Course Code	21ECC204T	Course Name	SIGNAL PROCESSING	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*ECE*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*understand the basic concepts, operations and types of signals and systems*
CLR-2:	*analyse the periodic and aperiodic Continuous signals using Fourier transform and Laplace transform*
CLR-3:	*analyse the discrete time signal using DFT and discrete time system using Z-Transform*
CLR-4:	*design FIR filter using windowing technique*
CLR-5:	*design Analog IIR filter, Conversion of Analog filter to digital Filter*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*summarize the Classification of Signals and Systems and various operations on signals*	*2*	*3*	-	-	-	-	-	-	-	-	-	-	-	-	*1*
CO-2:	*apply Fourier transform and Laplace transform on solving continuous time signals and systems*	-	*2*	-	*3*	-	-	-	-	-	-	-	-	-	-	*2*
CO-3:	*apply Discrete Fourier Transform and Z-Transform on Discrete time signals and systems*	-	*2*	-	*3*	-	-	-	-	-	-	-	-	-	-	*2*
CO-4:	*design Finite Impulse Response Filters using different types of windowing techniques*	-	*2*	*3*	-	-	-	-	-	-	-	-	-	-	-	*3*
CO-5:	*design analog and digital Infinite Impulse Response Filters*	-	*2*	*3*	-	-	-	-	-	-	-	-	-	-	-	*3*

Unit-1 - Classification of Signals and Systems	***9 Hour***
Introduction to signal and systems, Real time Applications of Signals, Fundamental Signals-Unit impulse, Step, Ramp Various operations on signals- Time Shifting. Time reversal, Time Scaling, Amplitude Scaling, Signal Addition and Multiplication. Classification of Continuous and Discrete time signals- Periodic and Aperiodic, Even and Odd, Energy and Power, Deterministic and Random, Types of Systems- Linear and Non-linear, Time Variant and invariant, Causal and Non-Causal, Static, and dynamic, Stable and unstable systems.	
Unit-2 - Analysis of Continuous Time (CT) Signals and Systems	***9 Hour***
Fourier Transform and Inverse Fourier Transform, Properties of Fourier Transform, Analysis of LTI CT system using Fourier Transform, Frequency Response, Impulse Response and Step response, Laplace Transform and Inverse Laplace Transform, Region of Convergence (RoC) and Properties, Analysis of LTI CT system using Laplace Transform, Problems solving using properties of Laplace transform	
Unit-3 - Analysis of Discrete Time (DT) Signals and Systems	***9 Hour***
Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT), Problems solving on DFT, Fast Fourier Transform (FFT) - Decimation in Time Fast Fourier Transform (DIT-FFT), Decimation in Frequency Fast Fourier Transform (DIF-FFT), Linear Convolution and Circular Convolution, Z- Transform, Region of Convergence (RoC) and Properties, Analysis of DT system using Z- transform, Stability of a system, Inverse Z Transform using Partial fraction method.	
Unit-4 - Finite Impulse Response (FIR) Filter Design	***9 Hour***
Design of Linear Phase FIR Filters, Frequency Response of FIR Filter- N Odd (symmetric), Frequency Response of FIR Filter- N Even (Symmetric), FIR Filter Design using Windowing Technique, Design of FIR low pass, High pass, Band pass and Band Stop filter Design- Rectangular Window, Hanning Window, Hamming Window and Blackman Window.	
Unit-5 - Infinite Impulse Response (IIR) Filter Design	***9 Hour***
Introduction to IIR Filters- Comparison between FIR and IIR Filters, Analog IIR Filter design – Butterworth and Chebyshev Filters, Comparison of Properties of Butterworth and Chebyshev Filters, Design of IIR low pass and High Pass filter using Butterworth method, Design of IIR low pass and High Pass filter using Chebyshev method, Conversion of Analog filter into Digital Filter- Bilinear Transformation and Impulse Invariance Method	

Learning Resources	1. *Alan V Oppenheim, Ronald W. Schafer, "Signals & Systems", 2nd Edition, Printice Hall of India, 2015.* 2. *John G. Proakis, Dimitris G.Manolakis, "Digital Signal Processing: Principles, Algorithms and Principles", 4th Edition, Printice Hall of India, 2001.*	3. *Alan V. Oppenheim, Ronald W. Schafer, John R. Buck., "Discrete-Time Signal Processing", 2nd Edition, Pearson, 2011.* 4. *B.P. Lathi and Rpger Green, "Linear Systems and Signals", 3rd Edition, Oxford University Press, 2017*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*15%*	-	*15%*	-	*15%*	-
Level 2	*Understand*	*25%*	-	*20%*	-	*25%*	-
Level 3	*Apply*	*30%*	-	*25%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*25%*	-	*30%*	-
Level 5	*Evaluate*	-	-	*10%*	-	-	-
Level 6	*Create*	-	-	*5%*	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Anuj Kumar, Program Delivery Manager, Nagarro Software Pvt. Ltd. Gurgaon, kumaranuj.aniii@gmail.com*	1. *Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu*	1. *Mr. B. Ananda Venkatesan, SRMIST*
2. *Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com*	2. *Dr Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in*	2. *Dr. S. Dhanalakshmi, SRMIST*