INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE DESCRIPTOR

Course Title	**DIGITAL SIGNAL PROCESSING LABORATORY**				
Course Code	AEC107				
Programme	B. Tech				
Semester	VI	ECE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	3	2
Course Coordinator	Mr. K Chaitanya, Assistant Professor				
Faculty Coordinators	Dr. S China Venkateswarulu Mrs. C Devisupraja Mrs. S Sushma Mrs. M Sreevani				

I. COURSEOVERVIEW:

This course covers the analyze and implementing digital signal processing systems in time domain, and software development. It is aimed at helping students understand the reasons for choosing Sample and reconstruct analog signals. Topics covered include Compute circular convolution, linear convolution and the discrete Fourier transform (DFT) of discrete-time signals. The main objective of the course is to teach the students how to select and design frequency-selective digital filters and algorithms that are appropriate for problems that they might encounter in real life. This course in reached to student by power point presentations, lecture notes, and lab involve the problem solving in mathematical and engineeringareas. This lab use MATLAB for DSP system analysis and design.

II. COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AECB17	IV	Signals and Systems Laboratory	2

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Digital Signal Processing Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✔	Open Ended Experiments						

V. EVALUATIONMETHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	Laboratory		Total Marks
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination(CIE):
One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hoursduration.

Preparation	Performance	Calculations and Graph	Results and Error Analysis	Viva	Total
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES AREASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Videos/ Student Viva
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	3	Lab Exercises/ StudentViva
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Videos/ StudentViva
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	Lab Exercises
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage independent and life-long learning in the broadest context of technological change.	2	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES AREASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.	3	Videos
PSO2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product forbusiness success.	3	Lab Exercises

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest forhigher studies.	1	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES:

The course should enable the students to:	
I	Implementation of convolution inMATLAB.
II	Implementation of digital signal processing algorithms in MATLAB andC.
III	Understand the real-time operation of digitalfilters.
IV	Analyze the Multirate signal processingalgorithms.
V	Implementation of filters using DSP Kits

IX. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Analyze and implement digital signal processing systems in time domain.	CLO 1	To generate elementary signals/ waveforms and perform arithmetic operations on signals
		CLO 2	Calculate and Plot DFT / IDFT of given DT signal and to generate Sinusoidal signal through filtering
		CLO 3	Able to plot frequency response of a given system and verify the properties of LTI system.
CO 2	Develop and implement digital systems using the DFT and the Fast Fourier Transform (FFT).	CLO 4	Implement FFT of given sequence and identify the reduction of computations using FFT.
		CLO 5	Implementation of Linear convolution using DFT
		CLO 6	Implementation of Decimation-in-time radix-2 FFT algorithm
CO 3	Compute circular convolution, linear convolution and the discrete Fourier transform (DFT) of discrete-time signals.	CLO 7	Generation of linear convolution without using built in function and the function conv
		CLO 8	Generation of circular convolution without using built in function
		CLO 9	Compute the Discrete Fourier Transform and IDFT with and without fft and ifft
CO 4	Construct the digital filters using windows.	CLO 10	To Implement LP FIR filter for a given sequence and calculate the filter coefficients.
		CLO 11	Able to Implement IIR filter for a given sequence and plot the response of the same.
		CLO 12	Implementation of FIR digital filter using window (Rectangular, Hamming, Hanning, Bartlett) methods
CO 5	Design frequency-selective digital filters and Sample and reconstruct analog signals.	CLO 13	Understand the operation to generate DTMF signals
		CLO 14	Able to Implement I/D sampling rate converters and identify the importance of multi rate sampling
		CLO 15	Construct IIR and FIR Filter Implementation using DSP Kits

X. COURSE LEARNING OUTCOMES(CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC107.01	CLO 1	To generate elementary signals/ waveforms and perform arithmetic operations on signals	PO1	3
AEC107.02	CLO 2	Calculate and Plot DFT / IDFT of given DT signal and to generate Sinusoidal signal through filtering	PO3	3
AEC107.03	CLO 3	Able to plot frequency response of a given system and verify the properties of LTI system.	PO3,PO5	3
AEC107.04	CLO 4	Implement FFT of given sequence and identify the reduction of computations using FFT.	PO1, PO5	3
AEC107.05	CLO 5	Implementation of Linear convolution using DFT	PO1,PO 5	3
AEC107.06	CLO 6	Implementation of Decimation-in-time radix-2 FFT algorithm	PO3,PO5	3
AEC107.07	CLO 7	Generation of linear convolution without using built in function and the function conv	PO3,PO5	3
AEC107.08	CLO 8	Generation of circular convolution without using built in function	PO3,PO5	3
AEC107.09	CLO 9	Compute the Discrete Fourier Transform and IDFT with and without fft and ifft	PO1,PO 5	3
AEC107.10	CLO 10	to Implement LP FIR filter for a given sequence and calculate the filter coefficients.	PO2,PO5	3
AEC107.11	CLO 11	Able to Implement IIR filter for a given sequence and plot the response of the same.	PO2,PO5	3
AEC107.12	CLO 12	Understand the operations of binary search tree like tree traversals and counting the number of nodes in the binary search tree.	PO2, PO3	3
AEC107.13	CLO 13	Implementation of FIR digital filter using window (Rectangular, Hamming, Hanning, Bartlett) methods	PO3,PO5	3
AEC107.14	CLO 14	Understand the operation to generate DTMF signals	PO1,PO 5	3
AEC107.15	CLO 15	Able to Implement I/D sampling rate converters and identify the importance of multi rate sampling	PO2, PO3	3

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)				Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO5	PSO1	PSO2	PSO3
CO 1	3		3	2	3		
CO 2	3			2			2
CO 3	3		3	2			2
CO 4		3		2			
CO 5		3	3	2			2

XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												ProgramSpecific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3														
CLO 2			3										3		
CLO 3			3		2								3		
CLO 4	3				2										
CLO 5	3				2										2
CLO 6	3				2								3		
CLO 7			3		2								3		
CLO 8			3		2								3		
CLO 9	3				2								3		
CLO 10		3			2								3		
CLO 11		3			2										
CLO 12		3	3												2
CLO 13			3		2								3		
CLO 14	3				2								3		
CLO 15		3	3										3		2

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XIII. ASSESSMENT METHODOLOGIES –DIRECT

CIE Exams	-	SEE Exams	PO 1, PO2 PO 3, PO5	Lab Exercises	PO 5	Seminars	PO 1, PO2
Laboratory Practices	PO 1, PO 5	Student Viva	PO 1, PO 2 PO 3	Mini Project	-	Certification	-

XIV. ASSESSMENT METHODOLOGIES -INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

WEEK - l	**CONVOLUTION**
a) Generation of linear convolution without using built in function and the function conv in MATLAB b) Generation of circular convolution without using built in function inMATLAB	
WEEK-2	**DISCRETE FOURIER TRANSFORM**
Compute the Discrete Fourier Transform and IDFT with and without fft and ifft in MATLAB	
WEEK-3	**APPLICATION OF DFT**
Implementation of Linear convolution using DFT (Overlap-add and Overlap-Save methods)	
WEEK -4	**DIT - FAST FOURIER TRANSFROM**
Implementation of Decimation-in-time radix-2 FFT algorithm	
WEEK -5	**DIF - FAST FOURIER TRANSFROM**
Implementation of Decimation-in-frequency radix-2 FFT algorithm	
WEEK -6	**IIR - BUTTERWORTH FILTER**
Implementation of IIR digital filter using Butterworth method and bilinear transformation	
WEEK -7	**IIR - CHEBYSHEV FILTER**
Implementation of IIR digital filter using Chebyshev (Type I and II) method	
WEEK -8	**FIR FILTER - WINDOW TECHNIQUES**
Implementation of FIR digital filter using window (Rectangular, Hamming, Hanning, Bartlett) methods	
WEEK-9	**FIR FILTER – SAMPLING TECHNIQUE**
Implementation of FIR digital filter using frequency sampling method	
WEEK-l0	**FIR FILTER – OPTIMUM EQUIRIPPLE**
Implementation of optimum equiripple FIR digital filter using window methods	
WEEK-l1	**DUAL TONE MULTI FREQUENCY**
DTMF Tone Generation and Detection Using Goertzel Algorithm	
WEEK-l2	**SAMPLING RATE CONVERTERS**
Implementation of sampling rate conversion by decimation, interpolation and a rational factor using MATLAB	
WEEK-l3	**DFT AND SINEWAVE USING TMS320C6713 KIT**
a) Implementation ofDFT b) Sine wave generation using lookup table with values generated fromMATLAB	
WEEK-l4	**FILTERS USING TMS320C6713 KIT**
IIR and FIR Filter Implementation using DSP Kits	
TEXT BOOKS:	
1. John G.Proakis, DimitrisG. Manolakis, –Digital signal processing, Principles, Algorithms and Applications‖, Prentice Hall, 4th Edition,2007.	
REFERENCE BOOKS:	
1. P Ramesh babu, Digitalsignal processing, Principles, Algorithms , SCITECH, 6th Edition,2014. 2. B.PreethamKumar,–DigitalSignalProcessingLaboratory‖,CRCPress,2nd Edition,2010.	

3. B.Venkata Ramani, M.Bhaskar, ― Digital Signal Processors- Architecture, Programming and applications‖, TMH, 2nd Edition,2002.

WEB REFERENCES:

1. http://eceweb1.rutgers.edu/~orfanidi/ece348/
2. http://www.eecs.umich.edu/courses/eecs452/refs.html
3. http://www.dsp.sun.ac.za/lab-reference-guide/
   http://www.iare.ac.in

XVI. COURSEPLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	a. Generation of linear convolution without using built in function and the function conv in MATLAB b. Generation of circular convolution without using built in function inMATLAB	CLO 1	R1:15.1
2	Compute the Discrete Fourier Transform and IDFT with and without fft and ifft in MATLAB	CLO 2	T1:5.1
3	Implementation of Linear convolution using DFT (Overlap-add and Overlap-Save methods)	CLO 3	T1:5.2 R2 : 10.2
4	Implementation of Decimation-in-time radix-2 FFT algorithm	CLO 4	T1:7.1 T1:8.1
5	Implementation of Decimation-in-frequency radix-2 FFT algorithm	CLO 5	T2:26.8
6	Implementation of IIR digital filter using Butterworth method and bilinear transformation	CLO 6	T1:9.2
7	Implementation of IIR digital filter using Chebyshev (Type I and II) method	CLO 7	T2:26.14 R2:21.55
8	Implementation of FIR digital filter using window (Rectangular, Hamming, Hanning, Bartlett) methods	CLO 8	T1:7.2
9	Implementation of FIR digital filter using frequency sampling method	CLO 9	T1:7.2 R2:21.61
10	Implementation of optimum equiripple FIR digital filter using window methods	CLO 10	T2:25.12 R2:21.24
11	DTMF Tone Generation and Detection Using Goertzel Algorithm	CLO 11	T2:25.16 R2:21.29
12	Implementation of sampling rate conversion by decimation, interpolation and a rational factor using MATLAB	CLO 12	T1:8.1
13	a. Implementation of DFT b. Sine wave generation using lookup table with values generated fromMATLAB	CLO 13	T1:12.10 R1:13.7
14	IIR and FIR Filter Implementation using DSP Kits	CLO 14 CLO 15	T1:11.2 R1:10.2

XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSIONREQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Laboratory Sessions	PO 1, PO 2	PSO 1
2	Design and develop DSP programs with advanced devices	Lab Practices / NPTEL	PO 3, PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 3, PO 4	PSO 1

Prepared by:

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