FACULTY OF ENGINEERING AND TECHNOLOGY

B.Tech. II/IV (EI, ECE, EEE) (II-Semester) Examination

SIGNALS AND SYSTEMS

Time : Three Hours] [Maximum Marks : 100

Answer ALL questions.
All questions carry equal marks.

1. (a) Give definition of time variant, noncausal and linearity properties of system.
   (b) Evaluate Mean square error of a signal.
   (c) Explain difference between Fourier series and Fourier transform.
   (d) Explain Parsevals theorem.
   (e) Define Gaussian probability density.
   (f) Give classification of systems in Discrete Time.
   (g) Write two points about Z transform.

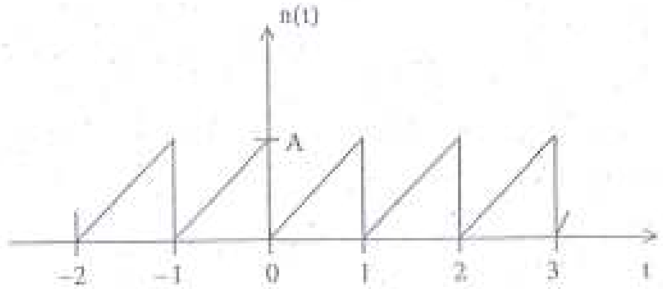
2. (a) Determine the convolution integral of the LTI system to x(t) be the I/P to an LTI system with unit impulse response h(t) where

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

   (b) Write differences between ESD and PSD.

OR

   (c) Determine the trigonometric Fourier series representation for Triangular wave shown in Fig.



   (d) Explain properties of Fourier series.

Or

[P.T.O.

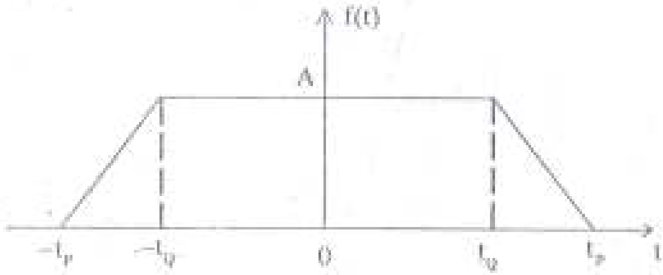
3. (a) Explain properties of Fourier Transform.

(b) Determine Fourier Transform of

$\delta(t)$, $u(t) \cos w_c t$, $\sin w_c t$.

OR

(c) Find the Fourier transform of the trapezoids pulse shown in Fig.



(d) Determine the Fourier transform of the signal

$x(t) = t \cos At\, u(t)$.

4. (a) Define auto correlation and cross correlation function of a random process x(–) and y(–). Show that the auto correlation function and the power spectral density function of a random process are Fourier Transform pair.

(b) Find energy of the six pulse

$x(t) = \sin(2wt)$.

OR

(c) Prove that the probability distribution of sum of two variables having Poisson distribution is also a Poisson distribution.

(d) Explain ESD/PSD.

5. (a) Explain properties of Z transform.

(b) Find Z transform of

$x[n] = \alpha^n u[n]$

OR

(c) Explain properties of ROC is Z transform.

(d) Find Inverse Z transform of

$$x(z) = \frac{1}{1 - az^{-1}}, |z| > |a|.$$

FACULTY OF ENGINEERING AND TECHNOLOGY

B.Tech. II/IV Year (EI, ECE, EE) (Semester) Examination

SIGNALS AND SYSTEMS

Time : Three Hours] [Maximum Marks : 100

*Answer **ALL** questions.*

All questions carry equal marks.

1. (a) Define Convolution in time domain.

   (b) Write below Fourier Transform Properties :

   (i) Symmetry Property

   (ii) Linearity Property.

   (c) Split the signal $X(t) = e^t$ into **even** and **odd** parts.

   (d) If **sin (ω)** is the input **Power Spectral Density,** what is the **Power Spectral Density** of the output of an ideal differentiator ?

   (e) Define Region of Convergence in the Z-Plane.

   (f) Write any two limitations of Z-Transforms.

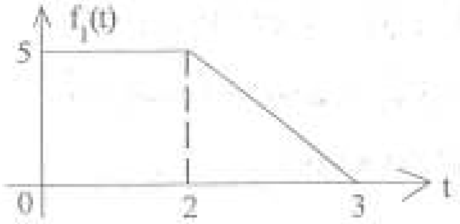
   (g) Write any two properties of Cumulative Distribution Function.

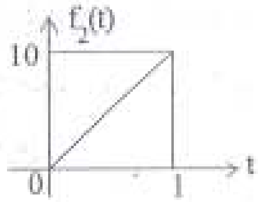
2. (a) Use convolution integral to find response y(t) of an LTI system with impulse response $h(t) = u(t-1)$ to the input $x(t) = e^{-2t}\, u(t)$. Sketch the result.

   (b) Find the Exponential Fourier series for $f(t) = \cos(\omega_0)t + \sin^2(\omega_0)t$.

OR

(c) Evaluate the convolution of $f_1(t)$ and $f_2(t)$ as shown below and plot the evaluated waveform.





(d) Split the signal $x(t) = e^t$ into even and odd parts. Show that they are orthogonal over the interval (a, a) for arbitrary 'a'.

3. (a) Find the Fourier transform of the 'signum' function. Draw its amplitude and phase spectrum.

(b) Consider a system with input denoted by x(t) and output denoted by y(t) is given by :

$$y(t) = 5t\,[x(n)]^2.$$

Test the system for

(i) Linearity

(ii) Time Invariant

(iii) Causality.

OR

(c) Find the power spectral density of $f(t) = a \cos(\omega_0 t + \theta)$.

(d) Derive the Parseval's theorem from the frequency convolution property.

4. (a) If the probability density function of a random variable 'X' is given by :

$$f_X(x) = K(1 - x^2) \text{ for } 0 < x < 1$$
$$= 0 \text{ elsewhere}$$

(i) Find the value of 'K'.

(ii) Find the probabilities that 'X' will takes on a value

(a) between 0.1 and 0.2

(b) greater than 0.5

(b) Let 'X' and 'Y' be the random variables having joint probability density function :

$f_{xy}(x, y) = (x + y)$ for $0 \le x \le 1, 0 \le y \le 1$

$= 0$ elsewhere.

Find :

(i) Var(X) (ii) Var(Y) (iii) σ_{xy} (iv) ρ

OR

(c) $f_z(z) = \frac{1}{2}$ for $-1 < z < 1$

$= 0$ elsewhere

$X = Z, Y = Z^2$ where X and Y are not statistically independent.

Find : (i) E(X) (ii) E(Y) (iii) E(XY) (iv) COV(XY).

(d) If X and Y are zero mean Gaussian random variables with variance σ_x^2 and σ_y^2, find the probability density function for Z where Z = X + Y.

5. (a) Find the Z-Transform of $x(n) = r^n \cos\omega n\, u(n)$.

(b) State and prove initial and final value theorem's with reference to Z-transform.

OR

(c) State the properties of 'Region of Convergence' in the Z-Transform.

(d) Determine the Z-Transform and ROC for the following sequence :

$x(n) = 2^n + 3^{-n}$ for $n \ge 0$

$= 0$ for $n < 0$.

FACULTY OF ENGINEERING AND TECHNOLOGY
II/IV B. Tech. (EI, EEE, ECE) (II Semester) Examination
SIGNALS AND SYSTEMS

ne : Three Hours] [Maximum Marks : 100

Answer all questions.
All questions carry equal marks.

(a) Differentiate between energy and power signals by giving example to each. 4

(b) Explain the terms orthogonality and complete or closed set. 4

(c) Write any *four* properties of Hilbert transform. 4

(d) Write short notes on tChebycheffs inequality. 4

(e) Write about realization of Direct forms. II. 4

(a) What is system ? Classify the systems by giving an example to each. 10

(b) Find the Fourier Series of a half wave rectified sine wave. 10

OR

(c) Explain what is singularity function and define any two singularity functions. 10

(d) Write mathematical form of convolution equation and explain it graphically by taking an example. 10

(a) State and prove following properties of Fourier transform :
 (i) Convolution in Time-domain
 (ii) Frequency Shifting
 (iii) Scaling. 10

(b) State and prove Parseval's theorem for Nonperiodic signals. Write properties of power density spectrum. 10

OR

(c) What do you mean by impulse response ? Develop the relationship between input, output and impulse response of the LTI system. 10

(d) Give the concept of Frequency response and transfer function of the linear time-invariant system. 10

4. (a) Give the classification of random processes. 10

(b) Consider the random process $v(t) = \cos(w_0 t + \theta)$ where θ is a random variable with uniform probability density function

$$f(\theta) = \begin{cases} \dfrac{1}{\pi - (-\pi)}; & -\pi \le \theta \le \pi \\ 0 & ; \text{ otherwise} \end{cases}$$

show that v(t) is a stationary process. 10

OR

(c) Find the relation between probability and probability density function. What do you mean by Joint and Conditional probability ? 10

(d) Define mean and variance of a random variable. Taking a random variable of your choice find out its mean and variance. 10

5. (a) State and prove any three properties of z-transform. 10

(b) Find the Inverse z-transform of the following signal using power series expansion : 10

$$X(z) = \frac{1}{1 + az^{-1}};\ |z| < |a|.$$

OR

(c) Obtain the z-transform of :

(i) $na^n u[n]$

(ii) $a^{-n-2} u[n]$. 10

(d) Write short notes on the following :—

(i) Linear convolution

(ii) Cascade and Parallel form of realization. 10

FACULTY OF ENGINEERING AND TECHNOLGGY

II/IV B.Tech. (EI, ECE, EE) (II-Semester) Examination

SIGNALS AND SYSTEMS

me : Three Hours] [Maximum Marks : 100

*Answer **ALL** questions.*

All questions carry equal marks.

(a) Distinguish between linear and non-linear systems and define the order of a system.

(b) Show that if f(t) is an even function of 't' then $f(jw) = 2\int_0^\infty f(t)\cos wt\,dt$.

(c) Determine the Fourier series of $x(t) = e^{-t}$ for $-1 < t \leq 1$.

(d) Explain Rayleigh's energy theorem for Fourier transform.

(e) Explain stationarity and ergodicity.

(f) Evaluate the z-transform for the following sequence :—

$x(n) = \{0, 1, -1, 0, 1, -1, 0, 1, -1, \ldots\ldots\}$.

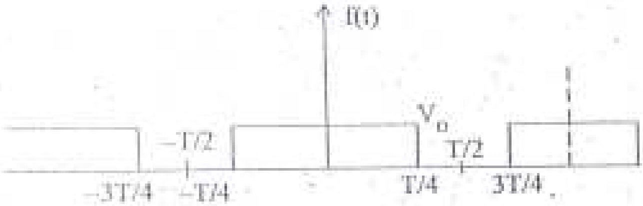
(g) By using appropriate tests check the following for causality, linearity and time invariance :—

(i) $y(n) = \begin{cases} 6x(n-5), \text{ for } 0 \leq n \leq 6 \\ 7x(n-5), \text{ for } n > 6 \end{cases}$

(ii) $y(n) = (n + 3)\, x(n - 3)$, for $n \geq 0$.

(a) Determine whether the following signal is periodic. If the signal is periodic, determine its fundamental period : $x(t) = \left[\sin\left(\frac{\pi t}{6}\right)\right]^2$.

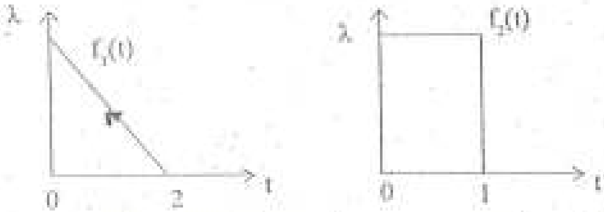
(b) Find the Fourier series of the function whose periodic waveform is shown below and plot its frequency spectrum.



OR

(c) Consider the signals $x(t) = \cos\frac{2\pi t}{3} + 2\sin\frac{16\pi t}{3}$ y(t) sin πt. Show that z(t) = x(t) · y(t) is periodic.

(d) Evaluate the convolution of $f_1(t)$ and $f_2(t)$ shown below and plot the evaluated waveform.



3. (a) Prove that the Fourier transform of an even and real function is even and real.

(b) Consider a system with input x(t) and with output y(t) given by $y(t) = \sum_{n=-\infty}^{\infty} x(t)\,\delta(t-nT)$

(i) Is this system linear ?

(ii) Is this system Time Invariant ? Justify your answers.

OR

(c) Show that the power-spectral density estimate $S_N(w)$ and the correlation function R(t) of a periodic waveform are Fourier transform pair.

(d) If $x_1(t)$ has a Fourier transform $X_1(F)$ and $X_2(t)$ has a Fourier transform $x_2(f)$ show that

$$\int_{-\infty}^{\infty} x_1(\tau)\, x_2(t-\tau)\, dz = X_1(F)\, X_2(F)$$

(a) Define auto correlation and cross correlation function of a random processes x(t) and y(t). Show that the auto-correlation function and the power spectral density function of a random process are Fourier transform pair.

(b) Calculate and sketch the auto correlation function of a rectangular pulse of duration 1 m-sec and amplitude of 3 volts.

OR

(c) Prove that the probability distribution of sum of two variables having Poisson distribution is also a Poisson distribution.

(d) A random variable has a probability density function given by $P(x)=\frac{1}{m-n}$; $n < x < m$; find its mean and variance.

(a) State and prove the properties of z-transform.

(b) Determine the inverse transform of the following functions :

(i) $X(z)=\frac{10}{(1-0\cdot5z^{-1})(1-0\cdot25z^{-1})}$

(ii) $X(z)=\frac{0\cdot5(z+1)}{(z-1)(z-0\cdot5)}$.

OR

(c) Obtain the z-transform for the following system and determine its (i) poles, zeros (ii) stability $y(n)=\frac{3}{4}y(n-1)-\frac{1}{8}y(n-2)+x(n)+\frac{1}{3}x(n-1)$. Obtain a cascade and parallel realization of the transfer function :

$$H(z)=\frac{(z^2+2z+2)(z+0\cdot6)}{(z-0\cdot8)(z+0\cdot8)(z^2+0\cdot1z+0\cdot8)}.$$

FACULTY OF ENGINEERING AND TECHNOLOGY

II/IV B.Tech. (EI, ECE, EE) II-Semester Examination

SIGNALS AND SYSTEMS

Time : Three Hours] [Maximum Marks : 100

1. (a) What are basis functions ? Explain and illustrate with examples.

(b) Explain the importance of mutually orthogonal functions in signal approximation.

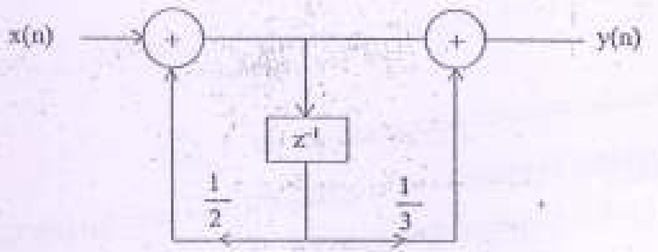
(c) Show that Fourier transform f(t) may also be expressed as

$$f(jw) = \int_{-\infty}^{\infty} f(t) \cos wt \, dt - j \int_{-\infty}^{\infty} f(t) \sin wt \, dt.$$

(d) Find the Z-transform of $n \cdot a^n u(n) + u(n-3)$.

(e) Define the moments of a random variable. Obtain the relation between 2[nd] central moments.

(f)



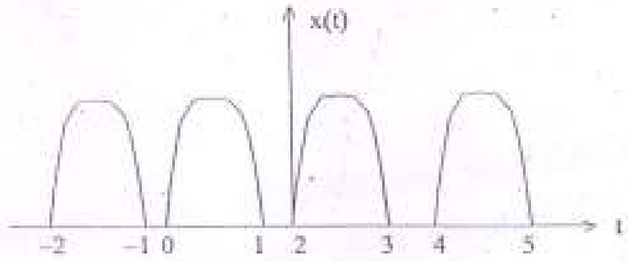
Obtain the transfer function for the above system shown in fig.

(g) A causal linear shift invariant system is described by $y(n) = y(n-1) + y(n-2) + x(n-1)$. Find the unit sample response of this system.

2. (a) Determine the Fourier series representation for the following signals (i) $\cos [\pi(t-1)/4]$, (ii) x(t) is periodic with period '2' and $x(t) = e^{-t}$ for $-1 < t > 1$.

(b) Obtain the trigonometric Fourier series for a rectangular pulse train of amplitude A_1 with a duration T_1 and period of 'T_0'.

(c) Obtain the exponential Fourier series for the following waveform.



OR

(d) Derive the relationship between trigonometric and exponential Fourier series.

3. (a) State and prove Time Convolution theorem applied to Fourier transform. Mention significance.

(b) A pulse of amplitude 'A' extends from t = −τ/2 to τ/2. Find Fourier transforms V Consider also the Fourier series for a periodic sequence of such pulses separated interval T_0. Compare the Fourier series 'a_n' with the transform with limit as $T_0 \rightarrow$

OR

(c) Show that the power spectral density estimate

$$S_N(w) = \frac{1}{N}|X_N(w)|^2 \quad \text{where } X_N(w) = \sum_{n=0}^{N-1} x_{ne}^{-jnWT_s}$$

discuss the consistency and unbiasedness of $S_N(w)$.

(d) Define the following properties of a system (i) Linearity, (ii) Causality, (iii) Stabil (iv) Time invariance. Explain them with suitable examples.

4. (a) Explain ensemble average, ergodicity and stationary random processes with suital examples.

(b) For a Random variable with Gaussian probability density function, calculate mea mean square and variance of random variable.

OR

(c) Consider a random process with autocorrelation

$$\hat{R}(k) = 0.8^{|k|},\ k = 0, \pm 1, \pm 2, \ldots\ldots$$

'10' data points are used in estimating this autocorrelation using the relation

$$\hat{R}(k) = \frac{1}{10} \sum_{i=0}^{10-|k|-1} x_i\, x_i + k\,.$$

What are the biases of this estimation for all 'k' ?

(d) Explain the classification of Random Processes with suitable examples.

(a) Show that a causal, linear, shift invariant system with unit impulse response h(n) is stable if and only if $\sum_{n} |h(n)| < \infty$.

(b) Determine the inverse Z-transform of

$$Y(z) = \frac{1 + 2z^{-1} + z^{-3}}{(1 - z^{-1})(1 - 0.5z^{-1})},$$ by the method of residues. Express the result in closed form.

OR

(c) Derive the relationship between Z-transform and Fourier transform. What do you mean by ROC ? Mention the significance of ROC.

(d) By using (i) direct form-II, (ii) cascade, (iii) parallel forms realise the following transfer function

$$H(z) = \frac{4(z-1)^4}{4z^4 + 3z^3 + 2z^2 + z + 1}.$$

FACULTY OF ENGINEERING & TECHNOLOGY

II/IV B.Tech. (EI, EEE, ECE) II-Semester Examination

SIGNALS AND SYSTEMS

Time : Three Hours] [Maximum Marks : 100

Answer **ALL** questions. All questions carry equal marks.

1. (a) Distinguish between linear and non-linear systems and define the order of a system.

   (b) Show that if f(t) is an even function of 't' then $f(jw) = 2\int_0^{\alpha} f(t)\cos wt\, dt$.

   (c) Determine the Fourier series representation for the signal

   $$x(t) = 3\cos\left(\frac{\pi}{2}t + \frac{\pi}{4}\right).$$

   (d) Explain Rayleigh's energy theorem for Fourier Transform.

   (e) Explain ergodicity.

   (f) Determine the Z-Transform of

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

   (g) Consider a discrete time whose input output relation is defined by

   $y[n] = r^n x[n]$, where $r > 1$.

   Show that the system is stable.

2. (a) Consider next the continuous Time system described by the input-output relation

   $y(t) = x(t)\, x(t-1)$.

   Show that this system is non-linear.

   (b) Determine the FS representation for

   $x(t) = 2\sin(2\pi t - 3) + \sin(6\pi t)$

OR

(c) Sketch the waveforms of the following signals :

(i) $x( ) = u(t) - u(t-2)$

(ii) $x(t) = u(t+1) - 2u(t) + u(t-1)$

(iii) $y(t) = r(t+1) - r(t) + r(t-2)$.

(d) The impulse response of an LTI system is given by $h[n]=\left(\frac{3}{4}\right)^n u[n]$.

Determine the o/p of the system at n = –1, n = 6 and when the I/P x[n] = u[n].

3. (a) Find the Fourier Transform of $x(t) = e^{-at} u(t)$.

(b) Determine whether the following continuous time systems are causal (or) non causal :—

(i) $y(t) = x(t) \cos(t+1)$

(ii) $y(t) = x(2t)$

(iii) $\frac{d}{dt} y(t) + 10y(t) + 5 = x(t)$.

OR

(c) A power signal g(t) has power spectral density $S_g(w)=\frac{N}{A^{r}}, -2\pi B \le w \le 2\pi B$

where A ξ N are constants.

Determine the PSD and mean square value of its derivative i.e. $\frac{d}{dt} g(t)$.

(d) Explain properties of Fourier Transform.

4. (a) Determine and sketch the autocorrelation function of given exponential pulse $f(t) = e^{-at}$.

(b) Explain Relation between Autocorrelation function and power spectral density

OR

(c) A random variable has at probability density function given by $P(x)=\frac{1}{m-n}$; $n < x < m$.

Find its mean and variance.

(d) Prove that the probability distribution of sum of two variables having Poisson distribution is also a Poisson distribution.

5. (a) Find Z-Transform of $(\cos w_o n)\, u[n]$

(b) Explain the initial value theorem.

OR

(c) Find the Inverse Z-transform of $X(z) = \frac{z}{(z+2)(z-3)}$

when ROC is

(i) ROC = $|z| < 2$ and

(ii) ROC = $2 < |z| < 3$.

(d) State and prove the properties of Z-transform.

6527/8

FACULTY OF ENGINEERING AND TECHNOLOGY

B.Tech. II / IV Year (EI, ECE, EE) II Semester Examination

SIGNALS AND SYSTEMS

Time : 3 Hours] *[Max. Marks : 100*

Answer **all** *questions.*
All questions carry equal marks.

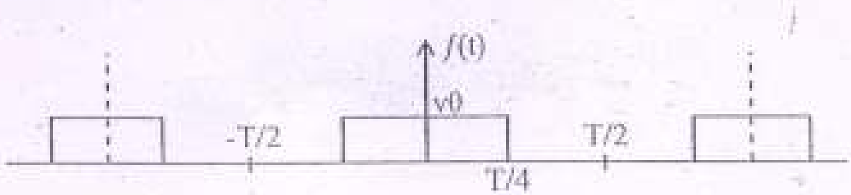
1. (a) Define Time variant, Time Invariant, Causal and Non Causal.
   (b) Show that cos nw_0t and sin nw_0t are orthogonal.
   (c) Find the exponential fourier series for the half wave rectified sinewave.
   (d) Explain Rayleigh's energy theorem for fourier Trasform.
   (e) Explain central limit theorem.
   (f) Determine the Z transform of $x(n) = a^n \cos(n\pi/2)$.
   (g) Check whether the following continuous time signals are time variant.
   i) $y(t) = \sin x(t)$ ii) $y(t) = t\, x(t)$.

2. (a) Let the input x(n) to a LTI system given by $x(n) = \alpha^n u(n) - u(n-10)$ and the impulse response of the system given by $n(n) = \beta^n u(n)$ where $0<\beta<1$. Find the output of this system.
   (b) Determine the fourier series representation for $x(t) = (Cos(3\pi\ +t) + Cos(\pi+2)$

Or

   (c) Evaluate the convolution of $f_1(t)$ and $f_2(t)$ shown below and plot the evaluated waveform.

   (d) Find the fourier series of the function whose periodic waveform is shown below



[P.T.O.

3. (a) Prove that the fourier transform of an even and real function is even and real.

(b) Consider a system with input x(t) and with output y(t) is given by

$$y(t) = \sum_{n=-\alpha}^{\alpha} x(t) f(t-n_{\gamma});$$

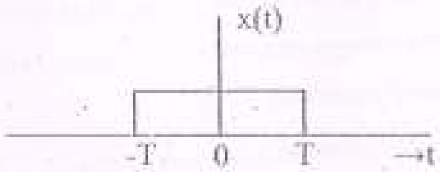
(i) Is this system linear?

(ii) Is this system Time Invariant? Justify your answers.

Or

(c) State and prove convolution theorem of fourier transform with example.

(d) Find Fourier Transform of the rectangular pulse shown below.



4. (a) Define auto correlation and cross correlation function of a random process x (–) and y (–). Show that the auto correlation function and the power spectral density function of a random process are Fourier transform pair.

(b) Find energy of the sinc pulse a *sin* c (2Wt)

Or

(c) Prove that the probability distribution of sum of two variables having poisson distribution is also a poisson distribution.

(d) A Random variable has a probability density function given by $P(x) = \frac{1}{m-n}$; $n < x < m$. Find its mean and variance.

5. (a) State and prove the properties of Z Transform.

(b) Find the Z Transform of $x(n) = \sin w_o n\, u(n)$

Or

(c) Obtain the Z Transform for the following system and determine its (i) Poles, Zeros, (ii) Stability. $y(n) = \frac{3}{4} y(n-1) - \frac{1}{8} y(n-2) + x(n) + \frac{1}{3} x(n-1)$. Obtain a cascade and parallel realisation of the transfer function.

$$H(z) \frac{(Z^2 + 2Z + 2)(Z + 0.6)}{(Z - 0.8)(Z + 0.8)(Z^2 + 0.1Z + 0.8)}$$

(6527/9)

FACULTY OF ENGINEERING AND TECHNOLOGY

II/IV B.Tech. (EI, ECE, EEE) (II Semester) EXAMINATION.

SIGNALS AND SYSTEMS

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

All questions carry equal marks.

1. (a) Find the period of the signal. (5)

$$x(n) = \cos\frac{\pi n}{2} - \frac{\sin \pi n}{8} + 3\cos\left(\frac{\pi n}{4} + \frac{\pi}{3}\right)$$

(b) Distinguish between linear and nonlinear systems and define the order of a system. (5)

(c) State the properties of a probability density function. (5)

(d) Consider the sequence $\{x(n)\}$ and its z-transform $x(z)$. (5)

Find the z-transform of the sequence $\{y(n)\} = \{a^n \times (n)\}$ where a is positive real number in terms of $x(z)$.

2. (a) Explain the properties of linear time invariant systems. (6)

(b) Consider a system with input $x(t)$ and with output $y(t)$ given by $y(t) = \sum_{t=-\infty}^{\infty} x(t)\, \delta(t - nT)$. (8)

(i) is this system linear

(ii) is this system time invariant. Justify your answers.

(c) Suppose that the input to this system is $x(t) = \cos 2\pi t$. Find the output $y(t)$ if $T = 1/4$. (6)

Or

(d) Consider the signals $x(t) = \cos\frac{2\pi t}{3} + 2\sin\frac{16\pi t}{3}$ $y(t) = \sin \pi t$. Show that $z(t) = X(t)\ y(t)$ is periodic. (6)

(e) Explain singularity functions (6)

[P.T.O.]

(f) Determine which of the properties of systems hold for the system $y(t)=\int_{-\infty}^{3-t}x(T)\,dT$ where $x(t)$ is the input and $y(t)$ is the output. (8)

3. (a) Determine the Fourier transform for the time functions.

(i) $f(t)=t\ u(t)$ and

(ii) $\cosh t\ u(t)$ if they exist. (10)

(b) State sampling theorem in time domain and frequency domain. (10)

Or

(c) Determine whether the discrete LTI systems characterized by the following impulse response are stable or causal. (10)

(i) $h(t)=e^{-3t}u(t-1)$

(ii) $h(t)=e^{-t}u(t+100)$.

(d) What is Hilbert transform? List the properties of Hilbert transform. (10)

4. (a) Distinguish between a random variable and a random process. (10)

(b) The joint probability density of the random variable x and y is $f(x,y)=\frac{1}{4}e^{-|x|-|y|}\ \begin{matrix}-\infty<x<\infty\\ -\infty<y<\infty\end{matrix}$. Calculate the probability that $x\le 1$ and $y\le 1$. (10)

Or

(c) Find out the cumulative distribution (CDF) of the Gaussian random variable. (10)

(d) State and explain central limit theorem. (10)

5. (a) Determine the properties of z-transform. (10)

(b) Consider a left-sided sequence $x(n)$ with z-transform $x(z)=\dfrac{1}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-z^{-1}\right)}$. Find $x(n)$. (10)

Or

(c) Find the z-transform and ROC of the following two sequences :

(i) $x(n) = b^n u(n)$.

(ii) $x(n) = -b^n x(-n-1)$. (10)

(d) Find the inverse z-transform of the following system transfer *fn* :

$$H(z) = \frac{A^2 z^2}{(z-b)^2} \quad ROC = |z| > b \quad 0 < b < 1.$$ (10)

Or

[P.T.O.

FACULTY OF ENGINEERING AND TECHNOLOGY

B.Tech. II/IV Year (EI/EEE/ECE) (II-Semester) Examination

SIGNALS AND SYSTEMS

Time : Three Hours] [Maximum Marks : 100

Note :— *(1) Answer ALL questions.*

(2) All questions carry equal marks.

1. (a) Give classification of continuous time systems.
   (b) Explain analogy between vectors and signals.
   (c) Define Energy Spectral Density.
   (d) Write about LTI system.
   (e) Define Rayleigh probability density.
   (f) Explain Time scaling operation with example.
   (g) Write two properties of Z-transform.

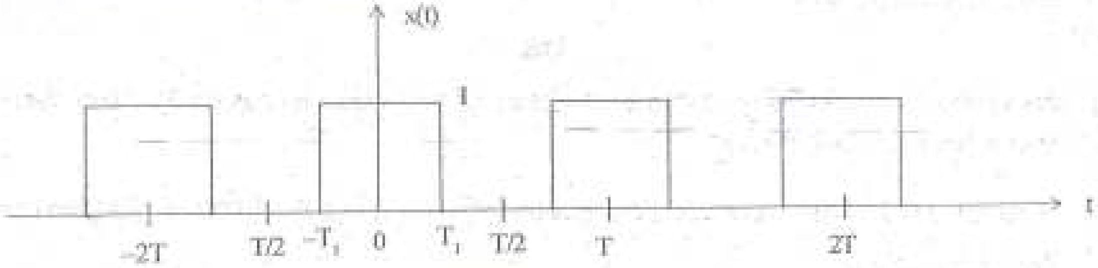
2. (a) Explain Basic operations on independent variable in continuous time with two examples.

OR

(b) The periodic square wave sketched in fig. and defined over one period as

$$x(t) = \begin{cases} 1 & |t| < T_1 \\ 0 & T_1 < |t| < T/2 \end{cases}$$

Determine the Fourier series.

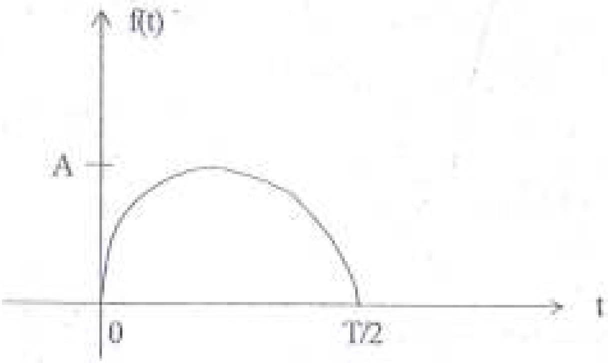


(c) Explain properties of Fourier Transform.

3. (a) Find Fourier Transform of

$$f(t) = e^{-t^2/2\sigma^2}.$$

(b) Determine the Fourier Transform of the sinusoidal pulse shown in Fig.



OR

(c) Find the fourier transform of a periodic Gate function of width τ seconds and repeating every T seconds.

(d) Find Fourier Transform of u(t) cos w_c t and u(t) sin w_c t.

4. (a) A signal e^{-3t} u(t) is passed through an Ideal L_pF with cut off frequency of 1 rad per second :

(i) Test whether I'_p is an energy signal.

(ii) Find the I'_p and O'_p energy.

(b) Find the power of a signal at f(t) where A is a constant and the signal f(t) is a power signal with zero mean value.

OR

(c) Prove that the probability distribution of sum of two variables having Poisson distribution is also a Poisson distribution.

(d) A function f(t) has power density spectrum $S_f(w)$. Find the PDS of $\int$ of f(t) and Time derivative of f(t).

5. (a) Explain properties of ROC in Z Transform.

(b) Find Inverse Z transform

$$X(z)=\frac{3-\frac{5}{6}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-\frac{1}{3}z^{-1}\right)},\quad |z|>\frac{1}{3}.$$

OR

(c) Find Z transform of

$x[n] = b^{|n|}$, $b > 0$

and draw needful diagram.

(d) Find Inverse Z transform of

$$X(z)=\frac{3-\frac{5}{6}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)\left(1-\frac{1}{3}z^{-1}\right)},\quad \frac{1}{4}<|z|<\frac{1}{3}.$$