Bihar Engineering University, Patna
End Semester Examination - 2023

Course: B.Tech. | *Semester: IV* | *Time: 03 Hours*
Code: 103404 | *Subject: Signal and System* | *Full Marks: 70*

Instructions:-
(i) The marks are indicated in the right-hand margin.
*(ii) There are **NINE** questions in this paper.*
*(iii) Attempt **FIVE** questions in all.*
(iv) Question No. 1 is compulsory.

Q.1 ***Choose the correct answer of the following (Any seven question only):*** **[2 x 7 = 14]**

(a) The range for unit step function for u(t – a), is _____
(i) t < a (ii) t ≤ a (iii) t = a (iv) t ≥ a

(b) Z-transform of δ(n+3).
(i) Z (ii) Z^2 (iii) 1 (iv) Z

(c) Signal x(t)=Acos(ωt+ϕ) is
(i) An energy signal (ii)A power signal
(iii) An energy as well as a power signal (iv) none

(d) Nyquist sampling rate if sinc(300t) is
(i) 600 (ii) 150 (iii) 300 (iv) 400

(e) Find the Fourier transform of $\frac{1}{1+jt}$
(i) $2\pi e^{a\omega}$ u(ω) (ii) $2\pi e^{a\omega}$ u(−ω) (iii) $2\pi e^{-a\omega}$ u(ω) (iv) $2\pi e^{-a\omega}$ u(−ω)

(f) When x(t) is said to be non periodic signal?
(i) If the equation x (t) = x (t + T) is satisfied for all values of T
(ii) If the equation x (t) = x (t + T) is satisfied for only one value of T
(iii) If the equation x (t) = x (t + T) is satisfied for no values of T
(iv) If the equation x (t) = x (t + T) is satisfied for only odd values of T

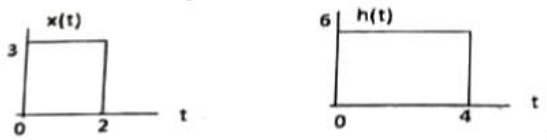
(g) Zero-state response of the system is _____
(i) Response of the system when initial state of the system is zero
(ii) Response of the system due to input alone
(iii) Response of the system due to input alone when initial state of the system is zero
(iv) Response of the system due to input alone when initial state is neglected

(h) Comment on the periodicity of a constant signal?
(i) It is periodic
(ii) It is not periodic
(iii) It is a mixture of period and aperiodic signal
(iv) It depends on the signal (i) Proactive (table-driven) routing protocols

(i) The energy of the signal x(n)= $(-0.4^n)u(n)is$
(i) $\frac{1}{16}$ J (ii) $\frac{1}{36}$ J (iii) $\frac{25}{21}$ J (iv) $\frac{5}{13}$ J

(j) A system is linear if it satisfy
(i) Principle of superposition (ii) Principle of homogeneity
(iii) Both (i) & (ii) (iv) Only (i)

Q.2 find the time response of LTI system with impulse response h(t) to the input x(t) **[14]**



Q.3 (a) Solve the difference equation $y[n] + 3y[n-1] = x[n]$ With initial conditions $y[-1] = 1$ and determine $y[n]$ for the input $x[n] = 7u[n]$. **[7]**

(b) Find the Laplace transform and sketch ROC of signal $x(t) = -e^{at}\, u(-t)$. **[7]**

Q.4 (a) Find the discrete-time Fourier transform of $x[n] = \{1, -1, 2, 5\}$. **[4]**

(b) Find the inverse Z-transform of $X(Z) = \frac{Z(Z^2 - 4Z + 5)}{(Z-3)(Z-1)(Z-2)}$ for ROC : $2 < |Z| < 3$. **[10]**

Q.5 (a) Sketch the signal x(-2t+3) as shown in fig-1 **[10]**

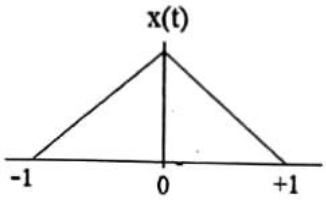


fig. 1

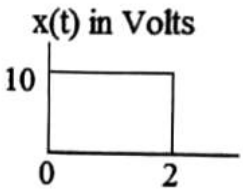
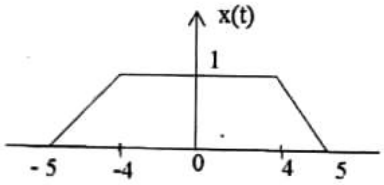


fig. 2

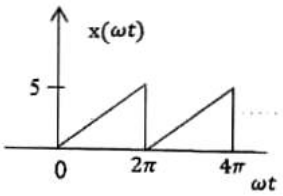
(b) Find the Fourier transform of a rectangular pulse of duration 2 second and having a magnitude of 10 volt as shown in fig. 2. **[4]**

Q.6 (a) Find Energy of the signal in given fig: **[7]**

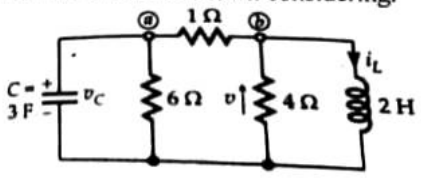


(b) Determine whether the signal is linear or non-linear $y(n) = x(n^2)$. **[7]**

Q.7 Find the trigonometric Fourier series of the periodic signal with period 2π as shown below **[14]**



Q.8 Obtain the state equation for the circuit as shown considering. **[14]**



Q.9 Write short notes on ***any two*** of the following: **[7x2=14]**

(a) Properties of z-Transform
(b) causal & non causal signals with examples
(c) Zero order hold circuit
(d) Aliasing and its effect

Code : 110406/103404

B.Tech 4th Semester Exam., 2022

(New Course)

SIGNALS AND SYSTEMS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Answer any *seven* of the following as directed : 2×7=14

(a) Determine the fundamental period of the signal

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

(b) Check whether the signal

$$x(t) = 2e^{j\left(t+\frac{\pi}{4}\right)}u(t)$$

is periodic or not. If periodic, then compute the periodicity.

(c) Find the convolution of two signals

$$x_1(t) = e^{-t^2} \text{ and } x_2(t) = 3t^2$$

(d) Let $X(e^{j\omega})$ be the DTFT of $x[n]$, prove that

$$X(e^{j0}) = \sum_{n=-\infty}^{\infty} x[n]$$

(e) The step response of an LTI system when the impulse response $h(n)$ is unit step $u(n)$ is _____.

(Fill in the blank)

(f) Use the convolution property of Laplace transform to determine

$$y(t) = e^{at}u(t) * e^{bt}u(t)$$

where symbols have their usual meanings.

(g) Determine the Laplace transform of the signal $x(t) = \cos^3(3t)u(t)$.

(h) If $X(z) \xleftarrow{z} x[n]$ with ROC : R, then prove that

$$Z\{x[-n]\} = X(z^{-1})$$

with ROC : $\frac{1}{R}$.

(i) List down the properties of region of convergence (ROC).

(j) Determine the conditions on the sapling interval T_s so that

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

is uniquely represented by the discrete-time sequence $x[n] = x(nT_s)$.

2. (a) Consider a causal LTI system that is represented by the difference equation

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

Find the frequency response $H(e^{j\omega})$ and the impulse response $h(t)$ of the system. 3+4=7

(b) Find the inverse DTFT of

$$X(e^{j\omega}) = \delta(\omega), \; -\pi < \omega \le \pi$$ 3

(c) Find the Fourier transform of

$$x(n) = a^{|n|}, \; |a| < 1$$ 4

3. (a) Find the Z-transform of

$$x(n) = \begin{cases} (0\cdot5)^n u(n), & n > 0 \\ (0\cdot25)^{-n}, & n < 0 \end{cases}$$ 6

(b) Find the inverse Z-transform of

$$X(z) = \frac{1 - \frac{1}{4}z^{-1}}{1 - \frac{1}{9}z^{-1}} \quad \text{ROC} : |z| > \frac{1}{3}$$ 4

(c) Comment on the causality of the system whose transfer function is given by

$$H(z) = \frac{3 - 4z^{-1}}{1 - 3\cdot5z^{-1} + 1\cdot5z^{-2}}, \; |z| > 3$$ 4

4. (a) Derive the condition for BIBO stability. 2

(b) Consider a continuous-time system with input $x(t)$ and output $y(t)$ is related by $y(t) = x(\sin(t))$. Is the system *(i)* causal and *(ii)* linear? 5

(c) Sketch the signal $x(t) = \delta(\cos t)$. 3

(d) Find even and odd components of signal $x(t) = e^{-2t}\cos(t)$. 4

5. (a) Compute the Fourier transform of the signal shown in Fig. 1 : 6

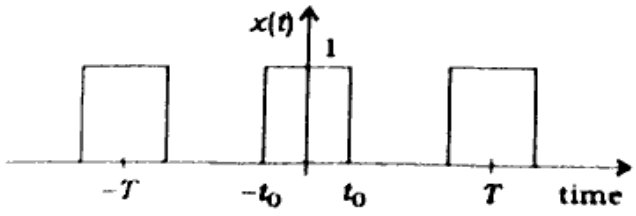


Fig. 1

(b) Compute the step response of the LTI system

$$H(s) = \frac{6(s+1)}{s(s+3)};\ \mathrm{Re}\{s\} > 0$$ 5

(c) State and prove Parseval's theorem. 3

6. (a) A system is defined as $y(n) = x(n^2)$. Check whether the system is linear or non-linear, time-varying or time-invariant, causal or non-causal and memory less or memory type. 5

(b) Compute the convolution

$$y[n] = x[n] * h[n]$$

where

$$x[n] = u(n-1) \text{ and } h[n] = \alpha^n u(n-1)$$ 7

(c) Compute the Nyquist sampling rate for the signal

$$g(t) = 10\cos(50\pi)\cos^2(150\pi t)$$ 2

7. (a) Consider the causal difference equation

$$y[n] - 0\cdot 8y[n-1] = 2x[n]$$

where the input signal is

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

with $y[-1] = 0$. Find the output response $y[n]$. 4

(b) Compute the inverse Z-transform of

$$X(z) = \frac{z}{(1-0\cdot 5z^{-1})};\ |z| < 0\cdot 5$$

Find the signal $x[n]$ using the power series expansion method. 4

(c) Consider the stable LTI system defined by its transfer function

$$H(z) = \frac{z^2 + z - 2}{z^2 + z + 0\cdot 5}$$

Sketch the pole-zero plot for this transfer function and give its ROC. Is the system causal? Sketch the direct form realization of this system. 1+1+4=6

8. (a) Let $x[n]$ be an arbitrary function with even and odd parts as $x_e[n]$, $x_0[n]$, respectively. Show that

$$\sum_{n=-\infty}^{\infty} x^2[n] = \sum_{n=-\infty}^{\infty} x_e^2[n] + \sum_{n=-\infty}^{\infty} x_0^2[n]$$ 4

(b) Perform the convolution operation between

$$x[n] = \left\{0, 0, 0, 0, \underset{\uparrow}{2}, -3, 1, 0, 0\right\}$$

$$h[n] = \left\{0, 0, 0, 1, \underset{\uparrow}{2}, 2, 0, 0, 0\right\}$$

using graphical method. 6

(c) The signal $x(t)$ is shown in Fig. 2. Sketch the signals for $\alpha = \frac{1}{2}$ and $\alpha = 2$: 4

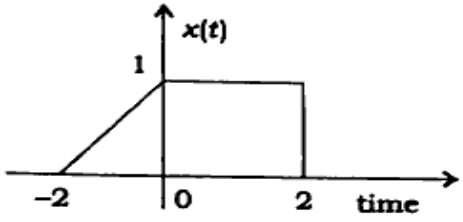


Fig. 2

9. Write short notes on any *four* of the following : 3½×4=14

(a) Power and energy signals

(b) Relationship between Laplace and *Z*-transform

(c) Initial and Final value theorems

(d) Properties of Fourier transform

(e) Zero-order hold circuit

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Code : 031510

B.Tech. 5th Semester Exam., 2013

SIGNAL AND SYSTEM

Time : 3 hours *Full Marks* : 70

Instructions :

(i) All questions carry equal marks.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

(iv) Question No. 1 is compulsory.

1. Choose the correct answer (any *seven*) :

(a) What is the fundamental period T of the signal $x(t) = 4\cos 5\pi t$?

(i) $\frac{5}{4}$ sec

(ii) $\frac{4}{5}$ sec

(iii) $\frac{2}{5}$ sec

(iv) 5π sec

(b) Which of the following systems is time-invariant?

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

(ii) $y(t) = x(t) + x(t-1)$

(iii) $y(t) = x\left(\frac{t}{2}\right)$

(iv) $y(t) = x(-t)$

(c) The system $y(t) = e^{x(t)}$ is

(i) stable, causal

(ii) noncausal, stable

(iii) unstable, causal

(iv) unstable, noncausal

(d) The system $y(t) = tx(t)$ is

(i) linear and time-invariant

(ii) linear and time-variant

(iii) nonlinear and time-invariant

(iv) nonlinear and time-variant

(e) A good measure of similarity between two signals $x_1(t)$ and $x_2(t)$ is

(i) convolution

(ii) correlation

(iii) power density spectrum

(iv) Laplace transform

(f) If $x(t)$ is odd, then its Fourier series coefficients must be

(i) real and odd

(ii) imaginary and odd

(iii) real and even

(iv) imaginary and even

(g) The Fourier transform of odd signal is

(i) real and even

(ii) imaginary and even

(iii) imaginary and odd

(iv) real and odd

(h) The inverse Laplace transform of the function

$$y(s) = \frac{s+5}{(s+1)(s+3)}$$

is

(i) $2e^{-t} - e^{-3t}$

(ii) $2e^{-t} + e^{-3t}$

(iii) $e^{-t} - 2e^{-3t}$

(iv) $e^{-t} + e^{-3t}$

(i) The number of complex multiplications required to calculate N-point DFT using radix-2 DTT-FFT algorithm is

(i) $N\log_2 N$

(ii) $\frac{N}{2}\log_{10} N$

(iii) $N\log_{10} N$

(iv) $\frac{N}{2}\log_2 N$

(j) The region of convergence of the z-transform of a unit step function is

(i) $|z|>1$

(ii) $|z|<1$

(iii) (Real part of z) > 0

(iv) (Real part of z) < 0

2. (a) Define z-transform. Which type of system is studied using z-transform? Find the z-transform and region of convergence (ROC) for the signal

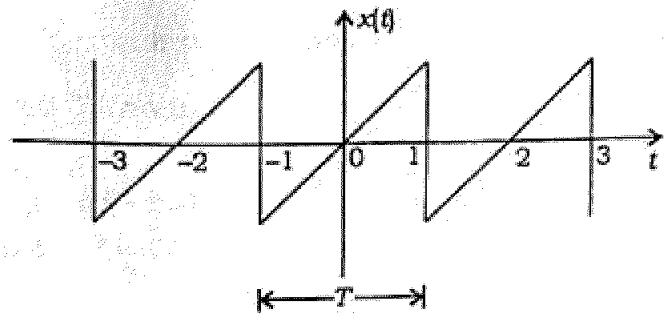
$$x(n) = -b^n u(-n-1)$$

(b) Find the inverse of z-transform of the following :

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

3. *(a)* What are Dirichlet conditions?

(b) Find the trigonometric Fourier series for the periodic signal $x(t)$ as shown in the figure below :



4. *(a)* Define Fourier transform for a periodic signal. Explain briefly how Fourier transform is different from Fourier series. Can we find the Fourier transform of $x(t) = e^{2t}u(t)$? If not, why?

(b) Find the Fourier transform of—

(i) sgn (t)

(ii) $u(t)$

5. *(a)* Define Laplace transform. Find out the relation between Fourier transform and Laplace transform. What is the difference between Laplace transform and Fourier transform?

(b) Find the Laplace transform and ROC of the signal

$$x(t) = e^{-3t}u(t) + e^{-2t}u(t)$$

6. *(a)* *(i)* Define convolution sum.

(ii) Determine convolution of the following sequence :

$$x(n) = 2\delta(n+1) - \delta(n) + \delta(n-1) + 3\delta(n-2)$$
$$h(n) = 3\delta(n-1) + 4\delta(n-2) + 2\delta(n-3)$$

(b) If $x(n) = x_1(n) * x_2(n)$, where

$$x_1(n) = \left(\frac{1}{3}\right)^n u(n)$$

$$x_2(n) = \left(\frac{1}{5}\right)^n u(n)$$

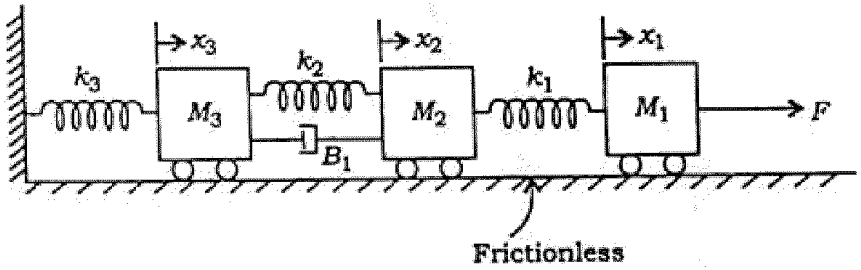
find $X(z)$ using convolution property for z-transform.

7. *(a)* Define discrete Fourier series. What is the condition for the existence of Discrete Time Fourier Transform? Does DTFT of the sequence $x(n) = 2^n u(n)$ exist?

(b) Find the Fourier transform of $x(n) = u(n-k)$.

8. *(a)* What do you mean by analogous system?

   (b) Draw force-voltage (*f*-*v*) and force-current (*f*-*i*) analogous circuits of the mechanical system shown in the figure below :



9. Write short notes on any *two* of the following :

   (a) Causal and noncausal signals

   (b) Bounded input bounded output (BIBO) stability criterion

   (c) Cross correlation

   (d) Relationship between *s*-plane and *z*-plane

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Code : 031510

B.Tech. 5th Semester Exam., 2014

SIGNAL AND SYSTEM

Time : 3 hours *Full Marks* : 70

Instructions :

(i) All questions carry equal marks.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

(iv) Question No. 1 is compulsory.

1. Choose the correct answer any *seven* of the following :

(a) The period of the signal $x(t) = \cos 60\pi t + \sin 50\pi t$ is

(i) $\frac{1}{5}$ sec

(ii) 5 sec

(iii) 10π sec

(iv) Not periodic

(b) The value of the following integral

$$x(t) = \int_{-\infty}^{\infty} e^{-\alpha t^2} \cdot \delta(t-10)\, dt$$

is

(i) $e^{-10\alpha}$

(ii) $e^{-\alpha t^2}$

(iii) $e^{-100\alpha}$

(iv) None of the above

(c) Which of the following is causal?

(i) $y(n) = x(n+1)$

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

(iii) $y(n) = e^{x(n^2)}$

(iv) None of the above

(d) Which of the following is linear?

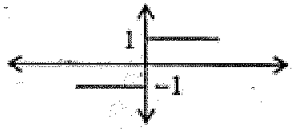
(i) $y(n) = nx^2(n)$

(ii) $y(n) = x(n^2)$

(iii) $y(n) = e^{x(n)}$

(iv) $y(n) = Ax(n) + B$

(e) The Fourier transform of the function shown below



is

(i) purely real

(ii) purely imaginary

(iii) complex

(iv) Does not exist

(f) The inverse Laplace transform of

$$X(s) = \frac{1}{s(s+2)}$$

is

(i) $e^{-t}u(t)$

(ii) $e^{-2t}u(t)$

(iii) $e^{2t}u(t)$

(iv) None of the above

(g) z-transform of convolution of two signals is equal to the —— of their z-transform.

(i) addition

(ii) subtraction

(iii) division

(iv) multiplication

(h) Which one of the following represents the impulse response of a system is defined by

$$H(z) = z^{-m}?$$

(i) $u(n-m)$

(ii) $\delta(n-m)$

(iii) $\delta(m)$

(iv) $\delta(m-n)$

(i) A system with input $x(t)$ and output $y(t)$ is described by the relation $y(t) = tx(t)$. The system is

(i) linear and time-variant

(ii) linear and time-invariant

(iii) non-linear and time-invariant

(iv) non-linear and time-variant

(j) The step response of the system whose impulse response $h(t) = tu(t)$ is given by

(i) $t^2u(t)$

(ii) $\frac{t^2}{2}u(t)$

(iii) $\frac{t^3}{3}u(t)$

(iv) $\frac{3t^2}{2}u(t)$

2. *(a)* Define z-transform. What is/are its application(s)? Find z-transform and ROC of the following signal :

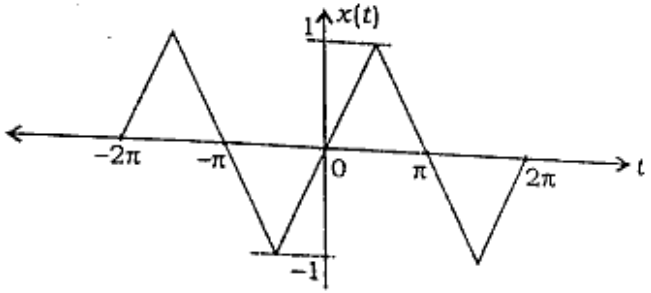
$$x(n) = [3(3)^n - 4(2)^n]\,u(n)$$

(b) Determine all possible signals $x(n)$ associated with z-transform

$$X(z) = \frac{5z^{-1}}{(1-2z^{-1})(1-3z^{-1})}$$

3. *(a)* Explain the conditions under which any periodic waveform can be expressed using Fourier series.

(b) Find trigonometric Fourier series representation of the triangular wave shown below :



4. *(a)* Define Fourier transform for a periodic signal. What are the conditions required for existence of Fourier transform?

(b) Find Fourier transform of—

(i) $x(t) = e^{-at}\,u(t)$;

(ii) $x(t) = e^{-3t}[u(t+2) - u(t-3)]$.

5. *(a)* Define Laplace transform. What is region of convergence? What is the necessary condition for existence of the Laplace transform? What is the difference between Laplace transform and Fourier transform?

(b) Find Laplace transform and ROC of the signal

$$x(t) = e^{-at}\,u(t) + e^{-bt}\,u(-t)$$

6. *(a)* Define convolution sum.

(b) Find the convolution of $x(t)$ and $h(t)$:

$$x(t) = 1 \quad 0 \le t < 2$$
$$= 0 \quad \text{otherwise}$$
$$h(t) = 1 \quad 0 \le t \le 3$$
$$= 0 \quad \text{otherwise}$$

7. *(a)* *(i)* Define Discrete Time Fourier Transfor (DTFT). What is the condition for th existence of DTFT? Does Fouri transform of sequence $x(n) = 3^n u$ exist? If not, why?

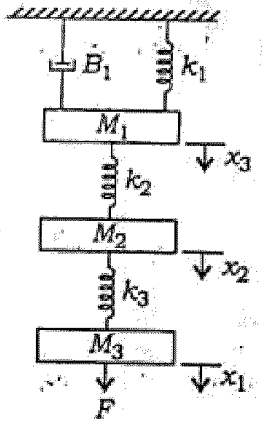
(ii) Find Fourier transform of the following sequence :

$$x(n) = \delta(n+2) - \delta(n-2)$$

(b) Find 4-point DFT of the following sequence :

$$x(n) = \sin \frac{n\pi}{2}$$

8. For the given mechanical system, draw the electrical analogous circuit using *f-v* (force-voltage) and *f-i* (force-current) analogies :



9. Write short notes on any *two* of the following :

(a) Energy signal and power signal

(b) Classification of system

(c) Analogous system

(d) Fast Fourier Transform (FFT)

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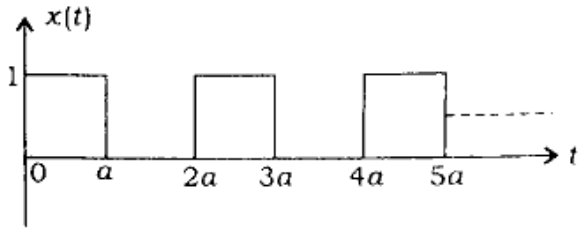
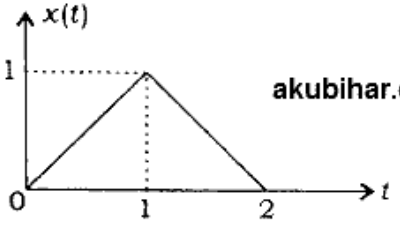
7. For the following waveforms, find the Laplace transform : 7+7=14

(a)



(b)



8. Using Laplace transform, solve the following differential equation : 14

$$\frac{d^3y(t)}{dt^3}+7\frac{d^2y(t)}{dt^2}+16\frac{dy(t)}{dt}+12\,y(t)=x(t)$$

if $\quad \frac{dy(0^-)}{dt}=0; \quad \frac{d^2y(0^-)}{dt^2}=0$

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

9. Find the impulse response and step response for the following system : 14

$$y(n)-\frac{3}{4}y(n-1)+\frac{1}{8}y(n-2)=x(n)$$

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B.Tech 6th Semester Exam., 2016

SIGNALS AND SYSTEMS

Time : 3 hours ***Full Marks : 70***

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No **1** is compulsory.*

1. Choose the correct answer (any seven) : 2×7=14

(a) Let $\delta(t)$ denote the delta function. The value of the integral

$$\int_{-\infty}^{\infty}\delta(t)\cos\left(\frac{3t}{2}\right)dt$$

is

(i) 1 (ii) −1

(iii) 0 (iv) $\pi/2$

(b) If a signal $f(t)$ has energy E, the energy of signal $f(2t)$ is equal to

(i) E (ii) $\frac{E}{2}$

(iii) $2E$ (iv) $4E$

 (Turn Over)

(c) The system $y(t) = e^{x(t)}$ is

(i) stable and causal

(ii) non-causal and stable

(iii) unstable and causal

(iv) unstable and non-causal

(d) The system represented by

$$h(n) = (0.99)^n u(n+2)$$

is

(i) unstable because it is an FIR system

(ii) stable because it is an IIR system

(iii) unstable because it does not obey BIBO stability criteria

(iv) stable because it obeys BIBO stability criteria

(e) The impulse response of a system is $h(t) = \delta(t - 0.5)$. If two such systems are cascaded, the impulse response of the overall system will be

(i) $0.5\delta(t - 0.25)$

(ii) $\delta(t - 0.25)$

(iii) $\delta(t - 1)$

(iv) $0.5\delta(t - 1)$

(f) If $x(t)$ is odd, then its Fourier series coefficients must be

(i) real and odd

(ii) imaginary and odd

(iii) real and even

(iv) imaginary and even

(g) The Laplace transform of a unit ramp function starting at $t = a$ is

(i) $\frac{1}{(s+a)^2}$

(ii) $\frac{e^{-as}}{(s+a)^2}$

(iii) $\frac{e^{-as}}{s^2}$

(iv) $\frac{a}{s^2}$

(h) If $L[f(t)] = \frac{2(s+1)}{s^2+2s+5}$, then $f(0^+)$ and $f(\infty)$ are given by

(i) 0, 2 respectively

(ii) 2, 0 respectively

(iii) 0, 1 respectively

(iv) $\frac{2}{5}$, 0 respectively

(Turn Over

If the impulse response of a discrete time system is $h(n) = -5^n u(-n-1)$, then the system function $H(z)$ is equal to

(i) $\frac{-z}{z-5}$ and the system is stable

(ii) $\frac{z}{z-5}$ and the system is stable

(iii) $\frac{-z}{z-5}$ and the system is unstable

(iv) $\frac{z}{z-5}$ and the system is unstable

The output of discrete LTI system is always identical to the input signal, when the unit impulse response $h(n)$ is

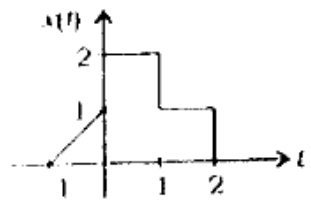
(i) unit step

(ii) unit impulse

(iii) all ones

(iv) ramp

For the signal $x(t)$ shown in the figure below, find the signals (i) $x(t-2)$, (ii) $x(2t+3)$, (iii) $x\left(\frac{3}{2}t\right)$ and (iv) $x(-t+1)$: 7



(Continued)

(b) Find whether the following signals are periodic or not : 7

(i) $x(t) = 2\cos(10t+1) - \sin(4t+1)$

(ii) $\cos 60\pi t + \sin 50\pi t$

(iii) $2u(t) + 2\sin 2t$

(iv) $3\cos 4t + 2\sin 2\pi t$

(v) $u(t) - \frac{1}{2}$

(vi) $\sin^2 t$

3. (a) Check whether the following systems are linear or not : 7

(i) $\frac{dy}{dt} + 3ty(t) = t^2 x(t)$

(ii) $\frac{dy(t)}{dt} + 2y(t) = x^2(t)$

(iii) $y(t) = \int_{-\infty}^{t} x(\tau)\,d\tau$

(iv) $\frac{dy}{dt} + 2y(t) = x(t)\frac{dx(t)}{dt}$

(v) $y(n) = Ax(n) + B$

(vi) $y(n) = 2x(n) + \frac{1}{x(n-1)}$

(vii) $y(n) = nx(n)$

(Turn Over)

(b) For each of the following systems, determine whether the system is time-invariant : 7

(i) $y(t) = tx(t)$

(ii) $y(t) = x(t)\cos(50\pi t)$

(iii) $y(t) = x(t^2)$

(iv) $y(t) = x(-t)$

(v) $y(t) = e^{x(t)}$

(vi) $y(n) = x(2n)$

(vii) $y(n) = x(n) + nx(n-1)$

(viii) $y(n) = x^2(n-1)$

(a) Prove that the output of a discrete time system can be represented as a weighted sum of shifted impulse responses. 7

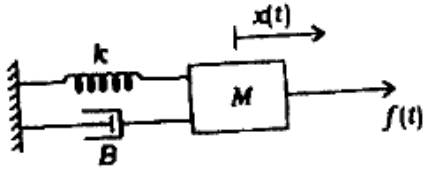
(b) Obtain the convolution of the following sequence : 7

$x(n) = u(n) - u(n-7),\ h(n) = u(n-1) - u(n-4)$

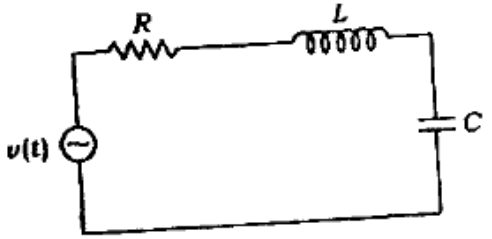
(Continued)

5. Obtain the differential equations governing the following systems : 14

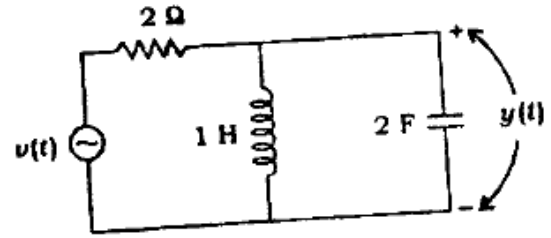
(a)



(b)



(c)



6. Find cosine Fourier series of half-wave rectified sine function. 14

(Turn Over)