Department of Electrical and Electronics Engineering

COURSE MODULES OF THE COURSE TAUGHT FOR THE EVEN SESSION SEPTEMBER-DECEMBER 2024-25

Course Syllabi with CO's

Faculty Name: **Ms. Kavyashree S**			Academic Year: 2024-25				
Department: Electronics and Electronics Engineering							
Course Code	Course Title	Core/Elective	Prerequisite	Contact Hours			Total Hrs/ Sessions
				L	T	P	
BEE502	**Signals & Digital Signal Processing**	**IPCC**	Discrete time signal and system analysis, Fourier transforms, convolution, analog filters.	**3**	**0**	**2**	**40 hours Theory +10 Lab slots(2 hour /slot) =Total 60**

Objectives	1. To explain basic signals, their classification, basic operations on signals, and the properties of the systems. 2. To explain the convolution of signals in continuous and discrete time domain and the properties of impulse response representation. 3. To explain the computation of Discrete Fourier Transform of a sequence by direct method, Linear transformation Method and using Fast Fourier Transformation Algorithms. 4. To explain design of IIR all pole analog filters and transform them into digital filter using Impulse Invariant and Bilinear transformation Techniques and to obtain their Realization. 5. To explain design of FIR filters using Window Method and Frequency Sampling Method and to obtain their Realization.

Topics Covered as per Syllabus

Module - 1

Signals, systems and signal processing, classification of signals, Basic Operations on Signals, Basic Elementary Signals, properties of systems. concept of frequency in continuous and Discrete time signals, sampling of analog signals, the sampling theorem, quantization of continuous amplitude and sinusoidal signals , coding of quantized samples, digital to analog conversion,

Time-domain representations for LTI systems: Convolution, impulse response representation, Convolution Sum and Convolution Integral, properties of impulse response representation, solution of difference equations.

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding, L3 – Applying, L – 4 Analyzing,

Module – 2

Discrete Fourier Transforms (DFT): Introduction to DFT, definition of DFT and its inverse, matrix relation to find DFT and IDFT ,Properties of DFT, linearity, circular time shift, circular frequency shift, circular folding, symmetry of : real valued sequences, real even and odd sequences, DFT of complex conjugate sequence, multiplication of two DFTs- the circular convolution, Parseval's theorem, circular correlation, Digital linear filtering using DFT. Signal segmentation , overlap-save and overlap-add method

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding, L3 – Applying, L – 4 Analysing,

Module – 3

Fast-Fourier-Transform (FFT) algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms)., speed improvement factor, Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and Decimation-in-frequency algorithms, calculation of DFT when N is not a power of 2

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding, L3 – Applying, L – 4 Analysing,

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Module – 4

IIR filter design: Classification of analog filters, generation of Butterworth polynomials, frequency transformations. Design of Butterworth filters, low pass, high pass, band pass and band stop filters, Generation of Chebyshev polynomials, design of Chebyshev filters, design of Butterworth and Chebyshev filters using bilinear transformation and Impulse invariance method, representation of IIR filters using direct form one and two, series form and parallel form

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding, L3 – Applying, L – 4 Analysing,

Module – 5

FIR filter design: Introduction to FIR filters, symmetric and antisymmetric FIR filters, design of linear phase FIR filters using - Rectangular, Bartlett, Hamming, Hanning and Blackman windows, design of FIR differentiators and Hilbert transformers, FIR filter design using frequency sampling Technique. Representation of FIR filters using direct form and lattice structure.

Bloom's Taxonomy Level	L1 – Remembering, L2 – Understanding, L3 – Applying, L – 4 Analysing,

Sl. NO	**Experiment**
1.	Verification of Sampling Theorem in time and frequency domains
2.	Generation of different signals in both continuous and discrete time domains
3.	To perform basic operations on given sequences- Signal folding, evaluation of even and odd signals
4.	Evaluation of impulse response of a system.
5.	Solution of a difference equation.
6.	Evaluation of linear convolution and circular convolution of given sequences
7.	Computation of N- point DFT and IDFT of a given sequence by use of (a) Defining equation; (b) FFT method
8.	Evaluation of circular convolution of two sequences using DFT and IDFT approach.
9.	Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject filters).
10.	Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using different window functions.
11.	Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using frequency sampling technique.
12.	Realization of IIR and FIR filters.

List of Text Books

1. Introduction to Digital Signal Processing, Jhonny R. Jhonson, Pearson, 1 st Edition, 2016.

List of Reference Books

1. Digital Signal Processing – Principles, Algorithms, and Applications, Jhon G. Proakis Dimitris G. Manolakis, Pearson 4th Edition, 2007.
2. Digital Signal Processing, A.Nagoor Kani, McGraw Hill, 2nd Edition, 2012.
3. Digital Signal Processing, Shaila D. Apte, Wiley, 2nd Edition, 2009.
4. Digital Signal Processing, Ashok Amberdar, Cengage 1st Edition, 2007.
5. Digital Signal Processing, Tarun Kumar Rawat, Oxford, 1st Edition, 2015.

List of URLs, Text Books, Notes, Multimedia Content, etc

Web links and Video Lectures (e-Resources):

1. http://www.freebookcentre.net/Electronics/DSP-Books
2. https://www.electronicsforu.com/special/cool-stuff-misc/8-free-digital-signal-processing-ebooks
3. http://nptel.ac.in/courses/117104074/

4. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring.../lecture-notes

MOOCs:

1. https://nptel.ac.in/courses/117102060
2. https://onlinecourses.nptel.ac.in/noc21_ee20/preview

Course Outcomes	**At the end of the course the student will be able to:** **CO1**: Perform elementary signal operations, **apply** convolution for both continuous & discrete time signals and to understand sampling theorem. [L3] **CO2**: **Evaluate** Discrete Fourier Transform of a sequence, to understand the various Properties of DFT and Signal segmentation using overlap save and add method. [L4] **CO3**: **Evaluate** Discrete Fourier Transform of a sequence using decimation in time and decimation in frequency methods. [L4] **CO4**: **Design** Butterworth and Chebyshev IIR digital filters and to represent the IIR filters using different methods. [L4] **CO5**: **Design** FIR filters using window method and frequency sampling method and to represent FIR filters using direct method and lattice method. [L4]

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and 10 marks for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC. CIE for the practical component of the IPCC
- 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

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The Correlation of Course Outcomes (CO's) and PO's and PSOs

Course Code:	BEE502	Title: Signals & Digital Signal Processing												
Course Outcomes	Program Outcomes												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO-1	3	3	2	-	2	-	-	-	2	2	-	2	-	3
CO-2	3	3	2	-	2	-	-	-	2	2	-	2	-	3
CO-3	3	3	2	-	2	-	-	-	2	2	-	2	-	3
CO-4	3	3	2	-	2	-	-	-	2	2	-	2	-	3
CO-5	3	3	2	-	2	-	-	-	2	2	-	2	-	3