Techno India NJR Institute of Technology

Course File

Signal & System (3EC4-05)

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SYLLABUS

II Year - III Semester: B.Tech. (Electronics & Communication Engineering)

3EC4-05: Signals & Systems

3 Credits | **Max. Marks: 150 (IA:30, ETE:120)**

3L:0T:0P | **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.	6
2	Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations	7
3	Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases	8
4	The Laplace Transform, notion ofeigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.	6
5	The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.	5
6	State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.	8
	Total	40

Course Overview:

Signals and Systems is an introduction to analog and digital signal processing, a topic that forms an integral part of engineering systems in many diverse areas, including seismic data processing, communications, speech processing, image processing, defense electronics, consumer electronics, and consumer products.

The course presents and integrates the basic concepts for both continuous-time and discrete-time signals and systems. Signal and system representations are developed for both time and frequency domains. These representations are related through the Fourier transform and its generalizations, which are explored in detail. Filtering and filter design, modulation, and sampling for both analog and digital systems, as well as exposition and demonstration of the basic concepts of feedback systems for both analog and digital systems, are discussed and illustrated.

Course Outcomes:

CO.NO.	Cognitive Level	Course Outcome
1	**Comprehension**	Classify different types of signals and system properties.
2	**Application**	Demonstrate continuous and discrete systems in time and frequency domain using different transforms.
3	**Analysis**	Analyze whether the system is stable.
4	**Synthesis**	Design and Develop Sampling and reconstruction circuit .
5	**Evaluation**	Evaluate the output of the MIMO systems.

Prerequisites:

1. Fundamentals knowledge of differentiation and integration.
2. Fundamentals knowledge of partial fraction.
3.

Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
CO. NO.	Domain Specific					Domain Independent						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	2	0	0	1	0	0	0	2
CO2	3	1	0	2	3	0	0	1	0	0	0	2
CO3	3	2	2	3	0	0	0	0	0	0	0	2
CO4	3	2	3	3	1	0	0	0	0	0	0	0
CO5	3	2	2	3	1	0	0	2	0	0	0	1
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	**1**	**INTRODUCTION: OBJECTIVE, SCOPE AND OUTCOME OF THE COURSE.**
2	1	Energy signals power signals
3	1	Continuous and discrete time signals.
4	1	Discrete amplitude signals
5	1	Discrete amplitude signals
6	1	System properties: linearity: additivity and homogeneity
7	**2**	**SHIFT-INVARIANCE, CAUSALITY**
8	2	Stability, realizability
9	2	Linear shift-invariant (LSI) systems
10	2	Impulse response
11	2	Step response
12	2	Convolution
13	2	Input output behavior with aperiodic convergent inputs
14	**3**	**CHARACTERIZATION OF CAUSALITY AND STABILITY OF LINEAR SHIFT-INVARIANT SYSTEMS**
15	3	System representation through differential equations and difference equations
16	3	Characterization of causality and stability of linear shift-invariant systems
17	3	System representation through differential equations and difference equations
18	3	Periodic and semi-periodic inputs to an LSI system
19	3	The notion of a frequency response
20	3	Its relation to the impulse response
21	3	Fourier series representation
22	**4**	**FOURIER TRANSFORM**
23	4	Convolution/multiplication and their effect in the frequency

		domain
24	4	Magnitude and phase response
25	4	Fourier domain duality
26	4	The Discrete-Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT)
27	4	Parseval's Theorem. The idea of signal space and orthogonal bases
28	**5**	**THE LAPLACE TRANSFORM**
29	5	Notion of eigen functions of LSI systems
30	5	A basis of eigen functions, region of convergence
31	5	Poles and zeros of system, Laplace domain analysis
32	5	Solution to differential equations and system behavior
33	**6**	**THE Z-TRANSFORM FOR DISCRETE TIME SIGNALS AND SYSTEMS- EIGEN FUNCTIONS**
34	6	Region of convergence, z-domain analysis
35	6	State-space analysis and multi-input, multi-output representation
36	6	The state-transition matrix and its role
37	6	The Sampling Theorem and its implications- Spectra of sampled signals.
38	6	Reconstruction: ideal interpolator, zero-order hold, first-order hold
39	6	Aliasing and its effects
40	6	Relation between continuous and discrete time systems

TEXT/REFERENCE BOOKS

1. Signals and Systems, A.V. Oppenheim, A.S. Willsky and I.T. Young, Prentice Hall, 1983.
2. Signals and Systems - Continuous and Discrete, R.F. Ziemer, W.H. Tranter and D.R. Fannin ,4th edition, Prentice Hall, 1998.
3. Circuits and Systems: A Modern Approach, Papoulis, HRW, 1980.
4. Signal Processing and Linear Systems, B.P. Lathi, Oxford University Press, 1998.

NPTEL COUSES LINK

1. https://nptel.ac.in/courses/108/106/108106163/
2. https://nptel.ac.in/courses/108/104/108104100/

QUIZ Link

1. https://www.sanfoundry.com/1000-signals-systems-questions-answers/

Faculty Notes Link

1. https://drive.google.com/drive/folders/14RQFN1jlEgWi29XYo__mM5lTYFXRXnVj?usp=sharing

Assessment Methodology:

1. Practical exam using MATALB software.
2. Two Midterm exams where student have to showcase subjective learning.
3. Final Exam (subjective paper) at the end of the semester.

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3E1148

Roll No.

Total No of Pages: 4

3E1148

B. Tech. III - Sem. (Main / Back) Exam., Dec. 2019
PCC Electronics Instrumentation & Control Engineering
3EI4-05 Signal & Systems
Common For EC, EI

Time: 3 Hours **Maximum Marks: 120**

Instructions to Candidates:

Attempt all ten questions from Part A, five questions out of seven questions from Part B and four questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×2=20]**

All questions are compulsory

Q.1 What are causal system? Why are non – causal system unrealizable?

Q.2 Check whether the following system is BIBO stable or not $y(n) = e^{-x(n)}$.

Q.3 State and prove convolution theorem in relation to Fourier Transform.

Q.4 How is Z– transform obtained from Laplace transform?

Q.5 Find Laplace transform of $f(t) = \left[\frac{1-e^t}{t}\right]$

Q.6 Find Z – transform for $x(n) = 2^n u(n-2)$

Q.7 What is Aliasing? Discuss any two corrective measures to combat the effect of Aliasing.

Q.8 Let x(n) be a real and odd periodic signal with period N = 7 and Fourier series coefficients X_K. Given that $X_{15} = j$, $X_{16} = 2j$, $X_{17} = 3j$. Determine values of X_0, X_{-1}, X_{-2}, X_{-3}.

Q.9 Sketch the following signal –

$x(t) = r(-0.5t + 2)$

Q.10 Evaluate $\int_{-\infty}^{\infty} e^{-2t^2}\,\delta(t + 5)\,dt$

PART – B

(Analytical/Problem solving questions)

Attempt any five questions [5×8=40]

Q.1 Determine Discrete time Fourier transform of –

$x(n) = \sin(\omega_0 n)\,U(n)$

Q.2 Determine Laplace transform of –

$x(t) = \cos^3(3t)\,U(t)$

Q.3 A second order discrete time system is characterized by difference equation $y(n) - 0.1y(n-1) - 0.02\,y(n-2) = 2x(n) - x(n-1)$. Determine y(n) for $n \geq 0$ when $x(n) = U(n)$ and initial condition are $y(-1) = -10$ & $y(-2) = 5$.

Q.4 Consider the continuous time signal $x(t) = \delta(t + 2) - \delta(t - 2)$. Calculate the value of energy signal Ey for the following signal:

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

Q.5 Find inverse Z – transform of $X(z) = e^{1/z}$ with ROC all z – plane except $|z| = 0$.

Q.6 Determine Z – transform of –

(a) $x(n) = -U(-n-1)$

(b) $x(n) = U(-n)$

Q.7 Differentiate between real and flat – top Sampling.