t is equivalent to differentiation of its Fourier Transform. [4]
6. Explain the Nyquist Criteria for sampling and aliasing effect. Find the Nyquist rate for the signal $x(t) = 30\sin(100\pi t) + 40\cos(400\pi t)\sin(300\pi t)$. [4+4]
7. a) Derive convolution sum for a LTI system. [6]
   b) Find the output of an LTI system, for input $x[n] = \left\{\frac{1}{4}, -1, 2\right\}$ and $h[n] = \left\{2, \frac{2}{4}, -2\right\}$. [6]
8. Find the frequency response and impulse response of the system characterized by linear constant coefficient difference equation y[n] = 0.5y [n-1] + x[n]. [8]

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TRIBHUVAN UNIVERSITY
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Examination Control Division
2080 Ashwin

Exam.	Back		
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Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis (*EX 651*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Determine whether the signal $x(t) = e^{-3t}$ is a power signal or energy signal or neither energy nor power signal. [4]
2. Determine whether the signal $x[n] = 5\,\mathrm{Sin}[\frac{3\pi}{8}n - \frac{\pi}{2}] - 2\mathrm{Cos}[\frac{7\pi}{12}n]$ is periodic or not. If the signal is periodic, calculate its fundamental period and fundamental frequency. [4]
3. What are the significance of Fourier series coefficients of a signal? State and prove time scaling and conjugation properties of continuous time Fourier series representation. [2+6]
4. Find the Fourier series coefficient of the signal. [6]

$$X[n] = 1 + \mathrm{Sin}\left[\left(\frac{2\pi}{N}\right)n\right] + 3\mathrm{Cos}\left[\left(\frac{2\pi}{N}\right)n\right] + \mathrm{Cos}\left[\left(\frac{4\pi}{N}\right)n\right]$$

5. Explain the convolution properties of continuous time Fourier transform. [6]
6. State and prove Parseval's theorem for continuous time aperiodic signal. [2+6]
7. Find the Fourier transform of continuous time Rectangular Pulse and Constant amplitude A. State Prove Duality property of Continuous Time Fourier Transform with suitable example. [4+4]
8. Consider an analog signal $x(t) = 3\cos 200\pi t + 2\sin 300\pi t - 3\cos 500\pi t$. [8]
   i) Determine the minimum sampling rate required to avoid aliasing.
   ii) Suppose that the signal is to be sampled at the rate of Fs = 400 Hz. What is the discrete time signal obtained after sampling?
   iii) Find reconstructed signal $x_r(t)$ from sampled signal calculated above in [ii].
9. a) Find the convolution between the signals [6]

   $x(t) = 1$ for $-1 < t < 1$
   0 otherwise

   and, $h(t) = 1$ for $-1 < t < 1$
   0 otherwise

   b) Evaluate the Step response of RC filter [5]
10. a) What is the condition for LTI system to be causal? [2]
    b) Determine if the following system is Linear [3]

    $y[n] = ax[n] + b$

    c) Check if the system is time invariant [3]

    $y[n] = nx[n] - x[n-1]$

11. a) Perform convolution sum of signal $x[n] = \{1, 2, 0, -1\}$ and $h[n] = \{2, 0, 2\}$ [6]
    b) Derive convolution sum equation for discrete time linear system. [3]

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2079 Ashwin

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Subject: - Signal Analysis *(EX 651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. a) Draw the following signal x[n] = u[n+2] – u[n-3] + nu[n-3] – nu[n-6]. [3]

   b) Determine the period of $x[n] = \sum_{k=-\infty}^{\infty} (-1)^k \delta[n-k]$. [2]

   c) For x[n] = {1, 2, 0, -2, 1}, find x[2n – 3]. [3]

2. a) Derive the Trigonometric Fourier Series expansion of a continuous-time periodic signal x(t). [5]

   b) State and prove the time-scaling property for discrete-time Fourier series pair. [4]

   c) Find the frequency domain representation (both magnitude and phase plot) of a periodic signal defined as x[n] = {1, -0.5, 0, 0, 0.5}, with period N = 5. [6]

3. a) Find the Fourier Transform of the signal $x(t) = e^{-a|t|}$; a > 0 and also plot the frequency spectrum. [5]

   b) Show that the convolution in time domain results multiplication in frequency domain using continuous time Fourier Transform. [5]

   c) Determine the discrete time fourier transform of signum function (sgn[n]) and use it to find the DTFT of unit-step signal u[n]. [4+8]

4. Determine the 4-point DFT of the signal x[n] = u[n] + u[n-1] - u[n-3] - u[n-4] using linear transformation method. [5]

5. What is aliasing and how can it be prevented? [6]

6. a) Find the convolution between the signals [8]

   $x(t) = 1 \quad \text{for } -1 < t < 1$
   $\quad\;\; 0 \quad\;\; \text{otherwise}$

   $h(t) = 1 \quad \text{for } -1 < t < 1$
   $\quad\;\; 0 \quad\;\; \text{otherwise}$

   b) Evaluate the step response of RC filter. [5]

7. a) What is the condition for LTI system to be causal? [5]

   b) Determine if the following system is Linear y[n] = ax[n] + b. [3]

   c) Check if the system is time invariant y[n] = nx[n] – x[n-1]. [3]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Jestha

Exam.	Back		
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Subject: - Signal Analysis *(EX 651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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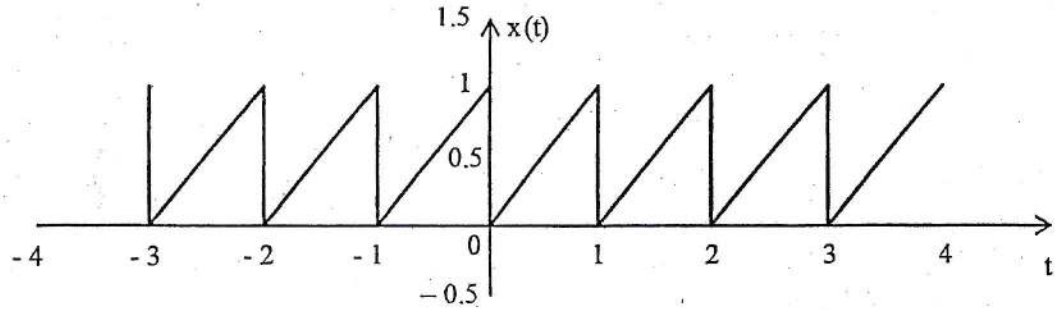
1. a) Define energy and power signals with examples. [4]
   b) Derive the necessary condition for the signal $e^{j\omega n}$ to be periodic. [4]
2. a) Calculate and plot magnitude and phase spectrum of the following periodic signal. [8]



   b) State and prove Parseval's relation for discrete time periodic signals. [6]
3. State and prove the complex conjugation property for continuous time a periodic signals. Also show that if the CT signal is purely real, its Fourier Transform is conjugate symmetric. [4+4]
4. a) Find the Fourier Transform of discrete time signal $[n] = a^n u[n]$, $0 < a < 1$. [6]
   b) Compute the 4-point DFT for $x[n] = \{3, -2, 1\}$. [6]
5. State Nyquist's sampling theorem. Find the Nyquist rate for the given CT signal [2+4]

$$x(t) = \frac{1}{2\pi}\cos(50\pi t)\cos(500\pi t)$$

6. a) What is an LTI system? Find the output of the LTI system with impulse response $h(t) = e^{-2t}u(t)$ when the input to the system is $\begin{cases} 1; & |t| < 5 \\ 0; & \text{otherwise} \end{cases}$. [2+8]
   b) Show that ideal low pass filter is not practically realizable. [7]
7. Find and plot the convolution sum of the signals $x[n] = \{-0.5, 1, -1, 0.5\}$ and $y[n] = \{1, 2, -1, 0, 2, -1\}$. [8]
8. For a system characterized by linear constant coefficient difference equation $y[n] = 0.4\, y[n-1] + x[n]$, find and plot the transfer function and impulse response of the system. [7]

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TRIBHUVAN UNIVERSITY
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2078 Baishakh

Exam.	Back		
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Subject: - Signal Analysis *(EX 651)*

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1. a) Differentiate between continuous time and discrete time signals with examples. [3]
   b) Determine the fundamental period and fundamental frequency of the periodic signal. [5]

$$x[n] = 3\sin\left(\frac{7\pi}{9}n - 2\right) + \cos\left(\frac{\pi}{13}n + 2\right)$$

2. a) "Even if a signal is periodic, its Fourier series might not exist." Justify the statement using three different examples. [4]
   b) State and prove Parseval's relation for Discrete Time Fourier series. [6]
3. Derive expression for Fourier transform of continuous time periodic signal. Find Fourier transform of signal $x(t)=e^{-2|t|}\sin(t)$. [5+5]
4. a) State and prove convolution properties for continuous time Fourier Transform. [4]
   b) Compute discrete time Fourier transform of the discrete time signal [4]

$$x[n] = \left(\frac{1}{2}\right)^{n-1} u[n-1]$$

5. a) Derive the convolution sum. [4]
   b) Find the convolution between the following sequences. [6]
   $h[n] = \{2, 1, 5, 7\}$
   $x[n] = \{1, 3, 5, 9, 6\}$
   Choose origin as per your choice.
6. a) What is impulse train sampling? How do you reconstruct original signal from its sample? [2+6]
   b) Derive and plot the impulse response and frequency response of a system characterized by the different equation. [6]

$$y[n] + 0.55y[n-1] = x[n]$$

7. a) What do you mean by impulse response of a LTI system? Derive formula to calculate impulse response of continuous time ideal low pass filter. [6]
   b) If the impulse response of a discrete LTI system is $h[n]=u[n]$ and input to the system is $x[n]=2^n u[-n]$, determine the output $y[n]$ of the system. [6]
8. a) State and prove commutative property of continuous time LTI system. [3]
   b) Explain Invertibility of LTI system and derive the necessary condition for two LTI systems to become inverse of each other. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Poush

Exam.	Back		
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Subject: - Signal Analysis *(EX 651)*

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1. a) Given: x(t) = sin(t). Is this signal periodic? Is it an energy signal or power signal or neither? [1+3]
   b) "Combination of two continuous-time periodic signal might result in an aperiodic signal." Justify this statement using any numerical example. [4]
2. a) Derive the formula for synthesis equation and analysis equation of Fourier series. Mention the three conditions that guarantee the existence of Fourier series. [5+3]
   b) State and explain four properties of discrete time Fourier series. [6]
3. a) State and prove Parseval's relation for finite energy signal. Describe any three applications of Fourier Transform. [6+3]
   b) Calculate Fourier transform of a constant DC function. What are the physical meanings of Energy spectral Density and Power spectral Density? [5+3]
   c) How do you calculate the Fourier transform of periodic sequence? Explain with necessary steps. [5]
4. a) Explain practical sampling method using a circuit diagram. Describe band-pass sampling theorem. [4+2]
5. a) Elaborate the physical meaning of convolution integral using suitable example. [3]
   b) Derive convolution sum. Prove that an ideal low-pass filter is a non-causal system. [6+6]
6. a) Define transfer function and impulse response in discrete-time. Briefly explain the procedure of drawing a bode plot. [2+3]
   b) State and explain any six properties of a discrete-time LTI system. [6]
   c) Determine the range of a and b for which the given LTI system becomes stable whose impulse response is: [4]

   $h[n] = e^{an} U[n] + e^{bn} U[-n]$

   where, U[n] is discrete-time unit step function.

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- ✓ *Attempt **All** questions.*
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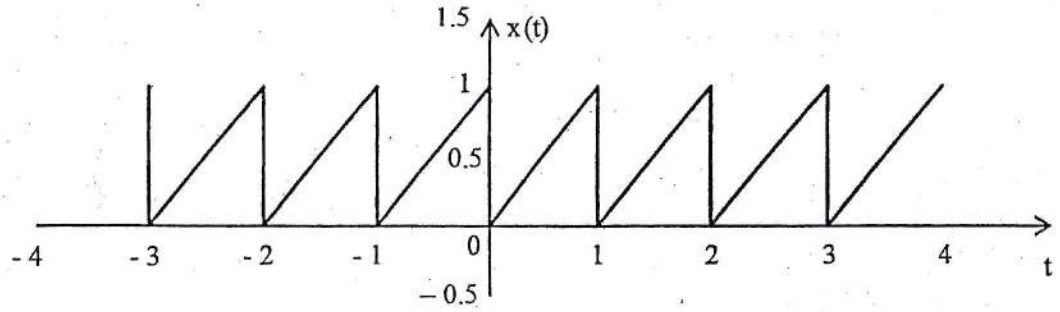
1. a) Define energy and power signals with examples. [4]
   b) Derive the necessary condition for the signal $e^{j\omega n}$ to be periodic. [4]
2. a) Calculate and plot magnitude and phase spectrum of the following periodic signal. [8]



   b) State and prove Parseval's relation for discrete time periodic signals. [6]
3. State and prove the complex conjugation property for continuous time a periodic signals. Also show that if the CT signal is purely real, its Fourier Transform is conjugate symmetric. [4+4]
4. a) Find the Fourier Transform of discrete time signal $[n] = a^n u[n]$, $0 < a < 1$. [6]
   b) Compute the 4-point DFT for $x[n] = \{3, -2, 1\}$. [6]
5. State Nyquist's sampling theorem. Find the Nyquist rate for the given CT signal [2+4]

$$x(t) = \frac{1}{2\pi}\cos(50\pi t)\cos(500\pi t)$$

6. a) What is an LTI system? Find the output of the LTI system with impulse response $h(t) = e^{-2t}u(t)$ when the input to the system is $\begin{cases} 1; & |t| < 5 \\ 0; & \text{otherwise} \end{cases}$. [2+8]
   b) Show that ideal low pass filter is not practically realizable. [7]
7. Find and plot the convolution sum of the signals $x[n] = \{-0.5, 1, -1, 0.5\}$ and $y[n] = \{1, 2, -1, 0, 2, -1\}$. [8]
8. For a system characterized by linear constant coefficient difference equation $y[n] = 0.4\, y[n-1] + x[n]$, find and plot the transfer function and impulse response of the system. [7]

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1. a) Define energy signal and power signal. Determine whether the signal $x(t) = e^{-3t}$ is a power signal or energy signal or neither energy nor power signal. [3+3]
   b) Define continuous time unit step signal. Derive the necessary condition for the signal $x(t) = e^{j\omega t}$ to be periodic. [1+3]
2. a) Derive the trigonometric fourier series expansion of a continuous-time periodic signal x(t). [5]
   b) State and prove the time-scaling property for continuous-time fourier series pair. [5]
   c) State and prove frequency shifting property of discrete time fourier series. [3]
3. a) Find the fourier transform of the signal $x(t) = e^{-a|t|}$; $a > 0$ and also plot the frequency spectrum. [5]
   b) Show that the convolution in time domain results multiplication in frequency domain using continuous time fourier transform. [5]
4. Determine the discrete time fourier transform of signum function (sgn[n]) and use it to find the DTFT of unit-step signal u[n]. [6+6]
5. a) State and prove the linearity and time shifting properties of DTFT [6]
   b) Define sampling theorem and Nyquist criteria for sampling. Find the Nyquist rate for the signal: $x(t) = 20\sin(500\pi t) + 10\cos(300\pi t) - 50\cos(1000\pi t)$ [3+3]
6. a) Derive convolution integral for continuous LTI system. [5]
   b) Find convolution between the signals $x[n] = \{3,5,6,9\}$ *and* $h[n] = \{-1,3,5\}$. Choose your appropriate origin. Show the output signal. [6]
7. a) Derive the expression for impulse response of RC filter and plot the magnitude and phase response. [6]
   b) Find the frequency response ($e^{j\omega}$), plot the magnitude and impulse response h[n] for a system characterized by linear constant coefficient difference equation
   $$y[n] = 0.5y[n-1] + x[n]$$ [6]

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- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Briefly explain CT unit impulse, unit step and unit ramp signal. What is the relationship between unit impulse, unit step and unit ramp signal? [4]
   b) Sketch the signal x(t) = 5cos(t). State whether the given signal is energy signal or power signal. [4]
2. Write down the condition of convergence of continuous time Fourier series. Find the Fourier series coefficient a_k for the continuous time period signal. [3+5]

$$x(t) = \begin{cases} 1.5, & 0 \le t < 1 \\ -1.5, & 1 \le t < 2 \end{cases}$$

3. State and prove:
   a) Parseval's theorem for a DT aperiodic signal. [4]
   b) Convolution property of the CT Fourier Transform. [4]
4. a) Derive the expression of Discrete Time Fourier Transform for periodic Sequence. [7]
   b) Differentiate between energy and power spectral density. [4]
5. a) How does Nyquist criteria prevent aliasing? Explain with diagram. [4]
   b) Find the Nyquist rate and interval for the following signal: [4]

   $x(t) = 2\cos(100\pi t)\cos(300\pi t)$
6. a) Derive the convolution sum for an LTI system. [6]
   b) Determine if the following system is linear y[n] = ax[n] +b [4]
7. a) Derive the expression for impulse response of ideal low pass filter. [5]
   b) Define LTI system. Explain the properties of discrete time LTI system. [6]
8. Find the output of an LTI System given by: x[n] = δ[n] + 2δ[n-1] – δ[n-3] and h[n] = 2δ[[n+1] + 2δ[n-1]. [8]
9. Find impulse response for the DT system given by the following Linear Constant Coefficient Difference Equation. $y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = 2x[n]$. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis (*EX 651*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define Power and Energy Type continuous Time signal with suitable examples. Check whether these signals are Energy or Power Type with required calculation. [2+4]
   a) $x(t) = u(t)$
   b) $x(t) = \delta(t)$
2. Derive the expression of Fourier Series Coefficient in exponential form for Continuous time periodic signal. Describe the condition for existence of Fourier series with suitable examples. [5+3]
3. a) Find the Fourier Transform of the signal $x(t) = e^{-a|t|}$; $a > 0$ and also plot the frequency spectrum. [5]
   b) Show that the convolution in time domain results multiplication in frequency domain using continuous time Fourier Transform. [5]
4. Derive the expression of Fourier Transform of Discrete Time aperiodic Sequence. [8]
5. Define sampling theorem. Determine the Nyquist rate for the continuous time signal, x(t).
   $x(t) = 1 + \cos(2000\pi t) + \sin(4000\pi t)$. [2+4]
6. What are the properties of system? Determine whether the given system is time-variant or not.
   $y(t) = \sin[x(t)]$ [2+5]
7. a) Describe different Properties of Discrete time LTI system with suitable example. [5]
   b) Convolve the signal $x[n] = \{3, 1, 5\}$ and $h[n] = \{1, 4, -2, 3\}$ [5]
8. a) Describe bode plot with example [4]
   b) Derive the expression for impulsive response of ideal low pass filter and discuss. [5]
9. a) State and prove the Time-Scaling property for discrete-time Fourier series pair. [4]
   b) Find the frequency domain representation (both magnitude and phase plot) of a periodic signal defined as $x[n] = \{1, -0.5, 0, 0, 0.5\}$, with period $N = 5$. [6]
10. What is aliasing and how can it be prevented? [6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Chaitra

Exam.	**Regular**		
Level	BE	**Full Marks**	80
Programme	BEL, BEX	**Pass Marks**	32
Year / Part	III / II	**Time**	3 hrs.

Subject: - Signal Analysis (*EX651*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Show that any signal can be decomposed into an odd and even component. Is the decomposition unique? Illustrate your argument using the signal.

   $x[n] = \{2, 3, 4, 5, 6\}$ [3+5]

2. a) Derive the Trigonometric Fourier series expansion of a continuous- time periodic signal x (t). [5]

   b) State and prove the Time- Shifting property for discrete – time Fourier series pair. [4]

3. a) State and prove convolution property of discrete time periodic signals. [2+3]

   b) What is Parseval's relation? Prove Parseval's relation for continuous-time periodic signal. [2+3]

4. a) Find the Fourier Transform of the signal $x(t) = e^{-a|t|}$; $a > 0$ and also plot the frequency spectrum. [5]

   b) Obtain the Fourier transform of the continuous–time signal. [6]

5. a) What is convolution? Obtain the expression for convolution sum. [6]

   b) Find and plot the convolution between [8]

$$x[n] = \begin{cases} |n|; & -2 \le n \le 2 \\ 0; & \text{otherwise} \end{cases} \quad \text{and} \quad y[n] = \begin{cases} 2n; & 2 \le n \le 5 \\ 0; & \text{otherwise} \end{cases}$$

6. a) What do you mean by aliasing? Compute Nyquist rate for [2+4]

   $x(t) = 5\cos(1500\pi t) - 2\sin(2000\pi t) + 3\sin(1850\pi t)$.

   b) Evaluate the Step response of RC filter. [5]

7. a) What is the condition for LTI system to be causal? [5]

   b) Determine if the following system is Linear [3]

   $y[n] = ax[n] + b$

   c) Check if the system is time invariant [3]

   $y[n] = nx[n] - x[n-1]$

8. a) Define energy and power signal. [2]

   b) Determine the energy of the signal [4]
   $X(t) = 5\cos\pi t + \sin 5\pi t$, $-\alpha < t < \alpha$

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX 651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define energy signal and power signal. Determine whether the signal $x(t) = e^{-5t}u(t+2)$ is energy signal or power signal or neither energy nor power signal. [3+4]

   b) x(t) and y(t) are continuous time signals defined as:
   $x(t) = \sin 6\pi t$ and $y(t) = \cos 8t$
   Determine whether:

   (i) x(t) is periodic.
   (ii) y(t) is periodic.
   (iii) x(t) + y(t) is periodic

   If periodic, find the fundamental time period of x(t), y(t) and x(t)+y(t). [3]

2. a) A continuous time Fourier Series is evaluated over infinite duration while a discrete time Fourier series is evaluated over one time period only. Why? [2]

   b) Obtain fourier series coefficients of the signal:

$$x[n] = 1 + 3\cos\left(\frac{2\pi n}{N} + \frac{\pi}{3}\right)$$

   Where,

   N is the fundamental time period of x[n].

   Also, Plot magnitude and phase spectrum of the coefficients. [2+2+2]

   c) Derive exponential form of Fourier series for discrete time signal. [4]

3. a) Derive the Fourier Transform equation for discrete time aperiodic signals. Also prove that the DTFT is periodic with period 2π. [4+2]

   b) Given discrete time signal is :

$$x[n] = a^n U[n], \ |a|<1$$

   Given that Fourier transform of x[n] is continuous in nature, plot magnitude and phase response of the transformed signal. [4]

4. a) State and prove duality property of continuous time Fourier Transform. [5]

   b) State and explain Energy density spectrum. [5]

5. a) Derive the convolution integral. [4]

   b) Find the convolution between the following sequences.
   $h[n] = \{2, 0, -1, 2\}$
   $x[n] = \{1, 2, -1, 3\}$
   Choose origin as per your choice. [6]

6. a) What do you mean by causal and non causal systems? Derive the condition for a continuous time LTI system to be causal. [2+3]

   b) Prove, with necessary derivations, that an ideal low pass filter is not physically realizable. Also derive the expression for step response of ideal low pass filter. [3+3]

7. a) Define Nyquist sampling theorem. Explain using frequency domain analysis of impulse train sampling. [6]

   b) Find the frequency response and impulse response for a system characterized by linear constant coefficient difference equation $y[n] = 0.5y[n-1]+x[n]$. [4+2]

8. Consider a continuous time system with input $x(t)$ and output $y(t)$ related by $y(t) = x(t-2)+x(2-t)$. Is the system Linear Time invariant? Explain. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX 651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define even and odd signal in both continuous time and discrete time with examples. [4]
   b) Explain time shifting, time scaling and time inversion of a continuous time signal with example. [3]
2. a) Derive necessary condition for a discrete time signal to be periodic. Find the energy and power of the discrete time signal $x[n] = e^{jw_o n}u[n]$, where u[n] is unit step function. [3+4]
   b) Explain the behaviour of discrete time complex exponential $x[n]=c\alpha^n$ where c and α are real. [4]
3. a) What is Parseval's relation? Prove Parseval's relation for continuous-time periodic signal. [2+4]
   b) State and prove time scaling properties of exponential fourier series. [4]
4. a) Derive Fourier series synthesis and analysis equation for discrete time periodic signal. [6]
   b) Explain with necessary derivation that the discrete time Fourier Transform is periodic in frequency with period 2π. [4]
5. a) State and prove frequency derivative property of fourier transform. Use same property to find fourier transform of x(t)=t*exp(-a*t)u(t), a>0 [3+4]
   b) Find Discrete time Fourier transform of the discrete time signal x[n]=u[n-2]-u[n-6]. [5]
6. a) What is aliasing in sampling? Determine the Nyquist rate for the continuous time signal $x(t)=1+\cos(2{,}000\pi t) + \sin(4{,}000\pi t)$ [2+4]
   b) Derive formula to calculate the impulse response of Ideal low pass filter in discrete time. [5]
7. a) Derive convolution sum. [4]
   b) Find the convolution sum of x[n]={1,3,4,3,1} and h[n]={2,2,-2} [6]
8. Write short notes: [3x3]
   a) Frequency shifting DT FT
   b) LTI system
   c) Bode plot

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

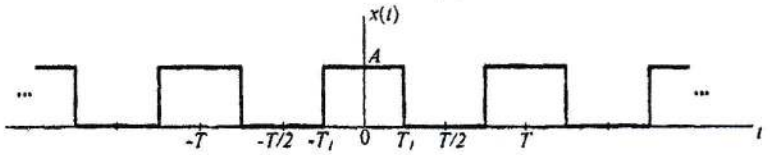
Subject: - Signal Analysis *(EX 651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Derive necessary condition for a discrete time signal $x[n] = e^{jw_0 n}$ to be periodic. Determine whether the discrete time signal $x[n] = 3e^{j3\pi(n+\frac{1}{2})/5}$ is periodic or not. [4+4]
2. Derive the expression to compute Fourier series coefficients of exponential Fourier series. Explain Gibbs phenomenon. [8]
3. a) State and prove Parseval's relation for Discrete-Time Fourier Series (DTFS). [5]
   b) A periodic square wave as shown in figure below is defined over one period as: [5]

$$x(t) = \begin{cases} A, & |t| < T_1 \\ 0, & T_1 < |t| < T/2 \end{cases}$$

Determine the Fourier series coefficients for x(t).



4. a) State and prove the convolution property of continuous-time Fourier Transform. [5]
   b) Find the Fourier Transform of the signal $x(t) = e^{-at}u(t)$, where a is real constant. Also, draw its amplitude and phase spectra. [6+2]
5. What is aliasing? Determine Nyquist rate for the continuous time signal $x(t)=1+\cos(2{,}000\pi t)+\sin(4{,}000\pi t)$ [2+4]
6. Derive formula to calculate convolution integral for continuous time LTI system. Find convolution between following continuous time signals $x(t) = e^{-t}u(t)$ and $y(t) = e^{-2t}u(t-3)$ [5+6]
7. a) The impulse response of a LTI system is
   $h[n] = \{1, \underset{\uparrow}{2}, 1, -1\}$
   Determine the response of the system to the input signal
   $x[n] = \{1, \underset{\uparrow}{2}, 3, 1\}$ [6]
   b) Check whether the discrete-time system described by the following input-output relation is linear or non-linear. [4]
   $y[n] = 2 \times x[n] + 5$
8. Define invertibility of LTI system with suitable example if impulse response $h[n] = U[n]$ and inverse system $h'[n] = \delta[n] - \delta[n-1]$. Prove that their convolution must be $\delta[n]$. [3+4]
9. Find the frequency response $H(e^{jw})$ and impulse response h[n] for a system characterized by linear constant coefficient difference equation $y[n]=0.3y[n-1]+x[n]$. [7]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define 'continuous' and discrete time signals giving suitable examples. [3]
   b) Show that any signal can be decomposed into an odd and even component. [4]
2. a) Derive necessary condition for a discrete time signal to be periodic. Determine whether the following signals are energy or power signal $f(t) = 5\cos \pi t + \sin 5\pi t$ [3+3]
   b) Explain the behaviour of continuous time complex exponential signal $x(t) = c\, e^{at}$. [3]
3. State Parseval's relation for discrete time Fourier series. Find the average power of discrete time periodic signal $X[n] = \sin\left(\frac{\pi n}{3}\right)$ using Fourier series coefficient. [2+5]
4. a) Obtain the expression for analysis equation for DTFS. [6+4]
   b) Show that fourier series coefficient of discrete time signal is periodic in nature. [6]
5. a) State and prove Time shifting property of continuous time Fourier Transform. [2+5]
   b) Find the Fourier transform of continuous time unit step signal. [5]
6. a) What do you mean by sampling, state the requirement of sampling frequency? Determine Nyquist rate for $x(t) = \frac{1}{2\pi}\cos(100\pi t)\cos(300\pi t)$ [2+4]
   b) Derive the transfer function for discrete time low pass filter. [4]
7. a) Determine whether the given system is linear or not. [4]
   $Y(t) = A\,x(t) + B$
   b) Derive convolution integral of a continuous time signal. [6]
8. Write short notes [3×3]
   i) Discrete data function
   ii) Energy and power signal
   iii) Causal and non causal system

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define even and odd signals. Develop the even/odd decomposition of a general signal x(t). [4+4]
2. a) Derive the Fourier Series Expansion of a continuous – time periodic signal x(t). [5]
   b) Find Fourier series coefficients and associated phase of the signal with fundamental frequency w_0: $x(t) = 1 + \sin(w_0 t) + 2\cos(w_0 t) + \cos(2w_0 t + \pi/4)$ [5]
   c) State and prove the time shifting property of Discrete – time Fourier series. [4]
3. a) Explain energy density spectrum of a continuous – time aperiodic signal with necessary derivation. [5]
   b) Find and sketch the Fourier Transform of exponential signal: $x(t) = \exp(-a|t|)\, u(t)$, $a>0$. [5]
4. a) State and prove convolution theorem of discrete – time aperiodic signal. [6]
   b) Compute four – point DFT of four – point sequence: x[n] = {0, 1, 2, 3}. [6]
5. Define sampling theorem and Nyquist criteria for sampling. Find the Nyquist rate for the signal: $x(t) = 20\sin(500\pi t) + 10\cos(300\pi t) - 50\cos(1000\pi t)$ [6]
6. a) Define system. Explain causality and time variance properties of continuous – time LTI system. [2+4]
   b) Find output y(t) of LTI system if input x(t) = exp (-at) u(t) and impulse response h(t) = u(t). [5]
   c) Derive the conditions for distortionless transmission for continuous – time LTI system. [4]
7. a) Derive the convolution sum for discrete – time LTI system. [5]
   b) Perform convolution between signals: $x_1[n]$ = {1, 2, 1, -1} with origin at second position from left and $x_2[n]$ = {1, 2, 3, 1} with origin at first position from left. [5]
   c) Find $H(e^{jw})$ and h[n] for a discrete – time LTI system with difference equation: [5]
   $y[n] = 0.5\, y[n-1] + x[n]$

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Differentiate between energy signal and power signal.Show by giving suitable example that power of the energy signal is zero and energy of the power signal is infinite. [2+5]
2. a) Derive necessary condition for a discrete time signal to be periodic. [3]
   b) Determine whether the following discrete time signals are periodic or not [4]
   (i) SPn 5n
   (ii) $\cos\left(\frac{2\pi n}{5}\right)+\cos\left(\frac{2\pi n}{7}\right)$
3. a) Derive the expression to compute Fourier series coefficients of exponential Fourier series. [5]
   b) Explain the Dirichel Conditions for convergence of Fourier series. [3]
4. a) State and prove time shifting and time scaling properties of continuous time Fourier series. [4]
   b) Find Fourier series coefficient of discrete time periodic signal
   $x[n] = \sin w_o n$ where $w_0 = \frac{2\pi}{N}$
   Plot the signal when N = 5. [4]
5. How do you find the Fourier transform of periodic signals? Find the Fourier transform of continuous time rectangular pulse and constant amplitude A and explain the result. [5+5]
6. Show that convolution in time domain results multiplication in frequency domain using continuous time Fourier transform. Determine discrete time Fourier transform of the discrete time signal $x(n) = 2^n U[n]$ and also plot magnitude and phase spectrum. [5+5]
7. State and prove frequency shifting property of Fourier transform. [2+3]
8. What is aliasing? Determine the Nyquist rate for the continuous time signal $x(t) = 1+\cos(2{,}000\pi t)+\sin(4{,}000\pi t)$ [2+4]
9. a) Derive convolution integral for continuous time LTI system. [6]
   b) Compute convolution sum of signal x[n] = {1, 2, 0, -1} and h[n] = {2, 0, 2}. [7]
10. For a system characterized by linear constant coefficient difference equation: y(n) = 0.3y(n-1)+x(n), find the transfer function, plot magnitude and find the impulse response of the system. [6]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define Energy signal and power signal. Determine whether the signal $x(t)=e^{-3t}$ is a power signal or energy signal or neither energy nor power signal. [3+4]
2. Derive the necessary condition for the discrete time signal $x[n]=e^{jwn}$ to be periodic. [4]
3. Derive the expression of continuous time exponential Fourier series $x[n]=A\sin\omega_0 n$ [6]
4. Find Fourier series coefficients of signal and plot the coefficients. [5]
5. State and prove the frequency shifting and convolution properties for discrete time Fourier series pair. [3+3]
6. State and prove the Parseval's relation for energy density spectrum. [2+4]
7. Find Fourier transform of signal $x[n]=a^n u[n]$(where $0<a<1$) and plot magnitude and phase spectrum. [3+2]
8. What is aliasing effect and how can we overcome it? Determine Nyquist rate for a continuous time signal $x(t)=2\sin 40\pi t+10\cos 200\pi t+5\cos 100\pi t$. [3+3]
9. What is LTI system? For LTI system, describe the properties: (a) linearity (b) stability (c) time invariance and (d) causality. [2+8]
10. Derive the expression for impulse response of RC filter and plot the magnitude and phase. [4+2]
11. What do you mean by convolution? Derive the expression for convolution of two discrete time signals. [2+6]
12. A discrete time LTI system is defined by the impulse response $h[n]=\begin{cases} n & ; -2\le n\le 2 \\ 0 & ; \text{otherwise} \end{cases}$. If the input to the given system is $x[n]=\{1,-0.25,0,-1,0.5,-0.5\}$, find and plot the output of the system. [7]
13. Find the Fourier Transform of the unit step signal. [4]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL. BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Differentiate between continuous time and discrete time signals with examples. Show that
$U[n] = \sum_{k=0}^{\infty} \delta[n-k]$ [2+4]

2. Calculate the fundamental period and fundamental frequency of the periodic signal
$x[n] = 3\sin\left(\frac{7\pi}{5}n + \frac{\pi}{2}\right)$ [4]

3. Derive the expression for finding even and odd part of signal x(t). Explain time scaling and time folding. [2+3]

4. Define discrete time complex exponential signal and its different types of behavior. [2+3]

5. a) Derive the expression for Fourier transform equation and inverse Fourier transform equation for continuous time aperiodic signals. [8]

   b) State and prove Frequency shift property of the continuous time Fourier Transform. [3]

6. State and prove Parseval's relation for the Discrete time periodic signal. [5]

7. What are the differences between Fourier series and Fourier Transform? Find the Fourier transform of the discrete time signal $x[n] = a^n \begin{cases} |a| < 1 \\ 0 < a < 1 \end{cases}$ [2+6]

8. Derive the expression for convolution integral for continuous time signal. [6]

9. What is LTI system? In a LTI system show that convolution operation is commutative, find y[n] when $x[n] = \{\underset{\uparrow}{1},2,3,4\}$ and $n[n] = \{\underset{\uparrow}{2},1,2\}$ [2+3+5]

10. What is sampling? Determine the Nyquist rate for the following signal: [2+3]
$x(t) = 1 + \cos(200\pi t) + \sin(4000\pi t)$

11. Derive Formula to calculate the impulse response of continuous time ideal low pass filter. Is this system practically realizable or not. [4+2]

12. Write short notes on: [3×3]
   i) Energy and power signals
   ii) Invertibility of LTI system
   iii) Nyquist theorem

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define even and odd discrete time signal. Derive the periodicity condition for discrete time signal. [2+3]
   b) Define discrete time delta function or signal. Show the relationship between delta function and unit slep function. [2+3]
2. a) Derive Fourier series representation for discrete time signal. [5]
   b) Find the Fourier Series coefficient of the following continuous time periodic signal. [5]

$$x(t)=\begin{cases}1.5 & 0\le t<1\\ -1.5 & 1\le t<2\end{cases}$$ with fundamental frequency π.

3. a) Derive the expression for Fourier transform of continuous time periodic signal. [5]
   b) Find the Fourier transform of the signal $x(t)=e^{-2|t-1|}$ [5]
4. a) State and prove the convolution property of continuous-time Fourier series. [2+4]
   b) What is Parseval's relation? Prove parseval's relation for discrete-time periodic signal. [2+4]
5. Find inverse Fourier transform of the rectangular pulse. [6]

$$X(jw)=1 \qquad -w_c<w<w_c$$
$$=0 \qquad \text{other wise}$$

6. What do you mean by convolution? Derive convolution sum expression. [2+5]
7. a) What do you mean by sampling? Explain. [2]
   b) The signal is sampled at the rate Fs = 300 samples/sec. Determine the frequency of the discrete-time signal $x[n]=x_a(nT), T=1/F_s$ [4]
8. What are the properties of LTI systems? Determine whether the given system is linear or not? $y[n]=e^{x[n]}$ [4+5]
9. Consider a system with impluse response [8]

   $h[n]=\{1, 2, 2, 5\}$

   Determine the output y[n] for input x[n] = {1,3}

10. The signal $x[n]=\cos\frac{\pi}{3}n$ is a periodic signal. What happens if the fundamental frequency of this signal is increased by 2π? [2]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

10

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define energy signal and power signal. Determine whether the signal is a power signal or energy signal. [3+3]
   $x(t) = e^{-at}$ for $a > 0$
   b) Define discrete time unit step signal. Derive the necessary condition for the signal $x[n] = e^{jwn}$ to be periodic. [1+3]
2. a) Derive exponential form of Fourier series for continuous time signal. [5]
   b) State and prove Parseval's relation for the Discrete time periodic signal. [5]
3. Derive the expression for Fourier transform of continuous-time periodic signals. Using this expression obtain the Fourier transform of periodic signal. [4+4]
   $x(t) = 1$ for $0 < t < T, 0$ otherwise
4. a) State and prove the linearity and time shift properties of discrete time Fourier series representation. [6]
   b) State and prove the conjugation property for continuous time Fourier transform. Show that if the signal is real valued in time domain, its spectrum is conjugated symmetric. [4+2]
5. Obtain the DTFT of the signal $x[n] = (n+1)a^n u[n], 0 < a < 1$ [6]
6. What is convolution? Obtain the expression for convolution integral. [2+6]
7. What is impulse train sampling? Explain the aliasing effect that may occur in impulse train sampling. How do you reconstruct original signal from its sample? [1+2+3]
8. What is LTI system? Explain the commutative, associative and distributive properties of discrete time LTI systems. [2+6]
9. The impulse response of a discrete time LTI system is $h[n] = \{\underset{\uparrow}{1}, 1, 2, -1\}$ if input is $x[n] = \{\underset{\uparrow}{1}, 2\}$, find the convolution sum and sketch the output $y[n]$. [6]
10. Find the frequency response $H(e^{jw})$ and impulse response $h[n]$ for a system characterized by linear constant coefficient difference equation $y[n]=0.5y[n-1]+x[n]$. [6]

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26 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BEL	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Find the energy and power of the signal $x[n] = e^{j\omega n}\, u[n]$. $u[n]$ is unit step function. What is the period of signal $x[n] = \cos\left(\frac{41\pi}{7} n\right)$? [6]
2. Plot the signal $x(t) = t(u(t+3) - u(t-3))$. [2]
3. Find Fourier series coefficients for periodic rectangular pulses with unity amplitude. Draw the magnitude spectrum. [5+1]
4. Derive the expression for discrete time Fourier series representation of the signal $x[n]$ periodic with period of N. [7]
5. Determine the expression of Fourier Transform for continuous time aperiodic signal. [7]
6. Perform the convolution and draw output $y[n]$ $x[n] = \{1\ \underset{\uparrow}{2}\ 2\ 3\}$ and $h[n] = \{1\ \underset{\uparrow}{4}\ 3\}$. [7]
7. State and prove Parseval's theorem for continuous time aperiodic signal. [2+4]
8. What is aliasing effect and how can we overcome it? Determine the Nyquist rate for a continuous time signal $x(t) = 6\cos 50\pi t + 20\sin 300\pi t - 10\cos 100\pi t$. [3+3]
9. Find convolution between two signals $x(t) = \begin{cases} e^{0.5t} & \text{for } 0 < t < 5 \\ 0 & \text{otherwise} \end{cases}$ and $h(t) = \begin{cases} 1 & \text{for } 1 < t < 3 \\ 0 & \text{otherwise} \end{cases}$. [7]
10. Derive the expression for impulse response and step response of ideal low pass filter. [4+4]
11. For the LTI system, describe following properties: (a) linearity (b) causality (c) stability (d) time invariance. [6]
12. If the impulse response of continuous time linear time invariant system is $h(t) = e^{-t}u(t-3)$ and input to the system is $x(t) = u(t-2)$, determine the output $y(t)$ of the system. [8]
13. Describe bode plot with example. [4]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX6541)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define energy and power signal with examples. Describe time shifting, time scaling of a signal. [3+4]
2. Derive convolution integral for continuous time LTI system. [8]
3. State and prove Parseval's Relation for Continuous Time Periodic Signal. [6]
4. Explain aliasing that may occur in any arbitrary band-limited signal x(t) with band-width 'W'. [5]
5. Derive the expression for continuous time Fourier series in exponential form. [7]
6. Explain the convolution properties of continuous time Fourier transform. [6]
7. Discuss the following properties of continuous time Fourier series. (a) Time shifting (b) Time scaling (c) Conjunction. [6]
8. Derive the expression of Fourier transform for continuous time signal. [8]
9. Derive the expression for impulse response of ideal low pass filter and discuss. [5]
10. Find the Fourier Transform of a continuous time unit step signal. [5]
11. Discuss different methods to reconstruct a signal. Determine the Nyquist rate for a continuous time signal $x(t)=\frac{1}{2\pi}\cos(200\pi t)\cos(300\pi t)$. [4+4]
12. Convolve the signals $x[n] = \{1, 2, 1\}$ and $h[n] = \{\underset{\uparrow}{1}, 2, 3, 1\}$. [6]
13. If the signal is periodic, find the fundamental period of the signal $x[n]=\cos\left(\frac{\pi}{2}n\right).\cos\left(\frac{\pi}{4}n\right)$. [3]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Calculate the total energy and total average power of the signal given below:

   $x(t) = (3+4j)\, e^{2t}\, u(-t)$

   Also state whether the signal is energy signal, power signal or neither. [3+1]

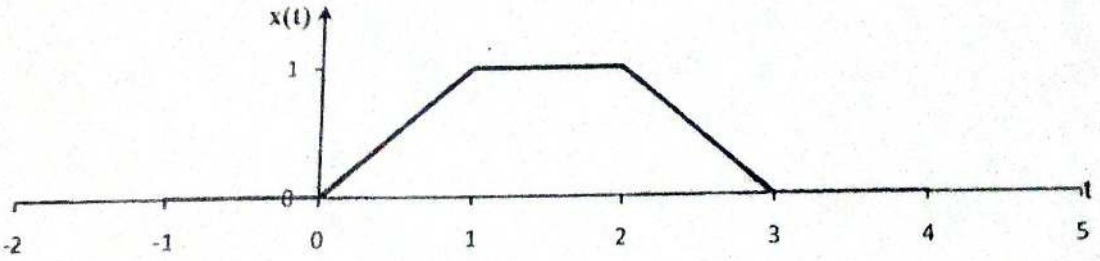
2. Determine whether the signal $x[n] = 5\sin\left(\frac{3\pi}{8}n - \frac{\pi}{2}\right) - 2\cos\left(\frac{7\pi}{12}n\right)$ is periodic or not. If the signal is periodic, calculate its fundamental period and fundamental frequency. [4]

3. How could you represent a signal x(t) with harmonically related exponentials? State and prove conjugation and conjugate symmetry property of CTFS. [4+4]

4. Find the Fourier series coefficients of the signal [6]

   $X[n] = 1 + \sin(2\prod/N)n + 3\cos(2\prod/N)n + \cos(4\prod/N)n$

5. Find the Fourier transform of a trapezoidal signal shown below: [8]



6. How can you generate Fourier transform for discrete time periodic signals? Explain. [3]
7. State and prove Parseval's relation for discrete time Fourier transforms. [5]
8. Compute 4-point DFT of a signal $x[n] = \{2, 1+j, 1-j\}$ and plot its magnitude and phase spectrums. [4+2]
9. State and prove sampling theorem for low pass signals. [6]
10. The impulse responses of two LTI systems are given by $h_1(t) = e^{-\frac{t}{2}}u(t)$ and $h_2(t) = u(t) - u(t-5)$. Determine the equivalent impulse response if these two systems are connected in cascade. Also sketch the graph of equipment impulse response. [8+2]
11. Derive the impulse response for ideal low pass filter with cutoff frequency ω_c. [5]
12. Given a system Y[n] = 0.5y[n-1]+x[n]+x[n+1]. Find out its impulse response and frequency response. [7]
13. What are the properties of LTI system? Show that the output of an LTI system is stable if the impulse response is absolutely summable. [8]

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21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. What do you understand by periodic and aperiodic signals? Explain with the help of examples. [4]

2. Determine whether the following signals are energy or power signals. [4]

   a) $f(t) = 3\cos(2\pi t)$

   b) $x[n] = \cos\left(\frac{n}{6}\right)$

3. What is the information provided by Fourier series coefficients of a signal? State and prove time shifting and conjugation properties of continuous time Fourier series representation. [1+6]

4. Find out Fourier series coefficients of a periodic discrete time signal described over a period as [5+2]

$$x[n] = \begin{cases} 2; & |n| \le 1 \\ 0; & 1 < |n| \le 1 \times 3 \end{cases}$$

Using the Fourier series coefficients calculated above; find the Fourier series coefficients of the signal $e^{j\frac{4\pi}{7}n} x[n]$.

9. Given the relationship $y(t) = x(t)*h(t)$ and $g(t) = x(3t)*h(3t)$ and given that $x(t)$ has the Fourier transform of $X(j\omega)$ and $h(t)$ has Fourier transform $H(j\omega)$, use Fourier transform properties to show that $g(t)$ has the form $g(t) = Ay(Bt)$. Determine the values of A and B. [8]

8. Explain the linearity and time shifting properties of continuous time Fourier transform. [4]

7. Find the Fourier transform of continuous time unit impulse and rectangular pulse. Discuss the result. [6]

8. Find the Fourier transform of everlasting sinusoid $X(t) = \cos\omega_o t$. [4]

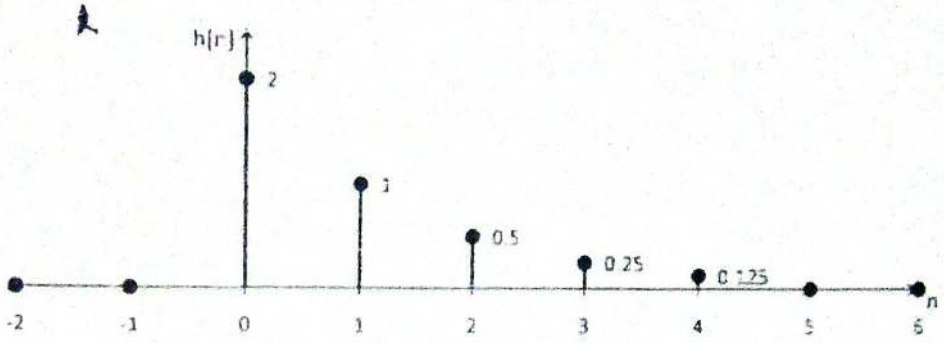
6. What do you mean by aliasing? Explain with the help of frequency domain analysis for impulse-train sampling. [1+5]

10. What are the properties of systems? Determine whether the given system is time-variant or not: $y(t) = \sin[x(t)]$. [2+3]

11. Let $x(t)$ be the input to an LTI system with unit impulse response $h(t)$, where, $x(t) = e^{-at} u(t)$, $a > 0$ and $h(t) = u(t)$. Verify commutative law of LTI system. [5]

12. What is distortionless transmission? Derive the expression for unit step response of ideal low pass filer. [5]

13. A discrete time LTI system has an impulse response as shown below: [6+2]



If the input to the given system is x[n] = {–0.25, 0.5, 1, –0.5, 0, 0.25}, calculate and plot the output of the system.

14. Define systems with memory and memory-less systems with examples. Explain the causality property of discrete time LTI systems. [3+4]

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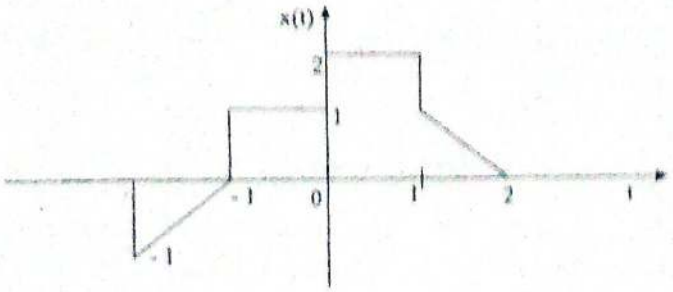
21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Signal Analysis *(EX651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define energy and power type signal with suitable examples. Sketch and label the signal $y(t) = \{x(t) + x(-t)\}u(t)$ for given signal $x(t)$ depicted below. [3+5]



2. Derive the expression for Fourier series representation of a signal x(t) periodic with period T. [8]
3. Find the Fourier series representation of the signal $x[n] = \sum_{\ell=-\infty}^{\infty} \delta[n - \ell N]$. [6]
4. State and prove Parseval's theorem for continuous time aperiodic signal. [4]
5. A LTI system has input $x(t) = e^{-t}u(t)$ and impulse response $h(t) = e^{t}u(-t)$. Find output y(t) of the system using Fourier transform of x(t) and h(t). [8]
6. Compute discrete time Fourier transform of the discrete time signal $x[n] = \left(\frac{1}{2}\right)^{n} u[-n-1]$ [5]
7. Find circular convolution of the signal $x[n] = \{\underset{\uparrow}{1}, 0, 0, 1\}$ and $y\{\underset{\uparrow}{2}, 0, 2\}$. [5]
8. What is sampling. How are spectrum of continuous time signal and its sampled version related? Illustrate with diagram. [6]
9. Write about the following properties of continuous time system: (a) Linearity (b) Causality (c) Memory (d) Stability (e) Time invariance. [5]
10. Derive the expression for impulse response and step response of first order continuous time system described by the differential equation $\tau \frac{dy(t)}{dt} + y(t) = x(t)$. [5]
11. If the impulse response of continuous time linear time invariant system is $h(t) = u(t)-u(t-3)$ and input to the system is $x(t) = u(t+4) - u(t)$, determine the output y(t) of the system. [5]
12. Find output of a LTI system using convolution sum, if the input signal is $x[n]=\delta[n]+2\delta[n-1]-\delta[n-3]$ and impulse response of the system is $h[n] = 2\delta[n+1] + 2\delta[n-1]$. [7]
13. For a system characterized by Linear constant coefficient difference equation $y[n] = 0.5y[n-1]+x[n]$, find the frequency response $H(e^{jw})$ and impulse response h[n]. Also plot the frequency response magnitude $|H(e^{jw})|$ [8]

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