DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGG.

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech in Instrumentation and Control Engineering		
Course Title	Signals and Systems - (IV Semester)		
Course Code	ICPC16 -(IV semester)	No. of Credits	03
Course Code of Pre-requisite subject(s)			
Session	January 2019	Section (if, applicable)	B
Name of Faculty	Dr. Karthick P.A	Department	ICE
Email	pakarthick@nitt.edu	Telephone No.	
Name of Course Coordinator(s) (if, applicable)			
E-mail		Telephone No.	
Course Type	☑ Core course	☐ Elective course	

Syllabus (approved in BoS)

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 model of systems – Concept of state variable – Normal form of system equations – Initial conditions.

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 Ztransform – Inversion of Z-transform –Application of Z-transform in analysis of discrete-time systems – Evaluation of discrete-time system frequency response – Inverse systems – Deconvolution.

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) – Properties of Discrete Fourier Transform – Circular convolution.

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 function.

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 - Analysis in the frequency domain.

COURSE OBJECTIVES

1. This course introduces the student to identify and represent the type of signals and systems.
2. The students are introduced to the mathematical tools available to analyze the signals and systems.
3. A section of the course introduces about the random phenomena in the real world and the mathematical models.
4. To introduce about pseudo-random signals in identifying systems.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
1. The students will be identify the types of signals and systems with general understanding of continuous time and discrete time signals and systems.	1, 3,4
2. The student will be able to analyze signals and systems using transforms.	3,5,6
3. The students will be able to classify random signals using statistical concepts and characterize systems using pseudorandom signals.	1,6,12

COURSE PLAN – PART II

COURSE OVERVIEW

This course is introduces the fundamental principles of signals and system analysis. These concepts form the building blocks of modern digital signal processing, communication and control systems.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	1 and 2 (6 Contact hours)	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 model of systems	Chalk & Talk/ Power point presentation
2	3 and 4 (6 Contact hours)	Concept of state variable, Normal form of system equations, Initial conditions. Impulse response of physical systems, Stability analysis of dynamic systems, Introduction to convolution, Convolution integral	Chalk & Talk/ Power point presentation

3	5 (2 contact hours)	System impulse response and step response using Laplace transform, Numerical convolution.	Chalk & Talk/ Power point presentation
4	5 (1 contact hour)	Assessment –1: Written exam (20% Weightage)	-
5	6 (3 contact hours)	Z-transform, Convergence of Z-transform, Properties of Ztransform, Inversion of Z-transform, Application of Z-transform in analysis of discrete-time systems	Chalk & Talk/ Power point presentation
6	7 (3 contact hours)	Evaluation of discrete-time system frequency response, Inverse systems, Deconvolution. Representation of signals in terms of elementary signals	Chalk & Talk/ Power point presentation
7	8 (3 contact hours)	Condition of orthogonality, Representation of signals by elementary sinusoids, Fourier series representation of periodic signals, Power spectrum.	Chalk & Talk/ Power point presentation
8	9 (3 contact hours)	Fourier transform, System frequency response, Realizability of frequency response, Energy spectrum. Calculation of simple transforms. Discrete-Fourier transform (DFT), Properties of Discrete Fourier Transform	Black/white board Power point presentation
9	10 (3 contact hours)	Circular convolution. Classification of random signals, Auto-correlation function, Properties of auto-correlation function, Measurement of auto-correlation function	Black/white board Power point presentation
10	11 (3 contact hours)	Application of auto-correlation functions. Cross correlation functions. Sum of random processes, Spectral density, Relation of spectral density to auto-correlation function	Black/white board Power point presentation
11	12 (1 contact hour)	Assessment –2: Written exam (20% Weightage)	-
12	12 (2 contact hour)	Auto-correlation function of system output, Cross-correlation between system input and output.	Black/white board Power point presentation
13	13 (3 contact hours)	White noise, Analysis of linear systems in time-domain using white noise, Mean and mean square value of system output.	Black/white board Power point presentation
14	14 (3 contact hours)	Generation of pseudo random binary noise (PRBN) and its use in system identification, Analysis in the frequency domain.	Black/white board Power point presentation

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	First Assessment (written exam)	5th week	One hour	20%
2.	Assignment -1 / Seminar	6th week	--	5%
3.	Second Assessment (Written Exam)	12th week	One hour	20%
4.	Compensation Assessment (Written Exam)-CPA	13th week	One hour	20%
5.	Assignment -2 / Seminar	13th week	---	5%
6.	Final assessment (Written Exam)	15th week	Three hour	50%

***mandatory; refer to guidelines on page 4**

ESSENTIAL READINGS : Textbooks, reference books, Website addresses, journals, etc.

Text Books:

1. Gabel R.A. and Robert R.A., Signals and Linear Systems, John Wiley and Sons, 3rd Edition, 1987.
2. Oppenheim A.V., Wilsky and Nawab, Signals and Systems, Pearson India Education Services Private limited India, 2nd Edition, 2016.
3. Chen C.T., Systems and Signal Analysis - A Fresh Look, Oxford University Press India, 3rd Edition, 2004.
4. B.P. Lathi, Principles of Linear Systems and Signals, Oxford University Press, 2nd Edition, 2009

Reference Books:

1. Cooper G.R and Mc Gillem C.D, Probabilistic Methods of Signals and System Analysis, Oxford University Press, 3rd Edition, 1999.
2. Chesmond, Wilson and Lepla, Advanced Control System Technology, Viva Books, 1st Edition, 1998.
3. Ziemer R.E., Tranter W.H., and Fannin D.R., Signals and Systems: Continuous and Discrete, Prentice Hall, 4th Edition, 1998.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

1. Indirect feedback through questionnaire.
2. Direct feedback from the students.
3. Feedback from the students during the class committee meetings.

COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, academic honesty and plagiarism etc.)

MODE OF CORRESPONDENCE (email/ phone etc.)

Any suggestions, Queries and feedback can be emailed to the Course Coordinator directly at pakarthick@nitt.edu

COMPENSATION ASSESSMENT

Only one compensation will be conducted during the 13th week for the student absent for assessment due to medical, on-duty and other genuine reasons. The course faculty decision will be the final to decide about retest. The exam will be conducted based on entire syllabus. The duration of the exam is 1 hours. If the student absents themselves for more than one assessment, other assessment marks will be awarded as zero.

Passing Criteria /Awarding Grade

35% marks or half of the class average marks whichever is higher is the minimum passing criteria for this subject. If student not met above mentioned criteria after reassessment or absent for reassessment, he/she should undergo formative assessment. Other grades are awarded with relative grades as per institute norms.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

1. **At least 75% attendance in each course is mandatory.**
2. **A maximum of 10% shall be allowed under On Duty (OD) category.**
3. Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

1. Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
2. Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
3. 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 INFORMATION

- Students can meet any time depends on their mutual availability.
- The course faculty will be available in ICE Department ground floor inside Process control lab in his cabin.
- Minor doubts will be clarified during the class hours.

FOR APPROVAL

Course Faculty P.A.Dev.Hed **CC-Chairperson** 28/11/19 **HOD** B. Venugopal 28/11/19