MUZAFFARPUR INSTITUTE OF TECHNOLOGY

MUZAFFARPUR

COURSE FILE

OF

SIGNALS & SYSTEM

(Course Code: 031510)

Faculty Name:

ANKIT KUMAR SINGH

ASSISTANT PROFESSOR, DEPARTMENT OF EE

विज्ञान एवं प्रावैधिकी विभाग
Department of Science and Technology
Government of Bihar

CONTENTS

Electrical Engineering Department

Vision of The Department

To produce cutting edge Electrical Engineers, innovators, researchers, and entrepreneurs with high human values to serve society, industry, nation and the world.

Mission of The Department

M1. To create state-of-the-art facilities for under-graduate, post- graduate and R&D work.

M2. To cater the needs of society with recent technologies, innovative ideas and inculcate ethical responsibilities.

M3.To develop strong collaborative links with premier industries, institutions and the government agencies.

Program Educational Objectives (PEOs) of Electrical Engineering Department

PEO 1. Students will be able to engage in life-long learning and research including supportive and responsible roles on multi-disciplinary tasks.

PEO 2. Students will acquire, use and develop skills as required for effective professional and societal practices and leadership quality.

PEO 3. Students will be able to create a new dimension of innovation and entrepreneurship.

Program Outcomes (POs) based on Program Educational Objectives (PEOs) of Electrical Engineering Department:

PO 1. Students will be able to apply knowledge of applied mathematics & science in electrical engineering problems.

PO 2. Students will be able to identify, formulate and solve society and industries related problems.

PO 3. Students will be able to apply knowledge to design a system, component or process to meet desired needs within realistic constraints.

PO 4. Students will be able to conduct laboratory experiments and to critically analyze and interpret experimental data.

PO 5. Students will be able to use the recent techniques, skills, and modern tools necessary for engineering practices.

PO 6. Students will be able to understand the impact of engineering problems, solutions in a global and societal context.

PO 7. Students will be able to demonstrate professional and ethical responsibilities.

PO 8. Students will be able to apply leadership quality to work with team in the area of electrical engineering towards the solution of multi-disciplinary tasks.

PO 9. Students will be able to communicate effectively through verbally, technical writing, reports and presentation.

PO 10. Students will be able to develop confidence for self-education and ability to engage in life-long learning.

Course Description and Objectives

This course deals with the basics of signals and systems analysis, different operations on discrete-time and continuous-time signals and study of different systems (linear, non-linear, time variant, time-invariant, stable and unstable systems)

Course Outcomes

At the end of the Course, the students will be able to:

CO.1. Define signals and systems, classify the signals and apply different operations on signal.

CO.2. Explain the Force Voltage analogy and Force Current analogy.

CO.3. Determine Fourier series coefficient and Fourier transforms for different types of signals.

CO.4. Determine Laplace transforms with their properties by using the concept of ROC.

CO.5. Determine Z transforms with their properties by using the concept of ROC and relate with Laplace transform.

SIGNALS AND SYSTEMS (EE-031510)

COURSE SYLLABUS

Max Marks: 100 L-T-P : 3-1-0
Final Exam: 70 Marks
Sessional: 20 Marks
Internals: 10 Marks.

UNIT-I

System and Signal: Definition, classification of systems, standard test signal, properties of system, properties of liner system.

UNIT-II

Analogous System: Force voltage analogy, Force current analogy, Mechanical coupling devices, and electromechanical system.

UNIT-III

Laplace transformation: Laplace transform of some important function, shift theorem and its application, Laplace transform of periodic functional, analysis of response, initial & final values theorem, response to periodic sinusoidal excitation.

UNIT-IV

Analysis of Fourier Methods: Fourier series expansion of periodic functional symmetry condition, exponential form of Fourier series, Fourier integral & Fourier transform, Analysis by Fourier methods, Fast Fourier transform.

UNIT-V

Z transformation: Z transform, discrete time, LTI system, solution of difference equation, Application of Z transform to open loop system.

Text Books:

1. Analysis of Linear System by D.K Cheng, Narosa pub. House

2. Modeling & Analysis of Liner System by J.P Tiwari. Dhanpat rai & Sons

Reference Books:

1. Signal & system by H.P Hus, Tata McGraw Hill

2. Signal & system by I.J. et. at., Tata McGraw Hill

GATE SYLLABUS

Signals & System

Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Mapping of PO's with CO's

Sr. No.	Course Outcome	PO
1.	**CO.1**. Define signals and systems, classify the signals and apply different operations on signal.	PO1, PO2, PO3
2.	**CO.2**. Explain the Force Voltage analogy and Force Current analogy.	PO2, PO3, PO5
3.	**CO.3.** Determine Fourier series coefficient and Fourier transforms for different types of signals.	PO1,PO3, PO5
4.	**CO.4**. Determine Laplace transforms with their properties by using the concept of ROC.	PO1,PO3, PO5
5.	**CO.5**. Determine Z transforms with their properties by using the concept of ROC and relate with Laplace transform.	PO3, PO5, PO6

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO.1. Define signals and systems, classify the signals and apply different operations on signal.	✓	✓	✓							
CO.2. Explain the Force Voltage analogy and Force Current analogy..		✓	✓		✓					
CO.3. Determine Fourier series coefficient and Fourier transforms for different types of signals.	✓		✓		✓					
CO.4. Determine Laplace transforms with their properties by using the concept of ROC.	✓		✓		✓					
CO.5. Determine Z transforms with their properties by using the concept of ROC and relate with Laplace transform.			✓		✓	✓				✓

TIME TABLE

DAY/TIME	9:00-10:00	10:0-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	15:00-16:00	16:00-17:00
MONDAY		SIG SYS (EE)			LUNCH			
TUESDAY			SIG SYS (EE)	SIG SYS (T2) (EE)				
WEDNESDAY			SIG SYS (EE)					
THURSDAY	SIG SYS (T1) (EE)							
FRIDAY				SIG SYS (T4) (EE)				
SATURDAY						SIG SYS (T3) (EE)		

STUDENT LIST

S. No.	Roll No.	Name of Students
1	16E01	NANDAN KUMAR
2	16E02	ANJALI KUMARI
3	16E03	KAUSTUBHA
4	16E04	RISHABH KUMAR
5	16E05	AMRITA KUMARI
6	16E06	SUMIT KUMAR
7	16E07	RITESH RAJ
8	16E08	VIPUL MISHRA
9	16E09	SAMEER KUMAR
10	16E10	MD SAIFULLAH SADIQUE
11	16E11	PREETI KUMARI
12	16E12	KULDEEP THAKUR
13	16E13	SHANTANU KUMAR SINGH
14	16E14	SEEMA KUMARI
15	16E15	PRIYAM KUMARI
16	16E16	VANDANA BIHARI
17	16E17	RAJNANDANI
18	16E18	SANJAY KUMAR YADAV
19	16E19	PRAVEEN DIVAKAR
20	16E20	AMIT KUMAR PANDIT
21	16E21	CHANDAN KUMAR THAKUR
22	16E22	ALOK KUMAR
23	16E23	DEVENDRA KUMAR
24	16E24	ARVIND KUMAR
25	16E25	AMITESH KUMAR
26	16E26	VIVEK KUMAR
27	16E27	VIKASH KUMAR RAY
28	16E28	ROHIT KUMAR
29	16E29	OM PRAKASH KUMAR
30	16E30	RAVI KUMAR
31	16E31	SANDEEP KUMAR
32	16E32	DEO ALOK
33	16E33	BAJRANGI KUMAR
34	16E34	MANOJ KUMAR SONI
35	16E35	SANJEEV KUMAR

36	16E36	NEERAJ KUMAR
37	16E37	SATYAM KUMAR
38	16E38	PRASHANT GAURAV
39	16E39	NITISH KUMAR RAJAK
40	16E40	UJJAWAL KUMAR
41	16E41	PRABHAT KUMAR
42	16E42	MD HASIM JILANI
43	16E43	SHIV CHARAN KUMAR
44	16E44	ANISH BHARTI
45	16E45	RAHUL KUMAR
46	16E46	RAJEEV RANJAN PRASAD
47	16E47	SHUBHAM KUMAR
48	16E48	TAHIR QAMAR
49	16E49	PRASHANT KUMAR
50	16E50	NAMAN KUMAR
51	16E51	KESHAV CHANDRA
52	16E52	SWETA BHARTI
53	16E53	PRATIK ANAND
54	16E54	SHAGUFTA ANJUM
55	16E55	GOLDEN KUMAR
56	16E56	MURLI MANOHAR
57	16E57	ARPIT ANAND
58	16E58	AKSHAT RAJ
59	16E59	ANJAN KUMAR
60	16E60	SUMAN KUMAR BHARTIYA
61	16E61	SAKET
62	16E62	RISHABH KUMAR
63	16E63	SUMAN KUMAR
64	16E64	SUNITA KUMARI
65	16E65	NISHANT RAJ
66	16E66	VIPIN SINGH
67	16E67	ANKIT RAJ
68	16E68	GUNJAN KUMAR
69	16E69	PRATAP CHANDRA CHOUDHARY
70	17(LE)E01	VIVEK KUMAR
71	17(LE)E02	RITIK KUMAR
72	17(LE)E03	ANAND RANJAN
73	17(LE)E04	ABHISHEK KUMAR
74	17(LE)E05	POONAM KUMARI
75	17(LE)E06	SAURABH KUMAR JHA
76	17(LE)E07	

77	17(LE)E08	ROHAN RAJ
78	17(LE)E09	ANAND KUMAR
79	17(LE)E10	MANISH

Course Plan

1. Scope and Objectives of the Course

It is a fundamental starting point in the field of electronics and communication engineering, and serves as the basic concepts that other advanced subjects in some electronics and communication engineering subjects are based. It covers the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals (singularity functions, complex exponentials and geometrics, Fourier representations, Laplace and Z transforms, sampling) and representations of linear, time-invariant systems (difference and differential equations, block diagrams, system functions, poles and zeros, convolution, impulse and step responses, frequency responses and also discuss Analogous System.

2. Textbooks

T1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.

T2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.

T3. Signals & Systems- Narayan Iyer and K Satya Prasad, Cenage Pub.

T4. Control System Engineering- I.J. Nagrath and M.Gopal

3. Reference Books

R1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.

R2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015

R3. Signals and Systems – K Raja Rajeswari, B VisweswaraRao, PHI, 2009

R4. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition, 2008.

R5. Signals and Systems – T K Rawat , Oxford University press, 2011

4. Web Resources

W1. http://nptel.ac.in/courses/117106114/

W2. https://www.tutorialspoint.com/signals_and_systems

Course Plan

S. No.	Topics	Text Book / Reference Book / Other reading material
1	Introduction to signals and Definition of Signals & Systems	T1 ,T3,R2
2	Classification of Signals	T1 ,T3, R2
3	Classification of Signals	T1 ,T3, R2
4	Operations on signals	T1 ,T3, R2
5	Operations on signals	T1 ,T3, R2
6	Operations on signals	T1 ,T3, R2
7	Properties of linear system	T1 ,T3, R2
8	Force voltage analogy	T4, R2
9	Force current analogy	T4, R2
10	Mechanical Coupling Devices	T4, R2
11	Electromechanical System	T4, R2
12	Review of Laplace transforms	T1 ,T3, R2
13	Relation between L.T, and F.T. of a signal	T1 ,T3
14	Shift theorem and its application	T1 ,T3
15	Shift theorem and its application	T1 ,T3
16	Laplace Transform of periodic functional	T1 ,T3, R2
17	Analysis of response	T1 ,T3, R2
18	Initial & final value theorem	T1 ,T3, R2
19	Initial & final value theorem	T1 ,T3, R2
20	Response to periodic sinusoidal excitation	T1 ,T3, R2
21	Representation of Fourier Series , TFS , EFS	T1 ,T3, R2
22	Properties of Fourier series	T1 ,T3, R2
23	Dirichlet conditions	T1 ,T3
24	Trigonometric Fourier Series	T1 ,T3
25	Exponential Fourier Series	T1 ,T3
26	Fourier Transform	T1 ,T3
27	Fourier Transform	T1 ,T3
28	Properties of Fourier Transforms	T1 ,T3
29	Properties of Fourier Transforms	T1 ,T3, R2

30	Fourier Transforms of periodic signal	T1 ,T3
31	Fast Fourier transform	T1 ,T3
32	Fast Fourier transform	T1 ,T3
33	Difference between CT and DT signals	T1 ,T3
34	Representation of DT signals using exponential and sinusoidal components	T1 ,T3
35	Periodicity ,Concept of Z-transform	T1 ,T3, R2
36	Periodicity ,Concept of Z-transform	T1 ,T3, R2
37	Properties of ROC	T1 ,T3, R2
38	Properties of Z-transform	T1 ,T3
39	Inverse Z-Transform	T1 ,T3
40	Transform of LTI-System Function & Impulse Function	T1 ,T3
41	Relation between Transfer function & Difference equation	T1 ,T3
42	Solution of Difference equations using Z-transform	T1 ,T3

Evaluation Scheme:

Component 1	Mid Semester Exam	20
Component 2	Assignment Evaluation	10
Component 3**	End Term Examination**	70
	Total	**100**

****** The End Term Comprehensive examination will be held at the end of semester. The mandatory requirement of 75% attendance in all theory classes is to be met for being eligible to appear in this component.

Lecture plan

Institute / College Name :	MIT MUZAFFARPUR		
Program Name	**Electrical Engineering**		
Course Code	031510		
Course Name	Signals & System		
Lecture / Tutorial (per week):	4	**Course Credits**	4
Course Coordinator Name	Ankit Kumar Singh		

Lecture Number	Topics	Date of Lecture
1	Introduction to signals and Definition of Signals & Systems	
2	Classification of Signals	
3	Classification of Signals	
4	Operations on signals	
5	Operations on signals	
6	Operations on signals	
7	Properties of linear system	
8	Force voltage analogy	
9	Force current analogy	
10	Mechanical Coupling Devices	
11	Electromechanical System	
12	Review of Laplace transforms	
13	Relation between L.T, and F.T. of a signal	
14	Shift theorem and its application	
15	Shift theorem and its application	
16	Laplace Transform of periodic functional	
17	Analysis of response	
18	Initial & final value theorem	

19	Initial & final value theorem	
20	Response to periodic sinusoidal excitation	
21	Representation of Fourier Series , TFS , EFS	
22	Properties of Fourier series	
23	Dirichlet conditions	
24	Trigonometric Fourier Series	
25	Exponential Fourier Series	
26	Fourier Transform	
27	Fourier Transform	
28	Properties of Fourier Transforms	
29	Properties of Fourier Transforms	
30	Fourier Transforms of periodic signal	
31	Fast Fourier transform	
32	Fast Fourier transform	
33	Difference between CT and DT signals	
34	Representation of DT signals using exponential and sinusoidal components	
35	Periodicity ,Concept of Z-transform	
36	Periodicity ,Concept of Z-transform	
37	Properties of ROC	
38	Properties of Z-transform	
39	Inverse Z-Transform	
40	Transform of LTI-System Function & Impulse Function	
41	Relation between Transfer function & Difference equation	
42	Solution of Difference equations using Z-transform	

Department of Electrical Engineering
Signals & System(EE-03610)

Assignment I

1. Define the following:
   a. Linear system
   b. Time invariant system
   c. Stable system
   d. Causal system
   e. Memory less system
   f. Invertible system
2. Differentiate between following:
   a. Energy and power signal
   b. Symmetric and antisymmetric signal
   c. Periodic and aperiodic signal
   d. Continuous time and discrete time signal
   e. Force-voltage analogy and force-current analogy

Assignment II

1. Write the Dirichlet's conditions for Fourier series
2. Differentiate between Fourier series and Fourier transform
3. Explain the concept of region of convergence (ROC) for Laplace transforms
4. Explain the Scaling and Frequency shifting properties of Laplace transform

Assignment III

1. Explain the concept of ROC for Z Transforms
2. Explain the relation between Laplace, Fourier and Z transforms
3. Write short notes
   a. Initial and final value theorem of Laplace transform
   b. Initial and final value theorem of Z- transform

QUESTION BANK

Code : 031610

B.Tech 6th Semester Exam., 2015

SIGNALS AND SYSTEMS

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. Answer any *seven* of the following questions :

   (a) Define causal system.

   (b) What is continuous time signal?

   (c) Write the condition of existence for Laplace transform.

   (d) Define Fourier transform of a sequence.

   (e) What is DTFT pair?

   (f) What is Fourier integral?

   (g) What are analogous systems?

(Turn Over)

AK15—500/606

(h) Find the z-transform of discrete-time unit impulse $\delta(n)$.

(i) What is z-transform of $A\delta(n-m)$?

(j) Define region of convergence (ROC).

2. (a) Sketch the following signal :

$x(t) = A[U(t+a) - U(t-a)]$ for $a > 0$

Also determine whether the given signal is a power signal or an energy signal or neither.

(b) Show that a system with excitation $x(t)$ and response $y(t)$ described by $y(t) = x(t/2)$ is linear, time-variant, non-causal.

3. (a) Compare energy and power signals.

(b) What are the elementary signals? Explain with suitable diagrams.

4. (a) Compare force-voltage analogy with force-current analogy.

(b) Obtain the solution of the differential equation given below using Laplace transform :

$$2\frac{dx}{dt} + 8x = 10$$

Given $x(0+) = 2$.

5. (a) The Laplace transform of $f(t)$ is given by

$$F(s) = \frac{4}{s(s+2)}$$

Find the final value using the final-value theorem and verify the result by determining $f(t)$ using inverse Laplace transform.

(b) Find the inverse Fourier transform of $\delta(\omega - \omega_0)$.

6. (a) Write the Dirichlet's conditions for Fourier series.

(b) Obtain Fourier series representation of the periodic rectangular waveform which is defined as

$$x(t) = \begin{cases} 0 & \text{for } t \in [-T/2, -T/4) \\ A & \text{for } t \in [-T/4, T/4) \\ 0 & \text{for } t \in (T/4, T/2) \end{cases}$$

7. (a) Explain the concept of negative frequency. Find the Fourier transform of the everlasting sinusoid $\cos\omega_0 t$.

(b) Explain the linearity and time-scaling properties of Fourier transform.

Code : 031610

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, then the unit impulse response $h(n)$ is

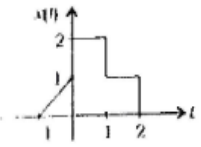
(i) unit step

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

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

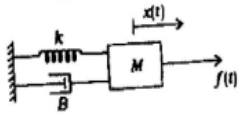
(a) Prove that the output of a discrete time system can be represented as a weighted sum of shifted impulse responses. 7

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

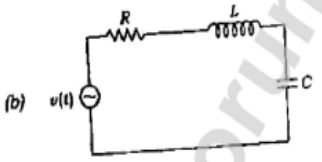
$x(n) = u(n) - u(n-7),\ h(n) = u(n-1) - u(n-4)$

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

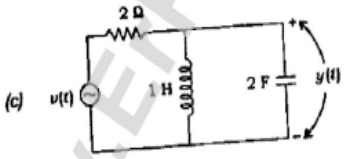
(a)



(b)



(c)



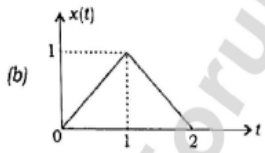
6. Find cosine Fourier series of half-wave rectified sine function. 14

(Turn Over)

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

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

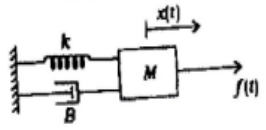
9. Find the impulse response and step response for the following system : 14

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

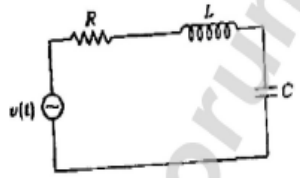
* * *

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

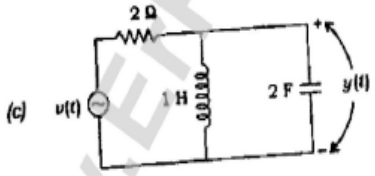
(a)



(b)



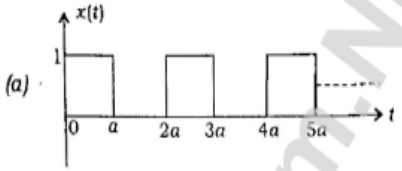
(c)



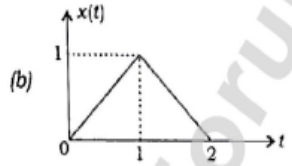
6. Find cosine Fourier series of half-wave rectified sine function. 14

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

(a)



(b)



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

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

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

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

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

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

★★★

Code : 031510

B.Tech 5th Semester Exam., 2017

SIGNALS AND SYSTEM

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. Fill in the blanks of the following (any *seven*) : 2×7=14

(a) The lengths of two discrete time sequences $x_1(n)$ and $x_2(n)$ are 5 and 7, respectively. The maximum length of a sequence $x_1(n) * x_2(n)$ is ____.

(b) For a signal $x(t)$, the Fourier transform is $X(f)$. Then the inverse Fourier transform of $X(3f+2)$ is ____.

(c) Two discrete time systems with impulse responses

$h_1[n] = \delta[n-1]$ and $h_2[n] = \delta[n-2]$

are connected in cascade. The overall impulse response of the cascaded system is ____.

(Turn Over)

(d) For a periodic signal

$v(t) = 30\sin 100t + 10\cos 300t + 6\sin(500t + \pi/$

the fundamental frequency in rad/ is ____.

(e) A discrete time system has impulse response $h(n) = 2^n u(n-4)$ ____.

Write 'Yes' if the system is stable or 'No' if the system is not stable.

(f) The impulse response of a system is

$h(t) = t\,u(t)$

For an input of $u(t-2)$ the output is ____.

(g) The average power in the signal

$s(t) = 10\cos(20\pi t - \pi/2) + 6\sin(15\pi t)$

is ____.

(h) $\int_{-\tau}^{\tau} \delta(t)\,dt =$ ____.

(i) The ROC of Laplace transform does no contain any ____.

(j) Z-transform is used for ____ tim signal.

2. Define the following : 2

(a) Stability

(b) Causality

(c) Random signal

(Conti

(d) Time-variant system

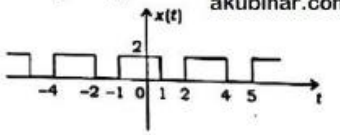
(e) Linear system

(f) Delta function

(g) Memoryless system

3. (a) Consider the system $y[n] = 2 \times [n^2]$. Determine whether it is memoryless, causal, linear and time-invariant. 7

(b) Determine the average power of the given signal $x(t)$. 7



4. A continuous time signal $x(t)$ is shown in the figure. Sketch the following signals : 2×7=14

(a) $x(3-t)$

(b) $x(4t+1)$

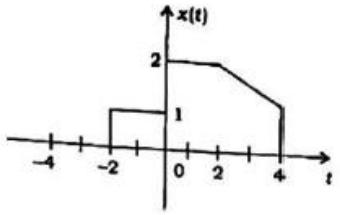
(c) $[x(t)+x(-t)]u(t)$

(d) $[\delta(t+1)+\delta(t-1)]x(t)$

(e) $x(t)x(t-5)$

(f) $x(t)\delta(t-3)$

(g) $x(2t-5)$



5. (a) (i) Find the inverse Fourier transform of

$$X(\omega) = \frac{1}{2-\omega^2+j3\omega}$$

(ii) Consider a causal LTI system with frequency response

$$H(j\omega) = \frac{1}{j\omega+3}$$

For a particular input $x(t)$ this system is observed to produce the output $y(t) = e^{-3t}u(t) - e^{-4t}u(t)$. Determine $x(t)$. 7

(b) Find the inverse z-transform of

$$X(z) = \frac{z}{z(z-1)(z-2)^2} \quad |z|>2$$ 7

6. Find the Laplace transform and the associated ROC for each of the following signals : 2×7=14

(a) $x(t) = \delta(t - t_0)$

(b) $x(t) = u(t - t_0)$

(c) $x(t) = e^{-2t}[u(t) - u(t-5)]$

(d) $x(t) = \sum_{k=0}^{\infty} \delta(t - kT)$

(e) $x(t) = \delta(at + b)$, a, b real constants

(f) $x(t) = 1/t$

(g) $x(t) = \sin t$

7. Determine whether or not each of the following signals is periodic. If a signal is periodic, determine its fundamental time period : 2×7=14

(a) $x[n] = \sin(\pi^2 n)$

(b) $x(t) = \cos t + \sin 3t$

(c) $x[n] = \cos\frac{n}{4}$

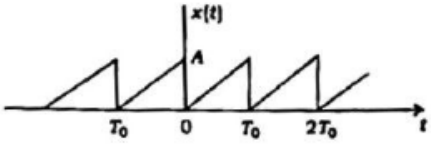
(d) $x[n] = \cos^2\frac{\pi}{8}n$

(e) $x(t) = \sin t + \sin 2t$

(f) $x(n) = \sin(5\pi n)$

(g) $x(t) = e^{-j3\pi/4}$

8. (a) Calculate the Fourier series coefficient a_k for the continuous time periodic signal. 7



(b) The system is described by

$$y'(t) + 2y(t) = x(t) + x'(t)$$

Find the impulse response of the LTI system if the system is causal. 7

9. Write short notes on any *two* of the following : 7×2=14

(a) Even and odd symmetric signal

(b) Initial and final value theorem of Laplace transform

(c) Random and deterministic signals

(d) Force voltage analogy

* * *

Code : 031510

B.Tech 5th Semester Examination, 2016

Signals and System

Time : 3 hours *Full Marks : 70*

Instructions :

(i) There are Nine Questions in this paper.

(ii) Attempt Five questions in all.

(iii) Question No. 1 is compulsory.

(iv) All the questions carry equal marks.

---

1. Fill in the blanks of the following (any seven). 2×7=14

(a) The z-transform of the sequence $x[n]$ is given by $X(z)\frac{1}{\left(1-2z^{1}\right)^{2}}$, with the region of convergence $|z| > 2$. Then, x[2] is.....8.....

(b) The input output relationship of a causal stable LTI system is given as $y[n] = \alpha\ y[n-1] + \beta \times [n]$ If the impulse response $h[n]$ of this system satisfies the condition $\sum_{n=0}^{\infty} h[n] = 2$, the relationship between α and β is .....

(c) Two discrete time systems with impulse responses $h_1[n] = \delta\ [n-1]$ and $h_2[n] = \delta\ [n-2]$ are connected in cascade. The overall Impulse response of the cascaded system is .....

(d) For a periodic signal $v(t) = 30 \sin 100t + 10 \cos 300t + 6 \sin (500t + \pi/4)$. the fundamental frequency in rad/s is .....

(e) A discrete time system has impulse response $h(n) = 2^n u(n-2)$, whether the system is stable or not not

(f) The impulse response of a system is $h(t) = t\,u(t)$. For an input of $u(t-1)$ the output is .....

(g) The average power in the signal $s(t) = 8 \cos (20\pi t - \pi/r) + 4\sin (15\pi t)$ is.....

(h) Fourier series is preferred for .periodic signal.

(i) The lengths of two discrete time sequences $x_1(n)$ and $x_2(n)$ are 4 and 5, respectively. The maximum length of a sequence $x_1(n) * x2(n)$ is .....

(j) For a stable LTI system, bounded input always provide bounded output.

2. Define the following : 2×7=14

(a) Stability

(b) Causality

(c) Random Signal

(d) Time variant system

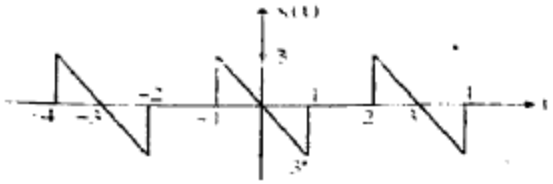
(e) Linear system

(f) Delta function

(g) Memory less system

3. (a) Consider the system $y(t) = 2 \times (t) + 3$. Determine whether it is Memory less, Causal, Linear and Time invariant. 7

(b) Determine the average power of signal $x(t)$. 7



4. A continuous time signal $x(t)$ is shown in figure. Sketch the following signals. 2×7=14

(a) $x(3-t)$

(b) $x(4t+1)$

(c) $[x(t) + x(-t)]\, u(t)$

(d) $[\delta(t+1)+\delta(t-1)]x(t)$

(e) $x(t)\, x(t-5)$

(f) $x(t)\delta(t-3)$

(g) $x(2t-5)$

(a) $x[n] = \sin(\pi^2 n)$

(b) $x(t) = \cos t + \sin 3t$

(c) $x[n] = \cos\frac{n}{4}$

(d) $x[n] = \cos^2\frac{\pi}{8}n$

(e) $x(t) = \sin t + \sin 2t$

(f) $x(n) = \sin(5\pi n)$

(g) $x(t) = e^{-j3\pi t}$

8. (a) Calculate the Fourier series coefficient a_k for the continuous time periodic signal. 7

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

With fundamental frequency $\omega_0 = \pi$.

(b) Given 7

$$X(z) = \frac{z(z-4)}{(z-1)(z-2)(z-3)}$$

(a) State all possible regions of convergence.

(b) For which ROC the X (z) is z-transform of a causal sequence.

www.akubihar.com

9. Write short notes on any two: 7×2=14

(a) Properties of convolution

(b) Initial and Final value theorem of Laplace transform

(c) Energy and power signals

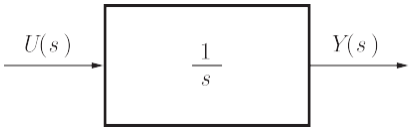
(d) Force voltage analogy

***

TUTORIAL

Department of Electrical Engineering
Signals & System (EE-031610)

1. For a periodic signal fundamental frequency in x(t) = 30 sin 100t + 10 cos 300t + 6 sin (500t + π / 4), in the rad /s is
   (A) 100 (B) 300
   (C) 500 (D) 1500
2. Which one of the following statements is NOT TRUE for a continuous time causal and stable LTI system?
   (A) All the poles of the system must lie on the left side of the jω axis
   (B) Zeros of the system can lie anywhere in the s-plane
   (C) All the poles must lie within |s| = 1
   (D)All the roots of the characteristic equation must be located on the left side of the jω axis.
3. Assuming zero initial condition, the response *y(t)* of the system given below to a unit step *u(t)* is



   (A) *u(t)* (B) *t u(t)*
   (C) $\frac{t^2}{2}u(t)$ (D) $e^{-t}u(t)$
4. The impulse response of a continuous time system is given by $h(t) = \delta(t-1) + \delta(t-3)$. The value of the step response at *t*=2 is
   (A) 0 (B) 1 (C) 2 (D) 3
5. The unilateral Laplace transform of transform of*f(t)* is $\frac{1}{S^2+S+1}$. The unilateral Laplace of *tf(t)* is
   (A) $-\frac{S}{\left(S^2+S+1\right)^2}$ (B) $-\frac{2S+1}{\left(S^2+S+1\right)^2}$
   (C) $\frac{S}{\left(S^2+S+1\right)^2}$ (D) $\frac{2S+1}{\left(S^2+S+1\right)^2}$
6. If x [n] = $(1/3)^{|n|}$ - $(1/2)^n$u [n],then the region of convergence (ROC) of its z-transform in the z-plane will be
   (A) $\frac{1}{3} < |Z| < 3$ (B) $\frac{1}{3} < |Z| < \frac{1}{2}$ (C) $\frac{1}{2} < |Z| < 3$ (D) $\frac{1}{3} < |Z|$
7. The Fourier transform of a signal h (t) is H (jω) = (2 cosω) (sin 2ω) / ω. The value of h (0) is
   (A) 1 / 4 (B) 1 / 2 (C) 1 (D) 2

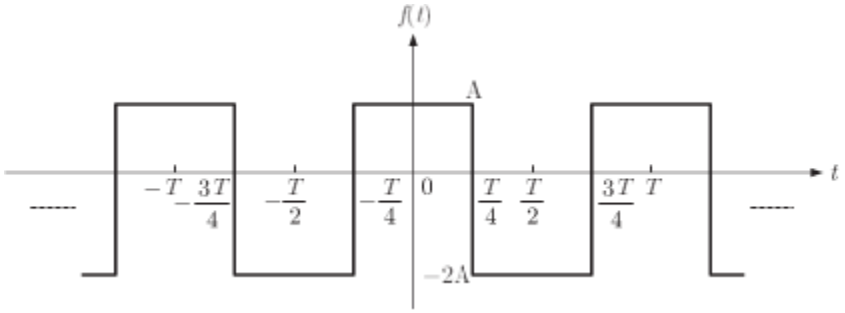
8. Let $y[n]$ denote the convolution of $h[n]$ and $g[n]$, where $h[n]=(1/2)^n u[n]$ and $g[n]$ is a causal sequence. If $y[0] = 1$ and $y[1] = 1/2$, then $g[1]$ equals

(A) 0 (B) 1 / 2 (C) 1 (D) 3 / 2

9. The trigonometric Fourier series of an even function does not have the
(A) dc term (B) cosine terms
(C) sine terms (D) odd harmonic terms

10. A system is defined by its impulse response $h(n) = 2^n u(n-2)$. The system is
(A) stable and causal (B) causal but not stable
(C) stable but not causal (D) unstable and non-causal

11. The trigonometric Fourier series for the waveform f (t) shown below contains



(A) only cosine terms and zero values for the dc components
(B) only cosine terms and a positive value for the dc components
(C) only cosine terms and a negative value for the dc components
(D) only sine terms and a negative value for the dc components

12. The Fourier series of a real periodic function has only cosine terms if it is even
(P) Cosine terms if it is even
(Q) Sine terms if it is even
(R) Cosine terms if it is odd
(S) Sine terms if it is odd
Which of the above statements are correct?
(A) P and S (B) P and R
(C) Q and S (D) Q and R

13. The input and output of a continuous time system are respectively denoted by $x(t)$ and $y(t)$. Which of the following descriptions corresponds to a causal system?

(A) $y(t)=x(t-2)+x(t+4)$ (B) $y(t)=(t-4)x(t+1)$

(C) $y(t) = (t+4)\,x(t-1)$ (D) $y(t)=(t+5)x(t+5)$

14. The Fourier transform of a real valued time signal has

(A) odd symmetry (B) even symmetry

(C) conjugate symmetry (D) no symmetry

15. If $F(s) = \frac{\omega}{s^2 + \omega^2}$ then the value of $\lim_{t \to \infty} f(t)$

(A) cannot be determined (B) is zero

(C) is unity (D) is infinite

16. The z -transform of a signal is given by $C(z) = \frac{z^{-1}(1 - z^{-4})}{4(1 - z^{-1})^2}$. Its final value is

(A)1 / 4 (B) zero

(C) 1.0 (D) infinity

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

(A) 1 (B) E / 2 (C) 2E (D) 4

18. A causal LTI system is described by the difference equation $2y[n] = \alpha y[n-2] - 2x[n] + \beta x[n-1]$ .The system is stable only if

(A) $|\alpha| = 2, |\beta| < 2$ (B) $|\alpha| > 2, |\beta| > 2$

(C) $|\alpha| < 2$, any value of β (D) $|\beta| < 2$, any value of α

19. Consider the sequence part of the sequence is x [n] = [- 4 - j51 + j25]. The conjugate anti-symmetric of the sequence is

(A) [- 4 - j2.5, j2, 4 - j2.5] (B) [- j2.5, 1, j2.5]

(C) [- j2.5, j2, 0] (D) [- 4, 1, 4]

20. The Fourier transform of a conjugate symmetric function is always

(A) Imaginary (B) Conjugate anti-symmetric

(C) Real (D) Conjugate symmetric

21. Match the following and choose the correct combination.

Group 1

E. Continuous and aperiodic signal

F. Continuous and periodic signal

G. Discrete and aperiodic signal

H. Discrete and periodic signal

Group 2

1. Fourier representation is continuous and aperiodic

2. Fourier representation is discrete and aperiodic

3. Fourier representation is continuous and periodic

4. Fourier representation is discrete and periodic

(A) E - 3, F - 2, G -4, H -1

(B) E - 1, F - 3, G -2, H -4

(C) E - 1, F - 2, G -3, H -4

(D) E - 2, F - 1, G -4, H -3

22.The power in the signal $s(t) = 8\cos(20\pi - \pi/2) + 4\sin(15\pi t)$ is

(A) 40 (B) 41 (C) 42 (D) 82

23. The type of systems which are characterized by input and the output quantized at certain levels are called as

(A) Analog (B) Discrete

(C) Continuous (D) Digital

24. A system which is linear is said to obey the rules of

a) scaling b) additivity

c) both scaling and additivity d) homogeneity

25.A time invariant system is a system whose output

a) increases with a delay in input b) decreases with a delay in input

c) remains same with a delay in input d) vanishes with a delay in input

26. All causal systems must have the component of

a) memory b) time invariance

c) stability d) linearity

27. y(t) = sin(x(t-1)) : Comment on its memory aspects.

a) Having memory b) Needn't have memory

c) Memoryless system d) Time invariant system

28. Construct the inverse system of y(t) = 2x(t)

a) y(t) = 0.5x(t) b) y(t) = 2x(t) c) y(2t) = x(t) d) y(t) = x(2t)

29.Comment on the causality of y[n] = x[-n].
a) Time invariant b) Causal c) Non causal d) Time varying

30. y(t) = x(t-2) + x(2-t). Comment on its causality:
a) Causal b) Time variant c) Non causal d) All of the mentioned

31.Comment on the causality of y[n] = n*x[n].
a) Time invariant b) Time varying c) Non causal d) Causal

32.Comment on the linearity of y[n] = n*x[n].
a) Linear b) Only additive c) Not scalable d) Non linear

33.Which of the following systems is linear?
a) y(t) = sin(x(t)) b) y(t) = log(x(t))
c) y(t) = cos(x(t)) d) y(t) = dx(t)/dt

34.Which of the following systems is stable?
a) y(t) = log(x(t)) b) y(t) = exp(x(t))
c) y(t) = sin(x(t)) d) y(t) = tx(t) + 1

35. Which of the following systems is time invariant?
a) y(t) = x(2t) + x(t) b) y(t) = x(t) + x(1-t)
c) y(t) = -x(t) + x(1-t) d) y(t) = x(t) + x(t-1)

36. Which of the following systems is memoryless?
a) y(t) = x(2t) + x(t) b) y(t) = x(t) + 2x(t)
c) y(t) = -x(t) + x(1-t) d) y(t) = x(t) + 2x(t+2)

37.For what value of k, will the following system be time invariant?
y(t) = x(t) + x(kt) – x(2t) + x(t-1)
a) 1 b) 2 c) 3 d) 2.5

38. Is the function y[n] = y[n-1] + x[n] stable in nature?
a) It is stable b) It is unstable
c) Both stable and unstable d) None of the mentioned

39. Comment on the causality of the following discrete time system: y[n] = x[-n].
a) Causal b) Non causal
c) Both Casual and Non casual d) None of the mentioned

40. Comment on the time invariance of the following discrete system: y[n] = x[2n+4].
a) Time invariant b) Time variant
c) Both Time variant and Time invariant d) None of the mentioned

41. Is the system $y[n] = x^2[n-2]$ linear? (yes/no)
42. Is the above system, i.e $y[n] = x^2[n-2]$ time invariant? (yes/no)