DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech. Degree		
Course Title	Signals and Systems		
Course Code	ECPC10	No. of Credits	4
Course Code of Pre-requisite subject(s)	-		
Session	July 2018	Section (if, applicable)	B
Name of Faculty	Dr.P.Palanisamy	Department	ECE
Email	palan@nitt.edu	Telephone No.	0431-2503312
Name of Course Coordinator(s) (if, applicable)	-		
E-mail	-	Telephone No.	-
Course Type	Core course		

Syllabus (approved in BoS)

Vector spaces. Inner Product spaces. Schwartzin equality. Hilbertspaces. Orthogonal expansions. Bessel's inequality and Parseval's relations.

Continuous-time signals, classifications. Periodic signals. Fourier series representation, Hilbert transform and its properties.

Laplace transforms. Continuous - time systems: LTI system analysis using Laplace and Fourier transforms.

Sampling and reconstruction of band limited signals. Low pass and band pass sampling theorems. Aliasing. Anti- aliasing filter. Practical Sampling - aperture effect.

Discrete- time signals and systems. Z-transform and its properties. Analysis of LSI systems using Z–transform.

Text Books

1. A.V.Oppenheim, A. Willsky, S. Hamid Nawab, "Signals and Systems (2/e)", Pearson 2000.

2. S.Haykin and B.VanVeen "Signals and Systems, Wiley, 1998.

3. M.Mandal and A.Asif, "Continuous and Discrete Time Signals and Systems, Cambridge, 2007.

Reference Books

1. D.C.Lay, "Linear Algebra and its Applications (2/e)", Pearson, 2000.

2. K.Huffman&R.Kunz, "Linear Algebra", Prentice- Hall, 1971.

3. S.S.Soliman&M.D.Srinath, "Continuous and Discrete Signals and Systems", Prentice-Hall, 1990.

COURSE OBJECTIVES

Course Learning Objectives

The aim of the course is for

- understanding the fundamental characteristics of signals and systems.
- understanding the concepts of vector space, inner product space and orthogonal series.
- understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
1. Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.	PO1, PO2
2. Analyse the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis.	
3. Classify systems based on their properties and determine the response of LSI system using convolution and analyze system properties based on impulse response and Fourier analysis	
4. Apply the Laplace transform and Z- transform respectively for the analyse of continuous-time and discrete-time signals and systems.	
5. Understand the process of sampling and the effects of under sampling.	

COURSE PLAN – PART II

COURSE OVERVIEW

Signals and Systems are encountered extensively in our day-to-day lives, from making a phone call, listening to a song, editing photos, manipulating audio files, using speech recognition software like Google now, to taking EEGs, ECGs and X-Ray images. Each of these involves gathering, storing, transmitting and processing information from the physical world. This course will equip the students to deal with these tasks efficiently by learning the basic mathematical framework of signals and systems.

This course will begin with the classification, representation and some common operations on both continuous-time and discrete-time signals. Next, Fourier series of continuous-time periodic

signals will be discussed as an orthogonal expansion of a signal over a certain period and the corresponding basics pertaining to Linear Algebra will also be discussed. Fourier Transform and Laplace transform on some common signal will be derived, and properties, theorems and applications will be covered for both the transforms. Systems, their classification, representation of LTI and LSI systems by means of continuous impulse response and discrete impulse response, system stability, and their eigen signals will be discussed. The concept of transfer function (system function) of a system, time and frequency domain analysis of LTI system will also be discussed. Hilbert transform will also be covered. The sampling and reconstruction of low-pass bandlimited signals and issues involved will be discussed thoroughly. Finally discrete Fourier series representation and Z transforms on common discrete-time sequences will be derived, and properties, theorems and applications will be discussed.

Ideas introduced in this course will serve as a central building block for students interested in further studying information processing in any form such as Digital Signal Processing, Analog Communication, Digital Signal Processors and Applications, Statistical Signal Processing, Advanced Digital Signal Processing, Spectral Analysis of Signals and Wavelet Signal Processing.

This course will develop a foundation in signal processing that can be used by the students as the basis for further study in signal processing domain.

COURSE TEACHING AND LEARNING ACTIVITIES

S. No.	Week/Contact Hours	Topic	Mode of Delivery
1	2	Signals – Definition, Basic signals, Representation of signals, Transformation of independent variables-for both continuous-time and discrete-time signals.	Chalk and Talk
2	2	Classification of signals: Energy signal, power signal, deterministic signal, random signal and periodic signals(Continuous-time and discrete-time signals)	Chalk and Talk
3	4	Vector space, subspace, linear independence, basis and dimension, Inner product, norm, inner product space, normed space Cauchy Schwarz inequality, Hilbert spaces.	Chalk and Talk
4	2	Orthogonality, Gram-Schmidt orthogonalization process, Set of nonzero orthogonal vectors are linearly independent, Orthonormal basis, complete orthogonal basis.	Chalk and Talk
5	2	Signals as a vector in vector space. Best approximation. Projection theorem. Generalized Fourier series representation. Bessel's inequality, Parsavel's theorem.	Chalk and Talk

6	2	Fourier series representation of continuous-time periodic signals (Complex exponential and Trigonometric Fourier series representations). Properties of Fourier series. Discrete Fourier series representation	Chalk and Talk
7	3	Fourier transform of continuous-time aperiodic signals. Definition. Properties of Fourier transform. Fourier transform for periodic signal. Inverse Fourier transform.	Chalk and Talk
8	4	Laplace transform of continuous –time signals. Definition. Regions of convergence. Properties of Laplace transform. Inverse Laplace transforms. Solutions of Linear constant coefficient differential equations using Laplace transform.	Chalk and Talk
9	3	Systems-Definition, classification, properties (Linearity, time-invariant, causality, stability, memoryless, invertible). Impulse response, representation of signals using impulses. Response of an LTI system (Convolution sum and convolution integral)	Chalk and Talk
10	4	Response of a continuous-time LTI system to periodic signals using Fourier series. Responses of an LTI system to arbitrary signals using Fourier transform. Eigen signals.Frequency response of a continuous-time LTI system. Hilbert transform and its properties. Analyses of an LTI system using impulse response. Necessary and sufficient conditions for causality and BIBO stability.	Chalk and Talk
11	2	Analyses of an LTI system using Fourier transform and Laplace transform. Transfer function. Causality and BIBO Stability Analysis of Continuous-time LTI system.	Chalk and Talk
12	4	Principles of Sampling. Low pas sampling theorem. Sampling using periodic impulse train, Sampling using periodic pulses (natural sampling), Flat-top sampling(using sample and hold circuit). Reconstruction of signals from its samples. Aliasing and aperture effects.	Chalk and Talk
13	2	Z transform of discrete-time sigansl. Definition. Properties of Z- transform	Chalk and Talk
14	2	Region of convergence. Inverse Z-transform (Power series method, Partial fraction method and Contour integration method).	Chalk and Talk
15	2	Solutions of Linear constant coefficient differenc equations using Z- transform. Analysis of a discrete-time LSI system using Z transform. System function. Causality and BIBO Stability Analysis of discrete-time LTI system	Chalk and Talk

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Test -1		1 hour	20%
2	Test 2		1 hour	20%
3	Home Works and Assignments		-	10%
CPA	Compensation Assessment*		1 hours	
6	Final Assessment *		3 hours	50%

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

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

Feedback from the students will be obtained as per the institute norms

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

MODE OF CORRESPONDENCE (email/ phone etc)

Through Class

COMPENSATION ASSESSMENT POLICY

There will be two tests and one final examination. All exams will be closed book. The exam topics will be a subset of the course learning outcomes and for each test and examination the portions will be intimated in the class. A Re-test/Re-exam will be given only in the case of illness and medical emergency (doctor's certificate is required), and only if I am notified in advance of the exam by email or telephone.

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

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

ACADEMIC DISHONESTY & PLAGIARISM

- 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 INFORMATION

I teach directly to specific course contents, so simply skipping class and reading a text book is unlikely to lead to success in this course. So, all the students are advised to come to class regularly.

FOR APPROVAL

Course Faculty	CC-Chairperson	Head of the Department