DEPARTMENT OF INSTRUMENTATION & CONTROL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I

Name of the programme and specialization	**B.Tech. Instrumentation & Control Engineering**		
Course Title	**Signals & Systems**		
Course Code	**ICPC 15**	No. of Credits	**3**
Course Type	✓ **Core course**	~~Elective course~~	
Pre-requisite(s)	NIL		
Session	**July 2023**	Section	**Section A**
Name of Faculty	**Dr. P A Karthick**	Department	**ICE Dept**
Email	**pakarthick@nitt.edu**		

Syllabus (As approved in BoS) Available on Department website

Introduction to signals – Transformation of the independent variable – Basic continuous-time signals – Basic discrete-time signals – Step and Impulse functions – Sampling theorem. Introduction to systems – Properties of systems – Classification of systems – Mathematical models of systems. Impulse response of physical systems – Stability analysis of dynamic systems – Introduction to convolution – Convolution integral – System impulse response and step response using Laplace transform – Numerical convolution. Z-transform – Convergence of Z-transform – Properties of Z-transform – Inversion of Z-transform –Application of Z-transform in analysis of discrete-time systems.

Representation of signals in terms of elementary signals – Condition of orthogonality – Representation of signals by elementary sinusoids – Fourier series representation of periodic signals – Power spectrum.

Fourier transform – System frequency response – Realizability of frequency response – Energy spectrum. Calculation of simple transforms. Discrete-Fourier transform (DFT).

Classification of random signals – Auto-correlation function – Properties of auto-correlation function – Measurement of auto-correlation function – Application of auto-correlation functions. Cross correlation functions. Sum of random processes- Spectral density – Relation of spectral density to auto-correlation.

Auto-correlation function of system output - Cross-correlation between system input and output. White noise - Analysis of linear systems in time-domain using white noise - Mean and mean square value of system output. Generation of pseudo random binary noise (PRBN) and its use in system identification.

Course Objectives

1. To introduce the student to identify and represent the type of signals and systems.
2. To introduce the mathematical tools available to analyze continuous time signals and systems.
3. To introduce the mathematical tools available to analyze discrete time signals and systems.
4. To introduce about the random phenomena in the real world, the mathematical models and pseudo- random signals in identifying systems.

Mapping of COs with Pos

Course Outcomes: On completing this course, the students will be able to	Programme Outcomes (PO) (Enter Numbers only)
1. Classify the signals and systems based on their properties and determine the response of LTI system using convolution	1, 2, 5, 10, 12
2. Analyze the spectral characteristics of continuous and discrete time signals and systems using Fourier transforms	1, 2, 5, 10, 12
3. Apply Laplace and Z transform to analyze continuous and discrete time systems	1, 2, 5, 10, 12
4. Understand the process of sampling and the effects of under sampling	1, 2, 5, 10, 12
5. Classify random signals using statistical concepts and characterize systems using pseudo-random signals.	1, 2, 5, 10, 12

COURSE PLAN – PART II

Course Overview

The course introduces the fundamental principles of signals and systems. The principles, computing tools and concepts from signals and systems, such as sampling, Fourier, Laplace and Z transform are an important component of almost every engineering field.

Course Teaching & Learning Activities

S. No	Week/Contact Hours	Topic	Mode of Delivery
1	Week 1 (3 contact hours)	Introduction to the course	Chalk and Talk/PPT
2	Week 2 (3 contact hours)	Continuous-time signals	Chalk and Talk/PPT
3	Week 3 (2 contact hours)	Fourier Series	Chalk and Talk/PPT
4	Week 4 and 5 (6 contact hours)	Fourier Transforms	Chalk and Talk/PPT
5	Week 6 (3 contact hours)	Discrete-time signals	Chalk and Talk/PPT
6	Week 7 (1 contact hour)	First Assessment	Chalk and Talk/PPT
7	Week 7 (2 contact hours)	Fourier Analysis	Chalk and Talk/PPT
8	Week 8 (3 contact hours)	Continuous-time systems	Chalk and Talk/PPT
9	Week 9 and 10 (6 contact hours)	Laplace Transformation	Chalk and Talk/PPT
10	Week 11 and 13 (6 contact hours)	Z-Transform	Chalk and Talk/PPT

11	Week 13 (1 contact hour)	Second Assessment	Chalk and Talk/PPT
12	Week 13 (2 contact hour)	Random Processes	Chalk and Talk/PPT
13	Week 14, and 15 (6 contact hours)	Cross correlation and Auto correlation	Chalk and Talk/PPT
14	Week 17 (3 contact hours)	Power spectral density estimation and revision	Chalk and Talk/PPT
15	Week 19	Final Assessment – [redacted]	-

Course Assessment Methods

S.No.	Mode of Assessment	Date	Duration	% Weightage
1	First Assessment (Written Exam)	6th week	1 hour	20%
2	Assignment -1 (Matlab)	7th week	-	10%
3	Second Assessment (Written Exam)	12th week	1 hour	20%
CPA	Compensation Assessment*	13th week	1 hour	20%
4	Assignement/Tutorials	14th week	-	10%
5	Final Assessment	19th week	3 hours	40%

Reference:

1. Oppenheim A.V., Wilsky and Nawab, Signals and Systems, Pearson India Education Services Private limited India, 2nd Edition, 2016.
2. Chen C.T., Systems and Signal Analysis - A Fresh Look, Oxford University Press India, 3rd Edition, 2004.
3. B.P. Lathi, Principles of Linear Systems and Signals, Oxford University Press, 2nd Edition, 2009

Course Exit Survey

Feedback from the students during the class committee meetings
Feedback before End-term examination through a questionnaire, for improvements in future.

Course Policy

- Compensation Assessment: A student can be, upon prior approval, absent from only one out of the continuous assessments (1 or 3), for which he/she is allowed to take the compensatory assessment. Note that this assessment is not offered as an improvement test for everyone.

ATTENDANCE

- Cf. B.4.5.2 (page 7, https://www.nitt.edu/home/academics/rules/BTech_Regulations_2018.pdf) 75% attendance is mandatory, with an exemption up to 10% on genuine grounds (on-duty); prior information and approval from the instructor is compulsory.
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded '**V**' grade.
- The only option for students with attendance < 65% is RE-DO.

ASSESSMENTS AND GRADING POLICY

- A student is declared pass upon accumulating a minimum of 35% over all the 5 assessments; grading is done for those students declared passed based on the class average – average and above shall get S, A, and B grades, and below average shall get C, D, and E.

ACADEMIC DISHONESTY & PLAGIARISM (cf. Institute Rules & Regulations)

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
- The above policy against academic dishonesty shall be applicable for all the programmes.

Additional Course Information

All the students are urged to be interactive during the classes; this is an essential component of the teaching-learning process. They are free to interact with me over email any time, and if needed meet me in person with prior appointment.

Any changes in the proposed layout of the semester, due to unavoidable circumstances, shall be intimated immediately to the students and to the Chairperson, PAC

Course Faculty	CC- Chairperson	HOD
(Dr. P. A. Karthick)	(Dr. Ramakalyan Ayyagari)	(Dr. K. Dhanalakshmi)