NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE PLAN – PART I			
Course Title	**SIGNALS AND SYSTEMS**		
Course Code	**ECPC10**	**No. of Credits**	**04**
Department	**ECE**	**Faculty**	**Dr. S. Deivalakshmi**
Pre-requisites Course Code	**NONE**		
Session	**August – 2020**	**Sem/Section (if, applicable)**	**III - B**
Pre-requisites Course Code	**NONE**		
Course Coordinator(s) (if, applicable)	**-**		
E-mail	**deiva@nitt.edu**	**Telephone No.**	**0431-2503321**
Course Type	**Core course**		

Syllabus (approved in BoS)

Vector spaces. Inner Product spaces. Schwartz inequality. Hilbert spaces. 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.

COURSE 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 (CO)	Aligned Programme Outcomes (PO)

At the end of the course students will be able to CO1: apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.	PO1,2
CO2: Analyse the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis.	PO1,2
CO3: 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.	PO 1,2
CO4: Apply the Laplace transform and Z- transform respectively for the analyse of continuous-time and discrete-time signals and systems.	PO1,2
CO5: Understand the process of sampling and the effects of under sampling.	PO1,2

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 softwares like Siri and Google now, to take EEGs, ECGs and X-Ray images. Each of these involves gathering, storing, transmitting and processing information from the physical world. This course will equip you to deal with these tasks efficiently by learning the basic mathematical framework of signals and systems.

This course will explore the various properties of signals and systems, characterization of Linear Shift Invariant Systems, convolution and Fourier Transform, Laplace Transform, Sampling theorem and Z-Transform. 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, spectral analysis of signals and wavelet signal processing. The concepts in this course are useful to students of other disciplines like electrical, instrumentation, mechanical, chemical and other branches of engineering and science.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
I	**1st week** **4 contact hours**	Signals- Definition, Basic Signals, Representation of Signals, Transformation of independent Variables- for both continuous-time and discrete-time signals.	**PPT/Digital Writing Board (online)**
2	**2nd week** **4 contact hours**	Classification of signals: Energy signal, power signal, deterministic signal, random signal and periodic signals(both continuous-time and discrete-time signals)	**PPT/Digital Writing Board (online)**
3	**3rd week** **4 contact hours**	Vector space, subspace, linear independence, basis and dimension, Inner product, norm, Inner product space, normed space, Cauchy Schwarz inequality, Hilbert spaces.	**PPT/Digital Writing Board (online)**

4	**4th week** **4 contact hours**	Orthogonality, Gram Schmidt orthogonalization process, Set of non zero orthogonal vectors are linearly independent, Orthogonal basis, complete orthogonal basis	**PPT/Digital Writing Board (online)**
5	**5th week** **3 contact hours**	Signals as a vector in vector space. Best approximation. Projection theorem. Generalized Fourier series representation. Bessel's inequality, Parseval's theorem.	**PPT/Digital Writing Board (online)**
6	**6th week** **4 contact hours**	Fourier Series representation of continuous-time periodic signals (Complex exponential and Trigonometric Fourier series representations), Properties of Fourier series, Discrete Fourier series representation.	**PPT/Digital Writing Board (online)**
		Assessment I-20 Marks	**Written/Objective/both**
7	**7th week** **4 contact hours**	Fourier Transform of continuous time aperiodic signals, Definition, Properties of Fourier Transform, Fourier Transform for periodic signal, Inverse Fourier Transform.	**PPT/Digital Writing Board (online)**
8	**8th week** **4 contact hours**	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.	**PPT/Digital Writing Board (online)**
9	**9th week** **4 contact hours**	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)	**PPT/Digital Writing Board (online)**
10	**10th week** **4 contact hours**	Response of 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. Analysis of an LTI System using impulse response. Necessary and sufficient conditions for causality and BIBO stability.	**PPT/Digital Writing Board (online)**
11	**11th week** **4 contact hours**	Analysis of an LTI system using Fourier transform and Laplace Transform. Transfer Function. Causality and BIBO stability, Analysis of continuous time LTI system.	**PPT/Digital Writing Board (online)**
		Assessment II-20 Marks	**Written/Objective/both**
12	**12th week** **4 contact hours**	Principles of sampling, Low pass 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	**PPT/Digital Writing Board (online)**

		aperture effects.	
13	**13th week** **4 contact hours**	Z Transform of discrete time signals. Definition. Properties of Z-Transform.	**PPT/Digital Writing Board (online)**
		CPA	**Written/Objective/both**
14	**14th week** **4 contact hours**	Region of Convergence, Inverse Z transform (Power series method, Partial Fraction method and contour integration method)	**PPT/Digital Writing Board (online)**
15	**15th week** **4 contact hours**	Solutions of Linear constant Coefficient difference equations using Z-transform. Analysis of a discrete time LSI system using Z transforms. System function. Causality and BIBO stability Analysis of discrete time LTI system	**PPT/Digital Writing Board (online)**
End Semester Assessment			**Written/Objective/both**

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment 1 (Descriptive-written/Objective/both) – **Online** (Institute Procedure)	1st week Oct'20	60 mins	20%
2	Assessment 2 (Descriptive-written/Objective/both) – **Online** (Institute Procedure)	4th week Oct'20	60 mins	20%
3	3 Assignments / Quiz – **Online mode/submission** (Institute Procedure)	During regular hours - Online		30%
CPA	Compensation Assessment* (Descriptive-written/ Objective/ both) – **Online** (Institute Procedure)	3rd week Nov'20	60 mins	Refer course policy
5	Final End Semester Assessment * (Descriptive-written/Objective/ both) – **Institute CBT platform** (Institute Procedure)	4th week Nov'20	120 mins	30 %

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

Text Books

1. A. V. Oppenheim, A. Willsky, S. Hamid Nawab, "Signals and Systems (2/e)", Pearson 2003.
2. S. Haykin and B.VanVeen "Signals and Systems, Wiley, 1998.
3. Mandal and A. Asif, "Continuous and Discrete Time Signals and Systems, Cambridge, 2007.

Reference Books

4. D. C. Lay, "Linear Algebra and its Applications (2/e)", Pearson, 2000.
5. K. Huffman & R. Kunz, "Linear Algebra", Prentice -Hall, 1971.
6. S. S. Soliman & M. D. Srinath, "Continuous and Discrete Signals and Systems", Prentice-Hall, 1990.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

1. The students through class representative may give their feedback at any time which will be duly addressed.
2. Feedback from the students through MIS and class committee meetings.

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

CORRESPONDENCE

1. All the students are advised to come to the class regularly. All the correspondence (schedule of classes/ schedule of assignment/ course material/ any other information regarding this course) will be intimated in the class only.

COMPENSATION ASSESSMENT POLICY

If any student who fails to attend assessment 1 or assesment 2 due to any **genuine reasons,** student is permitted to attend **compensation assessment** for the weightage of 20 % (Including assessment I & assessment 2 Portions)

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.**

ASSESSMENT

1. Attending **all the assessments are mandatory** for every student.
2. Finally every student is expected to score minimum 1/3 rd of the top rank holder (or ½ of class average) of the class (including all assessments) to pass the course. Otherwise student would be declared fail and 'F' grade will be awarded. Further he can take up only FORMATIVE ASSESSMENT.
3. Please refer to B.Tech Regulations 2015 for the letter grades and corresponding grades.

ACADEMIC DISHONESTY & PLAGIARISM

- Copying from others during an online 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. THE STUDENTS ARE EXPECTED TO FOLLOW INSTITUTE RULES.

ADDITIONAL COURSE INFORMATION
The faculty is available for consultation at times as per the intimation given by the faculty.
FOR SENATE'S CONSIDERATION
Course Faculty _____ CC-Chairperson _____ HOD _____