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
   $x[n] = \sin w_0 n$ 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
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. (7) [3+4]
2. Derive convolution integral for continuous time LTI system. (3) [8]
3. State and prove Parseval's Relation for Continuous Time Periodic Signal. (5) [6]
4. Explain aliasing that may occur in any arbitrary band-limited signal x(t) with band-width 'W'. (3) [5]
5. Derive the expression for continuous time Fourier series in exponential form. (7) [7]
6. Explain the convolution properties of continuous time Fourier transform. (6) [6]
7. Discuss the following properties of continuous time Fourier series. (a) Time shifting (b) Time scaling (c) Conjunction. (6) [6]
8. Derive the expression of Fourier transform for continuous time signal. (7) [8]
9. Derive the expression for impulse response of ideal low pass filter and discuss. (5) [5]
10. Find the Fourier Transform of a continuous time unit step signal. (4) [5]
11. Discuss different methods to reconstruct a signal. Determine the Nyquist rate for a continuous time signal $x(t)=\frac{1}{2\pi}\cos(200\pi t)\cos(300\pi t)$. (6) [4+4]
12. Convolve the signals x[n] = {1, 2, 1} and h[n] = {1, 2, 3, 1}. (6) [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) [3]

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10/09

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 πt + 20 sin 300 πt – 10 cos 100 πt. [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
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]

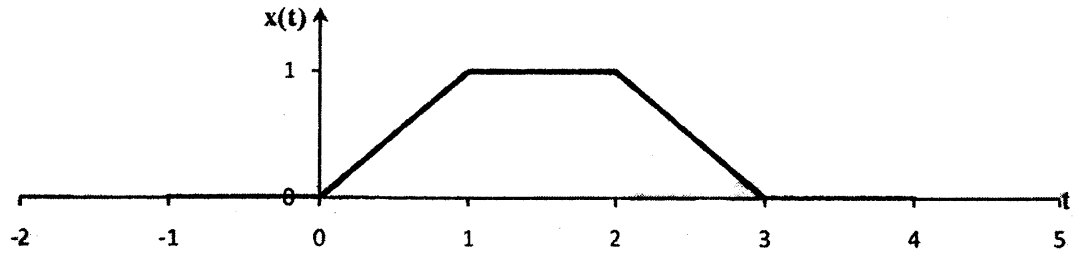
2. Determine whether the signal $x[n] = 5\sin\left(\frac{3\pi}{8}n - \frac{\pi}{2}\right) - 2\cos\left(\frac{7\pi}{12}n\right)$ is periodic or not. If the signal is periodic, calculate its fundamental period and fundamental frequency. [4]

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]

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

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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33G TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Signal Analysis *(EG634EX)*

- ✓ 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.*

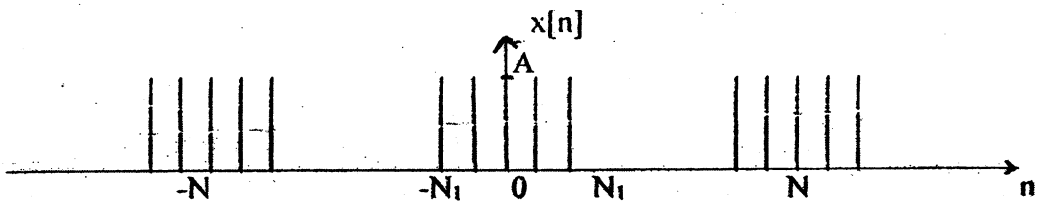
1. Define deterministic and random signal. Determine whether the given signal is energy signal or power signal or neither. [2+4]

$$x(t) = 5\cos(\pi t) + \sin(5\pi t), \quad -\infty < t < \infty$$

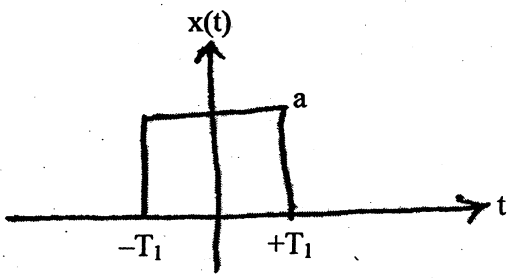
2. Find the fundamental period of the discrete-time signal given below. [4]

$$x[n] = 1 + e^{j(4\pi/7)n} - e^{j(2\pi/5)n}$$

3. How can you represent a signal x(t) with harmonically related exponentials? State and prove conjugation and conjugate symmetry property of continuous time fourier series. [3+5]
4. Determine the Fourier series coefficients of the periodic signal shown in figure below. [6]



5. **Determine the Fourier transform of the rectangular pulse shown in figure below:** [6]



6. State and prove multiplication property of Fourier transform. [4]
7. What is an ideal lowpass filter? Determine the response of RC lowpass filter to a unit step input signal. [2+6]
8. Define DFT. Compute DFT of the following sequence: [2+6]

$$x[n] = u[n] + u[n-1] - u[n-2] - u[n-4]$$

9. What is FFT? How it differs with DFT? Explain Radix-2 algorithm. [8]
10. A continuous-time signal x(t) is applied to the input of a continuous-time LTI system with impulse response h(t). Find the output y(t) given that $x(t) = e^{1}\,u(-t)$ and $h(t) = u(t-4)$. [7]
11. Consider the two sequences [9]

$$x[n] = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{Otherwise} \end{cases} \quad \text{and} \quad h[n] = \begin{cases} a^n, & 0 \le n \le 6 \\ 0, & \text{Otherwise} \end{cases}$$

12. What are the recursive and non-recursive systems? Explain with example. [6]

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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.*

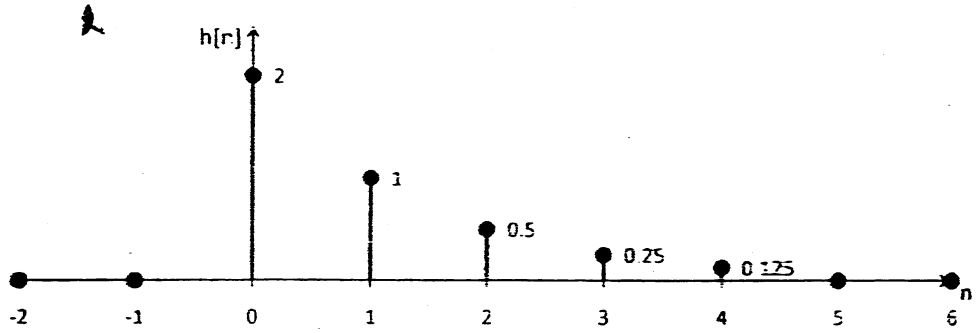
1. What do you understand by periodic and aperiodic signals? Explain with the help of examples. [4]
2. Determine whether the following signals are energy or power signals. [4]
   a) $f(t) = 3\cos(2\pi t)$
   b) $x[n] = \cos\left(\frac{n}{6}\right)$
3. What is the information provided by Fourier series 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 $e^{j\frac{4\pi}{7}n}x[n]$.
5. 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]
6. 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]
9. 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, $\underset{\uparrow}{1}$, –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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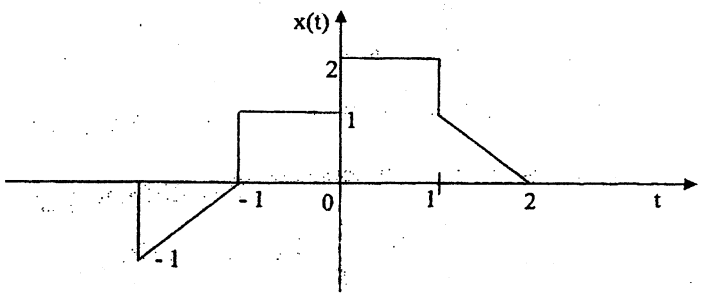
21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

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. ALTI system has input $x(t) = e^{-1}u(t)$ 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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31R TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

Subject: - Signal Analysis

- ✓ 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 $x(t) = e^{-10t}\cos(30\pi t)u(t)$. What is the period of signal $x(t) = \cos\left(\frac{t}{7} + \frac{\pi}{4}\right) + \cos\left(\frac{t}{11} + \frac{\pi}{3}\right)$ [6]
2. If compact trigonometric Fourier series representation of periodic signal x(t) with period T is $x(t) = c_0 + \sum_{n=1}^{\infty} c_n \cos(n\omega t - \theta_n)$ where c_0, c_n, θ_n are representation parameters, then derive expression for exponential Fourier series representation of the signal from the given compact trigonometric Fourier series representation. [6]
3. If periodic signal x(t) with period T = 4 is defined over a period as [6]
   $x(t) = \begin{cases} 1-|t|, & |t| \le 1 \\ 0, & |t| \le 2 \end{cases}$, then find the Fourier series coefficients of the signal.
4. A discrete time signal x[n] periodic with period N = 4 has Fourier series coefficients given by $a_k = \cos\left(\frac{3\pi k}{2}\right)$, find the expression for signal x[n] over a period. [6]
5. Determine the expression of Fourier Transform for continuous time aperiodic signal x(t). For given Fourier Transform, $x(jw) = \delta(w + 4) + \delta(w + 2) + \delta(w) + \delta(w - 2) + \delta(w - 4)$, find its inverse Fourier Transform x(t). [4+4]
6. If x(t) is real with Fourier transform $X(\omega)$ and $x_o(t)$ is odd component of x(t) then find Fourier transform of $x_o(t)$ in terms of $X(\omega)$. [6]
7. Determine the impulse response and step response of series RLC circuit with input voltage V(t) and output capacitor voltage $V_c(t)$. [7]
8. Convolve the signals $x_1[n] = 0.5^n u[n]$ and $x_2[n] = u[n] - u[n-5]$. [7]
9. If the impulse response of LTI system is $h(t) = e^{-1}u(t + 2)$ and input to the system is $x(t) = u(t) - u(t - 4)$ then determine the output of the system y(t). [5]
10. What do you mean by distortionless transmission line? [3]
11. If system $y(t) = x(2t + 2)$ where y(t) is output and x(t) is input to the system. Is the system (a) linear (b) time invariant (c) casual (d) memory-less (e) stable? [5]
12. Find the discrete Fourier transform of the signal $x[n] = [1, -1, 1, -1]$ using decimation in frequency Fast Fourier Transform algorithm. [7]
13. Find the system function H(z) of the system characterized by difference equation $y[n] = 0.9y[n - 1] + x[n]$. Plot the frequency response magnitude $|H(e^{j\omega})|$ and find the impulse response h(n) of the system. [8]

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31B TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

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

Subject: - Signal Analysis

- ✓ 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 signals with example. Determine whether the signal $x(t) = e^{-2t}\,u(t)$ is power or energy signal and calculate the corresponding measure. [6]
2. Find the Fourier series coefficients of periodic signal x(t) defined over a period of

$$T = 6 \text{ as } x(t) = \begin{cases} \text{rect}\left(\frac{t}{4}\right) + 2\delta(t-2) + 3\delta(t+2), & |t| \le 2 \\ 0, & 2 < |t| \le 3 \end{cases}, \text{ where } \text{rect}\left(\frac{t}{\tau}\right) = \begin{cases} 1, & |t| \le \frac{t}{2} \\ 0, & |t| > \frac{t}{2} \end{cases}$$

and $\delta(t) = \begin{cases} 1, & t = 0 \\ 0, & \text{otherwise} \end{cases}$. [10]

3. Determine the Fourier transform of the signal x(t) given by, [8]

$x(t) = (t-2)\{u(t-2) - u(t-3)\} - (-t-2)\{u(-t-2) - u(-t-3)\}$ where $u(t) = \begin{cases} 1, & t \ge 0 \\ 0, & t < 0 \end{cases}$.

4. Write the conjugation and conjugate symmetry property of Fourier transform. [6]
5. For linear time invariant system consisting of resistor R, capacitor C input $v_g(t)$ connected in series, if the output of the circuit is capacitor voltage $v_c(t)$, determine the impulse response and step response of this system. [8]
6. Determine the 4-point DFT of the signal $x(n) = [u(n) + u(n-1) - u(n-3) - u(n-4)]$. How FFT is efficient? Explain. [6+2]
7. Show that the energy spectral density of energy signal is the Fourier transform of its autocorrelation function. [5]
8. Find impulse response of ideal LPF for distortionless transmission. Is this system practically realizable or not? [5+2]
9. Find the circular convolution of signals $x_1[n] = [1,0,0,1]$ and $x_2[n] = [2,0,2]$. [5]
10. If the impulse response of system is $h(t) = e^{-1}\,u(t)$ and input to the system is $x(t) = u(-t-1)$, determine the output of the system y(t) where $u(t) = \begin{cases} 1, & t \ge 0 \\ 0, & t < 0 \end{cases}$. [5+1]
11. Define FFR and IFR system with examples for the system given [2+4]

$y[n] - \frac{3}{4}\,y[n-1] + \frac{1}{8}\,y[n-2] = 2x[n]$

Find out the impulse response.

12. Let a given system be $y(t) = x(t + t_0)$, $t_0 > 0$ where y(t) is output and x(t) is input to the system. Is the system (a) linear (b) time invariant (c) causal (d) memory less (e) stable? [5]

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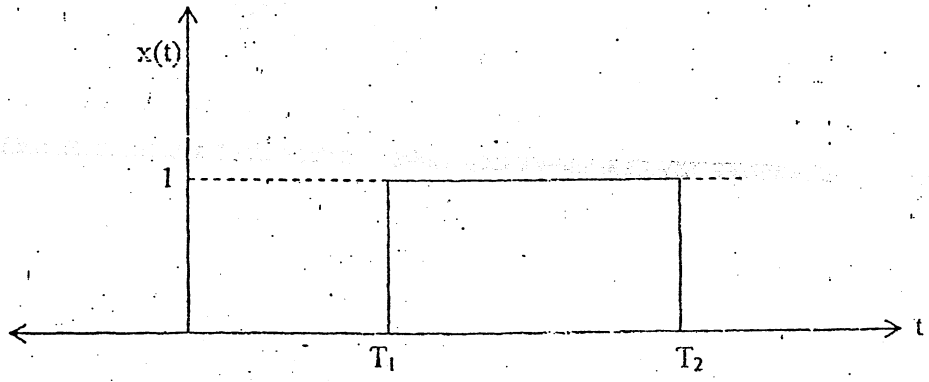
31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Jestha

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

Subject: - Signal Analysis

- ✓ 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 time variant and invariant system. Determine whether the system. [4+2+2]
   a) $y[n] = nx[n] + (1 - n)\, x[n]$ is time-variant or time invariant
   b) $y[n] = x[0] + x[-1] + nx[n]$ is linear or non linear
2. Show plot of the signal $\sum_{k=-\infty}^{\infty}\delta(t - kT)$. Is this signal discrete time or not? If it is discrete time signal, how can it be converted to continuous time; and if not in what respect it differ from it's discrete time counterpart? [2+4]
3. Prove that output of continuous time LTI system is convolution of input signal and its impulse response. [7]
4. Given a signal $x(t) = u(t)$, where $u(t)$ is casual unit step signal. Find out its total energy and total average power. Is this signal energy type or power type? [5+1]
5. State and verify distribute property of convolution of discrete time signals using convolution formula taking examples of three signals x[n], y[n] and z[n]. [1+5]
6. Consider a signal as shown in figure below. [4+6]



Find its Fourier transform and show it's magnitude and phase spectrum for
   a) $T_1 = 0$ and $T_2 = T$ (constant value)
   b) $T_1 = T/2$ and $T_2 = 3\,T/2$
   c) $T_1 = T/2$ and $T_2 = 5\,T/2$
7. Show, with necessary mathematical derivations, that "continuous time Fourier transform is the limiting case of continuous time Fourier series". [7]

8. Give a signal X(k) = $\{\underset{\uparrow}{0}, 1, 2, 3\}$ repeating every 4 points. Assume this as Discrete Fourier Transform of a discrete time signal x[n], determine x[n] and show it's plot for n = -3 to 7.
9. Using FFT algorithm, find the X(3) of the input sequence x(n) = $\{\underset{\uparrow}{0}, 1, 2, 3, 3, 2, 1, 0\}$.
10. Define recursive and IIR system. Highlight the difference between them.
11. Given an system in difference equation y[n] = 0.5y[n-1] + 0.3y[n-2] + 0.8x[n-1] + 0.6x[find out its impulse response and also draw direct from I structure of this system.
12. The ideal low pass filter is that filter whose output is exactly identical with input sig except some constant multiplier in amplitude and some shift in time domain. Prove t this will be possible only if transfer function of the filter is constant amplitude and lir phase. Also defined as Determine impulse response of ideal low pass filter. Is this cas anti-casual or non casual? Discuss.

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31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Jestha

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

Subject: - Signal Analysis

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 time variant and invariant system. Determine whether the system. [4+2+2]
   a) $y[n] = nx[n] + (1 - n)\,x[n]$ is time-variant or time invariant
   b) $y[n] = x[0] + x[-1] + nx[n]$ is linear or non linear

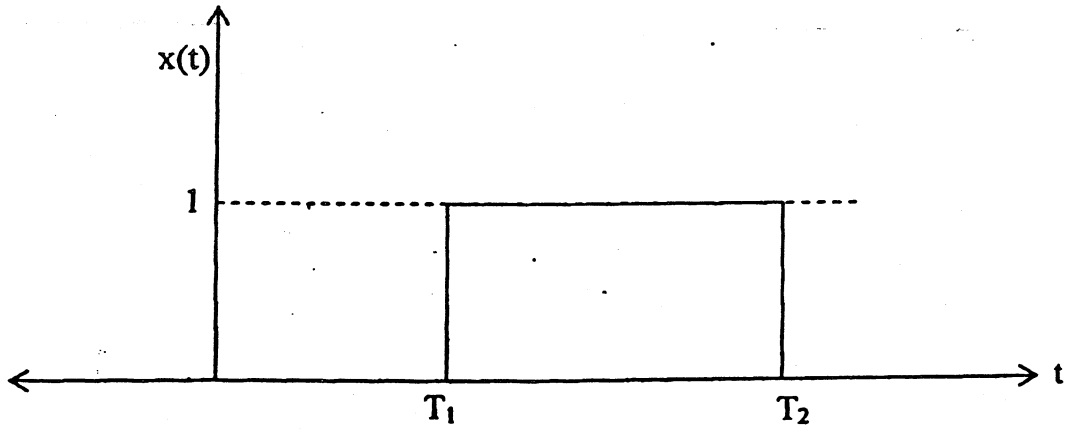
2. Show plot of the signal $\sum_{k=-\infty}^{\infty}\delta(t - kT)$. Is this signal discrete time or not? If it is discrete time signal, how can it be converted to continuous time; and if not in what respect it differ from it's discrete time counterpart? [2+4]

3. Prove that output of continuous time LTI system is convolution of input signal and its impulse response. [7]

4. Given a signal x(t) = u(t), where u(t) is casual unit step signal. Find out its total energy and total average power. Is this signal energy type or power type? [5+1]

5. State and verify distribute property of convolution of discrete time signals using convolution formula taking examples of three signals x[n], y[n] and z[n]. [1+5]

6. Consider a signal as shown in figure below. [4+6]



Find its Fourier transform and show it's magnitude and phase spectrum for
   a) $T_1 = 0$ and $T_2 = T$ (constant value)
   b) $T_1 = T/2$ and $T_2 = 3\,T/2$
   c) $T_1 = T/2$ and $T_2 = 5\,T/2$

Show, with necessary mathematical derivations, that "continuous time Fourier transform is the limiting case of continuous time Fourier series". [7]

8. Give a signal X(k) = $\{\underset{\uparrow}{0}, 1, 2, 3\}$ repeating every 4 points. Assume this as Discrete Fourier Transform of a discrete time signal x[n], determine x[n] and show it's plot for n = -3 to 7. [4+1]

9. Using FFT algorithm, find the X(3) of the input sequence x(n) = $\{\underset{\uparrow}{0}, 1, 2, 3, 3, 2, 1, 0\}$. [7]

10. Define recursive and IIR system. Highlight the difference between them. [4+2]

11. Given an system in difference equation y[n] = 0.5y[n-1] + 0.3y[n-2] + 0.8x[n-1] + 0.6x[n], find out its impulse response and also draw direct from I structure of this system. [4+2]

12. The ideal low pass filter is that filter whose output is exactly identical with input signal except some constant multiplier in amplitude and some shift in time domain. Prove that this will be possible only if transfer function of the filter is constant amplitude and linear phase. Also defined as Determine impulse response of ideal low pass filter. Is this casual, anti-casual or non casual? Discuss. [4+2]

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31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Bhadra

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

Subject: - Signal Analysis

- ✓ 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 energy and power signals? Explain with suitable examples. Find total energy and average power of the following signals. [4+2+2]
   a) $x(t) = e^{-4t} . u(t)$
   b) $x[n] = \{3, \underset{\uparrow}{1}, 0, 2+2j, 7\}$

2. Find the convolution of the two signals given in figures 2(a) and 2(b). [5+2]

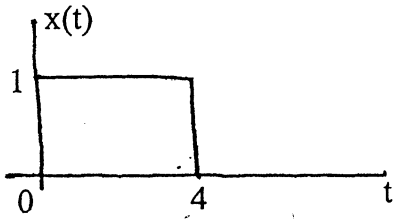


Figure 2(a)

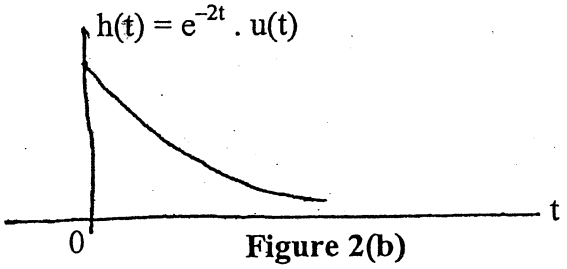


Figure 2(b)

If x(t) is advanced by 1 unit and h(t) is delayed by 1 unit, find the convolution of the new signals giving appropriate reasons.

3. A discrete time signal x[n] (shown in figure 3(a)) is applied to an LTI system to produce an output y[n] (shown in figure 3(b)). [6]

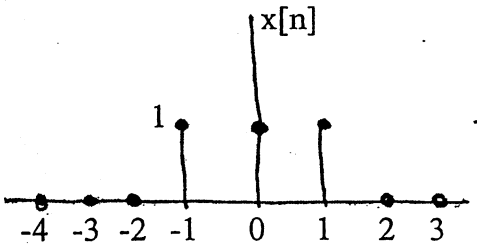


Figure 3(a)

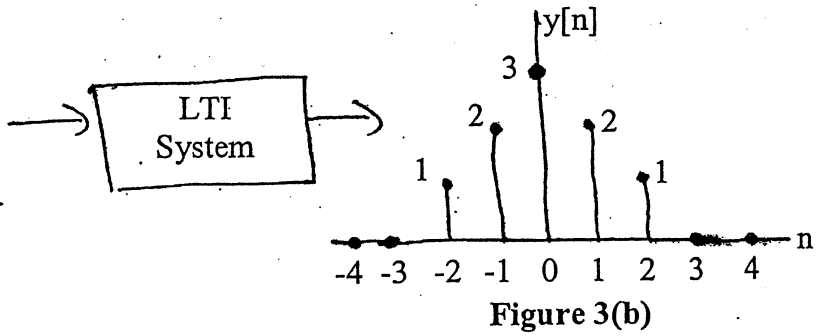


Figure 3(b)

Find the output of the same system, if signal w[n] as shown in figure 3(c) is applied to it.

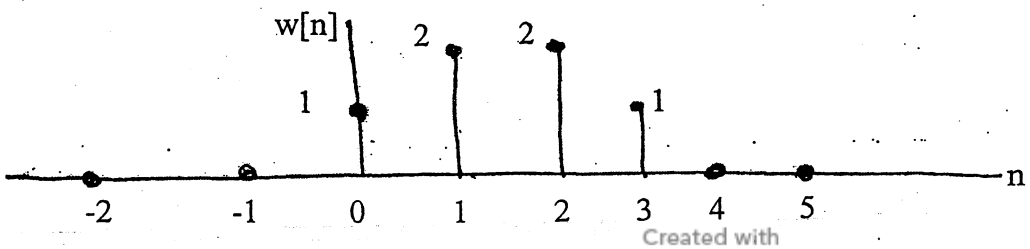
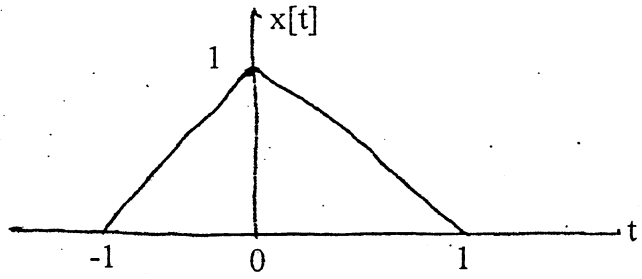


Figure 3(c)

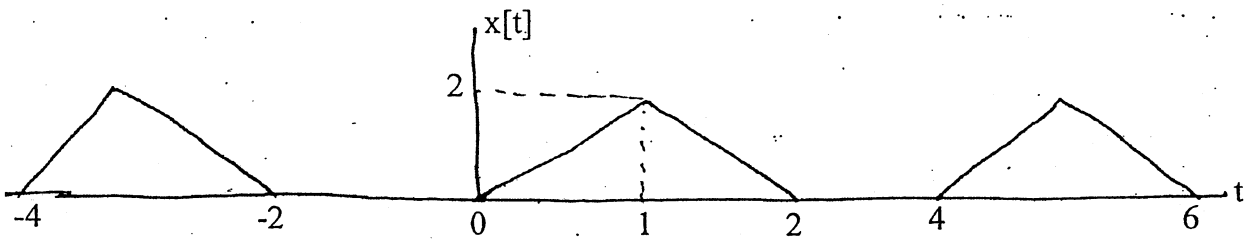
4. Find the Fourier transform of the continuous time aperiodic signal given below. [8]



5. What is the importance of FFT? Find 4-point DFT of the sequence, $x[n] = \{\underset{\uparrow}{1}, 7, 4, 3\}$ using FFT structure. [2+5]

6. Differentiate between FIR and IIR systems using suitable examples. An LTI system is defined by the system function, $H(z) = \frac{\alpha(1+z^{-1})(3-2z^{-1})}{3(1-z^{-1})(1-3/5z^{-1})(1+5/3z^{-1})}$. Realize the system using Direct Form II structure. [4+5]

7. Find the Fourier series coefficients of the continuous time periodic signal shown in figure below. [10]



8. Define distortion. What do you understand by ideal distortionless transmission line? Differentiate it from a practical transmission line. [2+6+1]

9. Prove that the discrete Fourier transform of circular convolution of two discrete time sequences is equal to the product of discrete Fourier transforms of individual sequences. [8]

10. Prove Parseval's theorem for continuous time periodic signals. What is its significance? [7+1]

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31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Bhadra

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

Subject: - Signal Analysis

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

1. What do you understand by energy and power signals? Explain with suitable examples. Find total energy and average power of the following signals. [4+2+2]

   a) $x(t) = e^{-4t} . u(t)$

   b) $x[n] = \{3, \underset{\uparrow}{1}, 0, 2+2j, 7\}$

2. Find the convolution of the two signals given in figures 2(a) and 2(b). [5+2]

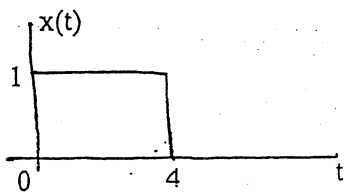


Figure 2(a)

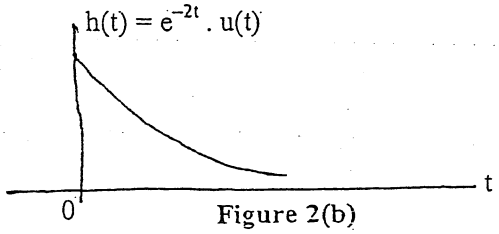


Figure 2(b)

If x(t) is advanced by 1 unit and h(t) is delayed by 1 unit, find the convolution of the new signals giving appropriate reasons.

3. A discrete time signal x[n] (shown in figure 3(a)) is applied to an LTI system to produce an output y[n] (shown in figure 3(b)). [6]

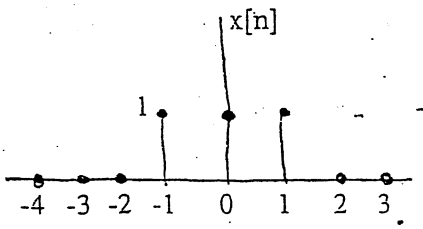
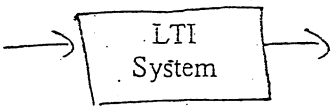


Figure 3(a)



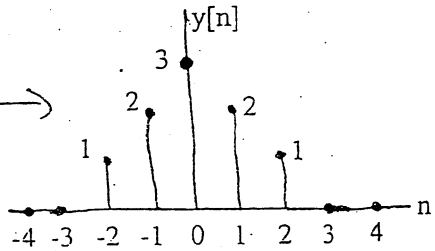


Figure 3(b)

Find the output of the same system, if signal w[n] as shown in figure 3(c) is applied to it.

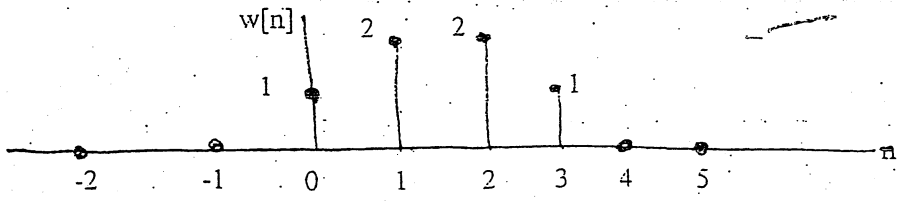
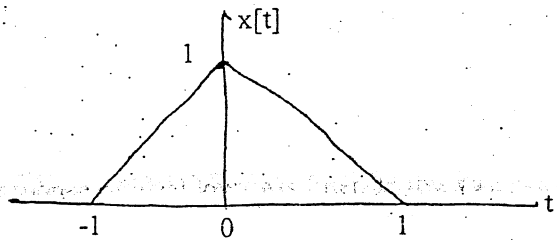


Figure 3(c)

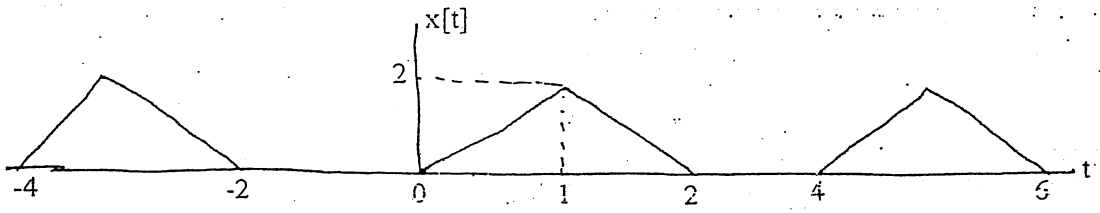
4. Find the Fourier transform of the continuous time aperiodic signal given below. [8]



5. What is the importance of FFT? Find 4-point DFT of the sequence, $x[n] = \{\underset{\uparrow}{1}, 7, 4, 3\}$ using FFT structure. [2+5]

6. Differentiate between FIR and IIR systems using suitable examples. An LTI system is defined by the system function, $H(z) = \frac{\alpha(1+z^{-1})(3-2z^{-1})}{3(1-z^{-1})(1-3/5z^{-1})(1+5/3z^{-1})}$. Realize the system using Direct Form II structure. [4+5]

7. Find the Fourier series coefficients of the continuous-time periodic signal shown in figure below. [10]



8. Define distortion. What do you understand by ideal distortionless transmission line? Differentiate it from a practical transmission line. [2+6+1]

9. Prove that the discrete Fourier transform of circular convolution of two discrete time sequences is equal to the product of discrete Fourier transforms of individual sequences. [8]

10. Prove Parseval's theorem for continuous time periodic signals. What is its significance? [7+1]

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4-24

31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Shrawan

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

Subject: - Signal Analysis

- ✓ 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. Discuss scope of signals and systems. Define continuous time unit step signal. Determine total energy and total average power of this signal. [3+6]
2. Show the graph (plot) of the signal defined as "1 – (full wave rectified sin signal with amplitude 1V and frequency 100Hz)". Find out its complex Fourier series coefficients and show line spectrum. [2+5+3]
3. Discuss alternate forms of Fourier series representation. Show relations between different forms of Fourier series coefficients. [5]
4. Define inverse Fourier transform. What happens in the frequency domain representation of signal x(t) when its time axis is scaled by real constant a (x(at))? Discuss and verify. [2+5]
5. Find out Fourier transform of a shifted rectangular pulse and show its spectrum. [4+4]
6. Find the impulse of RC low pass filter? Find out response of this RC low pass filter to a step signal input. [3+5]
7. Define power of a signal. Show that total average power of a continuous time periodic signal can also be determined from complex Fourier series coefficients. [7]
8. Define convolution of discrete time signals. Verify commutative property of convolution using the signals {1,2,3,4} and {2,1,2,1}. [2+4]
9. What is the condition for preventing time domain aliasing in DFT calculation? Discuss. Explain DFT computation as linear transformation with example. [2+4]
10. Find out DFT of the signal {1,2,3,4,1} using FFT algorithm. [6]
11. Define recursive and non-recursive systems. Give examples of each. Find out impulse response of the recursive system you discussed in above example. [5+3]

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31 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2064 Jestha

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

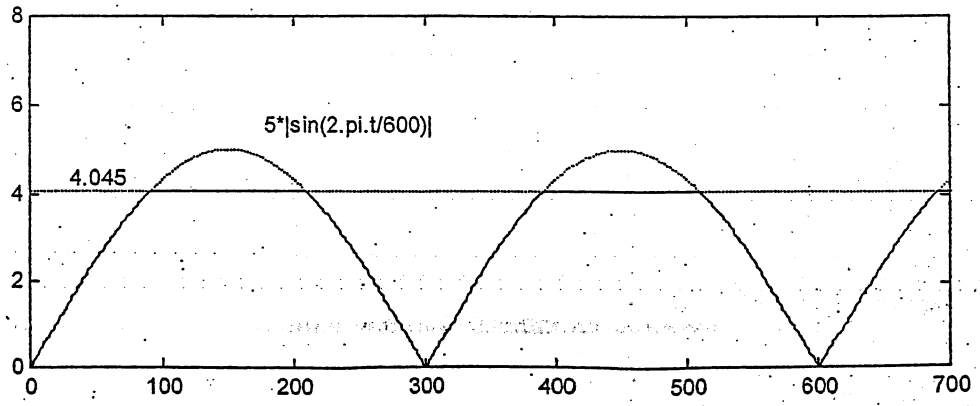
Subject: - Signal Analysis

- ✓ 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 signal and system. Discuss various characteristics of systems. (4+6)
2. Define causal system. Give an example of a causal system and discuss why it is causal (2+4)
3. Find out the convolution of the signals (8)

$$x(t) = \begin{cases} \exp(0.5t) & \text{for } 0 < t < 5 \\ 0 & \text{otherwise} \end{cases} \quad \text{and} \quad y(t) = \begin{cases} 1 & \text{for } 1 < t < 3 \\ 0 & \text{otherwise} \end{cases}$$

4. Define energy and power of a signal. Consider a periodic signal represented by the sequence {1, 2, 0, 5, 3, 7, 0, 9} repeating in a period of N = 8. Find its total average power and total energy. (4+5)
5. Consider a periodic signal x(t) = 5 sin(2.pi.t/600) as shown in the figure where vertical axis is the signal value and horizontal axis is the time (t) in seconds. Waveform is clipped at voltage level 4.045.



Find out its Fourier series coefficients using continuous time Fourier series analysis equation. Show plot the corresponding magnitude spectrum. (6+3)

6. State and prove multiplication property – time domain multiplication of two signals - of DTFT (discrete time Fourier transform) (7)
7. Distinguish between DFT and FFT. Explain linear transformation method of DFT calculation with a suitable example. (3+5)
8. Given a system y[n] = 0.5 y[n-1] + 0.3 y[n-2] + 0.8 x[n] + 0.6 x[n-1], find it's impulse response and determine whether it is causal or not. (5+2)
9. What are the characteristics of FIR system? Give an example of FIR system and discuss its characteristics that make it distinct from IIR system (4+4)
10. What are the characteristics of ideal channel for signal transmission? Also find the step response of ideal filter. (3+5)