Syllabus Short Form

BECE202L Signals and Systems 3 Credits (2-1-0-0-3)

Continuous time and discrete time signals, continuous time and discrete time systems, convolution and correlation of signals, Fourier Series, Fourier Transform and Discrete time Fourier transform, Magnitude and phase response of transfer function, Hilbert transform and processing of bandpass signals, Laplace and Z-transforms.

Course code	Signals and Systems	L	T	P	J	C
BECE202L		2	1	0	0	3
Pre-requisite	BMAT102L - Differential Equations and Transforms	Syllabus version				
		v. 1.0				

Course Objectives

1. To understand the basic attributes of signals and systems.
2. To analyse the signals and systems in time and transformed domains such as Fourier, Laplace and Z- transform.
3. To understand the concept of sampling process.

Course Outcome

On studying this course, students will be able to

1. Differentiate between various types of signals and understand the implication of operations on signals.
2. Understand the terms like causal, dynamic, linear, time invariant and stability of systems. Also, students will be able to compute impulse response of both continuous time and discrete time systems.
3. Perform the transformation of CT and DT signals from time domain to frequency domain and understand the concept of distribution of energy as a function of frequency.
4. Convert the CT signals to DT signals and vice versa and understand their consequences.
5. Processing of bandpass signals through bandpass systems.
6. Solve differential and difference equations, with initial conditions, using Laplace and Z transforms respectively.

Module:1	Continuous Time and Discrete Time signals	7 hours

Signal classification – Types of signals: Unit impulse, unit step, ramp, sign, and exponential signals – Operations on signals – Analogy between vectors and signals –Concept of linearly dependent and independent vectors, Orthogonality – Mean square error – Computation of energy, power, periodicity, Norms and moments of signals, – Distance metrics for signals.

Module:2	Continuous Time and Discrete Time systems	7 hours

Classification of systems – Linearity, time invariance, stability, Invertibility, Causality and memory systems. Interconnection of systems. Systems defined by differential & difference equations- Impulse and step response of the systems. Transmission of signals through LTI systems - Convolution and Correlation for CT and DT systems

Module:3	Fourier Series	5 hours

The response of LTI systems to complex exponentials, Fourier series representation of Continuous Time Periodic Signals, Gibb's phenomena, Properties of CTFS, Fourier series representation of Discrete Time Periodic Signals, Properties of DTFS, Power spectral density.

Module:4	Fourier Transforms	6 hours

Representation of aperiodic continuous signals: The Continuous Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of CTFT, Systems characterized by linear constant-coefficient Differential Equations.

Representation of aperiodic discrete signals: The Discrete Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of DTFT, DTFT of systems characterized by linear constant-coefficient Difference Equations. Energy spectral density.

Module:5	**Hilbert Transform and processing of Band Pass signals**	**6 hours**

Magnitude and phase response of the systems, Group delay, Representation of bandpass signals: In-phase and quadrature phase components, Hilbert transform – Pre and complex envelopes. Processing of bandpass signals through bandpass systems.

Module:6	**Sampling**	**4 hours**

Impulse train sampling -Zero order hold, Nyquist criteria – Aliasing - Reconstruction – Ideal filtering

Module:7	**Laplace Transform and Z-Transform**	**8 hours**

Laplace transform: Definition – ROC – Properties – S-plane causality and BIBO stability – Transfer function – Unilateral Laplace transform: Solution of differential equations with initial conditions.

Z-transform: Definition - S-plane to Z-plane mapping - ROC – Properties of Z-transform. System analysis – Transfer function - Causality- BIBO stability – Unilateral Z-transform, Solution of. Difference equations with initial conditions.

Module:8	**Contemporary Issues**	**2 hours**

Guest lecture from industry and R & D organizations

	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Alan V.Oppenheim, Alan S.Willsky, with S.Hamid Nawab, "Signals and Systems", Prentice-Hall of India.2nd Edition,2016
2.	M.J.Roberts, Govind Sharma, "Fundamentals of Signals and Systems", 2nd Edition, Tata McGraw-Hill,2017

Reference Books

1.	Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd edition, Wiley Publications, 2021
2.	P. Rama Krishna Rao and Shankar Prakriya, “Signals and Systems”, second edition - Mc-Graw Hill, 2017
3	Simon Haykin, “Communication systems”, 4th edition, Wiley Publications,
4	Lathi BP, “Signals, Systems and Communications”, 2nd Edition, BS Publications 2019

Mode of assessment: Continuous assessment / FAT / Assignments, Oral examination and others

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Approved by Academic Council	No. xx	Date	DD-MM-YYYY