NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE FILE

DIGITAL SIGNAL PROCESSING

COURSE CODE: R20EC3103

Academic Year: 2024-25

Year & Semester: I**II & I Semester**

Regulation: **R20**

Faculty Incharge:

Faculty Incharge **HoD ECE**

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NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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Institute Vision and Mission

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision and Mission of The Institute

Institute Vision:

To emerge as a Centre of excellence in technical education with a blend of effective student centric teaching learning practices as well as research for the transformation of lives and community,

Institute Mission:

M1: Provide the best class infra-structure to explore the field of engineering and research

M2: Build a passionate and a determined team of faculty with student centric teaching, imbibing experiential, innovative skills

M3: Imbibe lifelong learning skills, entrepreneurial skills and ethical values in students for addressing societal problems

Department Vision and Mission

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision and Mission of The Department

VISION OF THE ECE DEPARTMENT

To emerge as a center of excellence in Electronics and Communication Engineering through student-centric education and research focus to cater to the current and future needs of society.

MISSION OF THE ECE DEPARTMENT

M1: To provide the best infrastructure for empowering the students with quality education to motivate them towards higher studies and research.

M2: To provide qualified and experienced faculty for student-centric teaching in order to mold the students as successful professionals in the modern Electronics industry.

M3: To inculcate leadership qualities, professional etiquette, ethical values, and social responsibilities.

Program Educational Objectives and Program Specific Outcomes.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Demonstrate successful professional careers with strong fundamental knowledge in mathematics, science and engineering to meet real time requirements of industry.

PEO2: Learn continuously with a focus on advanced emerging trends in the field of ECE and allied to meet the societal needs.

PEO3: Pursue higher education leading to masters and research programs for knowledge dissemination in profession.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Design and develop IoT applications using Raspberry Pi, Arduino and other advanced processors.

PSO2: Design and synthesize various circuits using latest hardware and EDA tools.

PSO3: Design and analyse modern communication systems to meet the present and future needs of industry with cost effective solutions.

HoD, ECE

Program Outcomes.

PO 1 : Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering

PO 2 : Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering

PO 3 : 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

PO 4 : Conduct Investigations of Complex Problems : Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid

PO 5 : Modern Tool Usage : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the

PO 6 : The Engineer and Society : Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering

PO 7 : Environment and Sustainability : Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable

PO 8 : Ethics : Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering

PO 9 : Individual and Team Work : Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary

PO 10 : Communication : Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear

PO 11 : Project Management and Finance : Demonstrate knowledge and understanding of the engineering and management principles and apply these to

one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary

PO 12 : Life-Long Learning : Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological

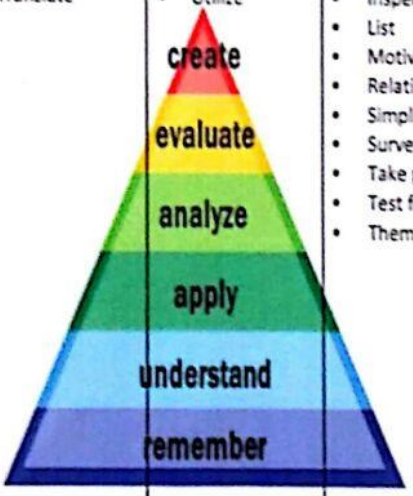
Bloom’s Taxonomy Levels.

NEC

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS)-NARASARAOPET

Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Conclusion • Contrast • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion • Perceive • Prioritize • Prove • Rate • Recommend • Rule on • Select • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory



Ref: Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing. Abridged Edition. Boston, MA: Allyn and Bacon.

Course Objectives and **Course Outcomes.**

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Year/ Sem: III B. Tech I SEMESTER Academic Year: 2024-25

COURSE NAME & CODE : **DIGITAL SIGNAL PROCESSING & R20EC3103**

COURSE OBJECTIVES:

1. Make Enhance the analytical ability of the students in the area of signal processing.
2. Develop ability among students to observe the response of the discrete time systems for different types of discrete time sequences.
3. Demonstrate basic knowledge of Digital Signal Processing by understanding various transformations.
4. Understand different types of filters (analog/digital) and their designs.
5. Design DSP systems which are used in the area of communications and networking.

COURSE OUTCOMES: After completion of the course, the student will be able to

CO1: Analyze the signals and system in Time and Frequency domain through transformations. **[K4]**

CO2: Solve DFT and IDFT coefficients of a given discrete time sequence using FFT algorithm**. [K3]**

CO3: Examine the significance of various filter structures and responses. **[K3]**

CO4: Construct the digital filter circuits for generating desired signal wave shapes. **[K4]**

CO5: Inspect the performance of a variety of windowing techniques. **[K3]**

COURSE
INFORMATION SHEET

NARASARAOPETA ENGINEERING COLLEGE

(Autonomous)
Yallmanda(Post), Narasaraopet- 522601
Department of Electronics & Communication Engineering

COURSE INFORMATION SHEET

PROGRAMME: B.Tech Electronics & Communication Engineering	
COURSE: **DIGITAL SIGNAL PROCESSING**	YEAR: **III** SEMESTER: **I** SECTION: ECE - CREDITS: **4**
COURSE CODE**:** R20EC3103 REGULATION: **R20**	COURSE TYPE (CORE /ELECTIVE / BREADTH/ S&H): **CORE**
COURSE AREA/DOMAIN: Signal Processing	PERIODS: 6 Per Week.

COURSE PRE-REQUISITES:

C.CODE	COURSE NAME	DESCRIPTION	SEM
R20CC1102	**Linear Algebra and Calculus**	Basics on systems of linear equations	**I**
R20CC1201	**Differential Equations and Vector Calculus**	Knowledge of integration and differentiation.	**II**
R20CC2101	**Numerical Methods and Transformations**	Acquire the fundamental Knowledge of Fourier series and Fourier Transform and able to give Fourier expansions of a given function.	**III**
R20EC2103	**Signals and Systems**	Concepts in signals and systems course, Fourier series and transforms.	**III**

COURSE OUTCOMES:

SNO	Course Outcome Statement
CO1	Analyze the signals and system in Time and Frequency domain through transformations. [K4]
CO2	Solve DFT and IDFT coefficients of a given discrete time sequence using Fast Fourier Transform algorithm. [K3]
CO3	Examine the significance of various filter structures and responses. [K3]
CO4	Construct the digital filter circuits for generating desired signal wave shapes. [K4]
CO5	Inspect the performance of a variety of windowing techniques. [K3]

SYLLABUS:

UNIT	DETAILS
I	**INTRODUCTION:** Review of Discrete Time Signals: Some Elementary Discrete-Time Signals, Classification of Discrete–Time Signals, Simple Manipulations of Discrete–Time Signals, Discrete Time Systems: Input-Output Description of Systems, Block Diagram Representation of Discrete-Time Systems, and Classification of Discrete-Time Systems Interconnection of Discrete-Time Systems. Frequency domain representation of Discrete Time Signals and Systems, Discrete-Time Fourier Transform (DTFT): Existence of DTFT, properties of DTFT
II	**DISCRETE FOURIER SERIES:** Properties of Discrete Fourier Series, DFS representation of periodic sequences. **DISCRETE FOURIER TRANSFORMS:** Properties of DFT, Circular & Linear Convolution of Sequences using DFT, and Computation of DFT: Direct evaluation of the DFT. **FAST FOURIER TRANSFORMS:** Radix-2 Fast Fourier Transforms (FFT), Decimation in Time and Decimation in Frequency FFT Algorithms: radix-2 DIT-FFT, DIF-FFT and Inverse FFT: IDFT-FFT.
III	**REALIZATION OF IIR FILTERS:** Block Diagram Representation of Linear Constant Coefficient Difference Equations, Basic structures of IIR systems: Direct form-I realization, Direct form-II realization, transposed, cascade form, parallel form. Lattice structures of IIR systems, Conversion from Lattice structure to direct form, Conversion from direct from to Lattice structure, Lattice-ladder structure. **REALIZATION OF FIR FILTERS:** Basic structures of FIR systems: Transversal structure, Linear phase, Lattice structure, Polyphase Lattice structures of FIR systems, Conversion from Lattice structure to direct form, Conversion from direct from to Lattice structure.
IV	**IIR DIGITAL FILTERS:** Analog filters approximations: Butterworth and Chebyshev, Design of IIR digital filters from analog filters, Design examples, Frequency Transformations in Analog Domain: Low pass to Low pass filter, Low pass to High pass filter, Low pass to Band pass filter, and Low pass to Band stop filter. Frequency Transformations in digital domain: Low pass to Low pass filter, Low pass to High pass filter, Low pass to Band pass filter, and Low pass to Band stop filter.
V	**FIR DIGITAL FILTERS:** Characteristics of FIR Digital Filters, Frequency Response. Design of FIR Digital Filters Using Window Techniques: Rectangular Window, Triangular or Bartlett Window, Raised Cosine Window Hanning Window, Blackman Window, Kaiser Window, Frequency Sampling Technique: Frequency Sampling Realization, Frequency Response, Design, Comparison of IIR and FIR filter.

TEXT BOOKS	
T	**BOOK TITLE/AUTHORS/PUBLISHER**
T1	John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles, Algorithms and applications", Pearson Education/PHI, 4th Edition, 2007.
T2	A.V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", 2nd Edition, PHI
REFERENCE BOOKS	
R	**BOOK TITLE/AUTHORS/PUBLISHER**
R1	Ramesh Babu, "Digital Signal Processing", Scitech Publications, 2011.
R2	Andreas Antoniou, "Digital signal processing", TATA McGraw Hill, 2006.
R3	R S Kaler, M Kulkarni,, Umesh Gupta, "A Text book on Digital Signal processing", I K International Publishing House Pvt. Ltd.
R4	M H Hayes, "Schaum's outlines, Digital signal processing", TATA Mc-Graw Hill, 2007.

WEB SOURCE REFERENCES:

1	https://nptel.ac.in/courses/117102060/
2	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
3	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/study-materials/
4	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/video-lectures/
5	https://nptel.ac.in/courses/108105055/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑ Chalk & Talk	☑ PPT	☐Active Learning
☑ Web Resources	☐Students Seminars	☐Case Study
☐Blended Learning	☑ Quiz	☐Tutorials
☐Project based learning	☑ NPTEL/MOOCS	☐Simulation
☐Flipped Learning	☐Industrial Visit	☐Model Demonstration
☐Brain storming	☐Role Play	☐Virtual Labs
☐Collaborative Learning	☑ Problem based Learning	☐Co-operative Learning

MAPPING CO'S WITH PO'S

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C313.1	3	3	1	1	-	-	-	-	-	-	-	2	2	3	2
C313.2	3	3	2	2	-	-	-	-	-	-	-	2	2	3	3
C313.3	3	3	2	2	1	-	-	-	-	-	-	2	3	3	3
C313.4	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
C313.5	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
Average	3.00	3.00	1.75	1.75	1.00	-	-	-	-	-	-	2.00	2.50	3.00	2.75

MAPPING COURSE WITH POs & PSOs

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C311	3.00	3.00	1.75	1.75	1.00	-	-	-	-	-	-	2.00	2.50	3.00	2.75

<table>
<tr><th colspan="3">Course Outcome Assessment Methods</th><th>Weightages</th><th rowspan="4">Final Course Outcome (100%)</th></tr>
<tr><td rowspan="3">Direct Assessment</td><td rowspan="3">Cumulative Internal Examinations (CIE)</td><td>Descriptive Test</td><td rowspan="3">30%</td><td rowspan="3">90%</td></tr>
<tr><td>Objective Test</td></tr>
<tr><td>Assignment Test</td></tr>
<tr><td colspan="2">Semester End Examinations (SEE)</td><td>70%</td></tr>
<tr><td>Indirect Assessment</td><td colspan="2">Course End Survey</td><td>10%</td></tr>
<tr><td colspan="5">Rubrics for overall attainment of course outcomes:</td></tr>
<tr><td colspan="5">If 50% of the students crossed 50% of the marks: Attainment Level 1</td></tr>
<tr><td colspan="5">If 60% of the students crossed 50% of the marks: Attainment Level 2</td></tr>
<tr><td colspan="5">If 70% of the students crossed 50% of the marks: Attainment Level 3</td></tr>
</table>

Note: Percentages mentioned in above rubrics can be slightly changed depending upon the complexity of your respected subject.

Course Instructor **Course Coordinator** **Module Coordinator** **Head of the Departmen**

ANNEXURE I:

(A) PROGRAM OUTCOMES(POs) Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.

2. 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. 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.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5.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.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of theengineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs) :

1. Design and develop IoT applications using raspberry pi, Arduino and other advanced processors.
2. Design and synthesize various circuits using latest hardware and EDA Tools.
3. Design and analyze modern communication systems to meet the present and future needs of industry with cost effective solutions.

Cognitive levels as per Revised Blooms Taxonomy:

Cognitive Domain	LEVEL	Key words
Remember	K1	Defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states.
Understand	K2	Comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives an example, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates.
Apply	K3	Applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, shows, solves, uses.
Analyse	K4	Analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates.
Evaluate	K5	Appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports
Create	K6	Categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, write

UNIT WISE SAMPLE ASSESSMENT QUESTIONS

COURSE OUTCOMES: Students are able to

CO1	Analyze the signals and system in Time and Frequency domain through transformations [K4]
CO2	Solve DFT and IDFT coefficients of a given discrete time sequence using Fast Fourier Transform algorithm. [K3]
CO3	Examine the significance of various filter structures and responses. [K3]
CO4	Construct the digital filter circuits for generating desired signal wave shapes. [K4]
CO5	Inspect the performance of a variety of windowing techniques. [K3]

S NO	QUESTION	KNOWLEDGE LEVEL	CO
	UNIT I		
1	Define and classify the discrete time signals and systems.	**K1**	**CO1**
2	Whatis discrete time fourier transforms(DTFT) and explain its properties.	**K2**	**CO1**
3	Show that the following systems are nonlinear and time invariant. $y(n+2) + 2y(n) = x(n+1) + 2.$	**K2**	**CO1**
4	What is discrete time fourier series and explain its properties.	**K2**	**CO1**
	UNIT 2		
1	Explain the properties of discrete fourier transform (DFT)	**K2**	**CO2**
2	Explain the use of Fast Fourier Transform algorithm in computing DFT?	**K2**	**CO2**
3	Compute the DFT of the following sequence using FFT decimation in frequency (DIF) algorithm.$X(k) = \{1,2,3,5,5,3,2,1\}$.	**K2**	**CO2**
	UNIT 3		
1	Discuss the properties of Z-transforms	**K2**	**CO3**
2	With respect to Z transforms define the properties of ROC.	**K2**	**CO3**
3	Realize the following IIR system functions in the direct form I and II and also parallel form. $H(z) = \frac{1}{(1-az^{-1})^2} + \frac{1}{(1-bz^{-1})^2}$.	**K2**	**CO3**
4	Given the three stage lattice filter with coefficients K_1=0.25, K_2=0.5 and K_3=1/3, **compute** the FIR filter coefficients for the direct-form structure.	**K2**	**CO3**
	UNIT 4		
1	**Derive** the expression for Bilinear Transform.	**K3**	**CO4**
2	Use bilinear transformation method to obtain H(z) if T= 1 sec and H(s) is 1/(s+1)(S+2) , 1/(s2+√2 s +1).	**K3**	**CO4**
3	**Compute** the impulse response of digital filter to correspond to an analog filter with impulse response $h_a(t) = 0.5\, e^{-2t}$ and with a sampling rate of 1.0kHz using impulse invariant method.	**K3**	**CO4**
	UNIT 5		
1	Comparison of FIR and IIR filters.	**K2**	**CO5**
2	**Design** a HPF of length 7 with cut off frequency of 2 rad/sec using Hamming window.	**K3**	**CO5**
3	**Compute** the coefficients of linear-phase FIR filter of length M=15 using frequency sampling method. The filter has a symmetric unit sample response and frequency response that satisfies the conditions $H_r\left(\frac{2\pi k}{15}\right) = \begin{cases} 1, & k = 0,1,2,3 \\ 0.4, & k = 4 \\ 0, & k = 5,6,7. \end{cases}$	**K3**	**CO5**

MODEL PAPER – I

III B.Tech I Semester Regular/Supple. Examinations, Month/Year

Sub Code: R20EC3103 **DIGITAL SIGNAL PROCESSING**

Time: 3 hours (ECE) Max. Marks: 70

Note: Answer All **FIVE** Questions.

All Questions Carry Equal Marks (5 X 14 = 70M)

Q.No		Questions	KL	CO	Marks
		UNIT-I			
1	a	i) Classify and demonstrate the discrete time signals and systems.	IV	1	7M
		ii) List and prove the properties discrete time Fourier transforms (DTFT).	IV	1	7M
		OR			
	b	i) Solve and show that the following systems are nonlinear and time invariant. $y(n+2) + 2y(n) = x(n+1) + 2.$	III	1	7M
		ii) Solve the following signals are either periodic or non-periodic. I. x(n) = cos((π/4)n + cos(2n) II. x(n)=[cos(π/3)n+sin(π/5)n]	III	1	7M
		UNIT-II			
2	a	Make use of DIT algorithm Compute the FFT for the sequence x(n) = 1 ; where N =8.	III	2	14M
		OR			
	b	Make use of DIF-FFT find the DFT for the sequence {2,2,2,2,1,1,1,1}.	III	2	14M
		UNIT-III			
3	a	i) Construct the Direct Form-II realization for the IIR system described by difference equation. $\boldsymbol{y(n) = 0.5y(n-1) - 0.25y(n-2) + x(n) + 0.4x(n-1)}$	III	3	7M
		ii) Build a Cascaded Form realization for the IIR system described by difference equation. $\boldsymbol{y(n) = -0.2y(n-1) + 0.24y(n-2) + x(n) + 0.4x(n-1)}$	III	3	7M
		OR			
	b	Explain Polyphase structure with one example	III	3	14M
		UNIT-IV			
4	a	i) Demonstrate the design procedure for IIR filters using Butterworth approximations.	II	4	7M
		ii) Design a digital Butterworth filter that satisfies the following constraint using bilinear transformation. Assume T=1sec. $0.9 \le \lvert H(e^{jw})\rvert \le 1 \quad 0 \le w \le \frac{\pi}{2}$ $\lvert H(e^{jw})\rvert \le 2 \quad \frac{3\pi}{4} \le w \le \pi$	III	4	7M
		OR			
	b	Use bilinear transformation method to obtain H(Z) if T= 1 sec and H(s) is $1/(s+1)(S+2)$, $1/(s2+\sqrt{2}\ s+1)$	III	4	14M
		UNIT-V			
5	a	Design a high pass filter using hamming window with a cutoff frequency of 1.2 radians/sec and N=9.	VI	5	14M
		OR			
	b	i) What are the effects of windowing? Comparing various windowing techniques	I	5	7M
		ii) What is a Kaiser window? In what way is it superior to other window functions?	I	5	7M

MODEL PAPER – II

III B.Tech I Semester Regular/Supple. **Examinations,** Month/Year

Sub Code: R20EC3103 **DIGITAL SIGNAL PROCESSING**

Time: 3 hours (ECE) Max. Marks: 70

Note: Answer All **FIVE** Questions.

All Questions Carry Equal Marks (5 X 14 = 70M)

Q.No		Questions	KL	CO	Marks
		UNIT-I			
1	a	i) Define the terms: linearity, time invariance, stability and causality for a discrete time system.	I	1	7M
		ii) Classify discrete time signals and explain.	IV	1	7M
		OR			
	b	i) List and explain elementary discrete time signals.	IV	1	7M
		ii) Solve the function and find the periodicity of the following discrete signals. a)$x(n)=\cos 4\pi n + 2\sin 6n$ b) $x(n) = (\sin 4\pi n)^2$	III	1	7M
		UNIT-II			
2	a	Make use of DFT find the linear convolution of the sequences x(n) ={1,2,3,1} and h(n)= {1,1,1,1}.	III	2	14M
		OR			
	b	Make use of DIT-FFT find the IDFT for the sequence {12,0,0,0,4,0,0,0}.	III	2	14M
		UNIT-III			
3	a	i) Construct the following IIR system functions in the direct form I and II and also parallel form. y(n)= -0.1y(n-1)+0.72y(n-2)+0.7x(n)-0.252x(n-2)	III	3	14M
		OR			
	b	Construct the direct form-I and direct form-II realizations for the transfer function of FIR systems : $H(z) = 0.0034 + 0.0106z^{-2} + 0.0025z^{-4} + 0.0149z^{-6}$	III	3	14M
		UNIT-IV			
4	a	Design a digital Butterworth filter that satisfies the following constraint using bilinear transformation. Assume T=1sec. $0.9 \le \lvert H(e^{jw})\rvert \le 1 \quad 0 \le w \le \frac{\pi}{2}$ $\lvert H(e^{jw})\rvert \le 2 \quad \frac{3\pi}{4} \le w \le \pi$	VI	4	14M
		OR			
	b	Explain the impulse invariance method of IIR filter design.	II	4	14M
		UNIT-V			
5	a	The desired frequency response of a low pass filter is $H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega}, & \frac{-3\pi}{4} \le \omega \le \frac{3\pi}{4} \\ 0, & elsewhere. \end{cases}$ Solve $H(e^{j\omega})$ for M=7 using rectangular window.	III	5	14M
		OR			
	b	Explain in detail about Frequency sampling method.	II	5	14M

Academic Calendar

Narasaraopeta Engineering College (Autonomous)
Kotappakonda Road, Yellamanda (P.O), Narasaraopet- 522601, Guntur District, AP.

ACADEMIC CALENDAR
(B.Tech. 2022 Admitted batch, Academic Year 2024-25)

2022 Batch 3rd Year 1st Semester			
Description	**From Date**	**To Date**	**Duration**
Commencement of Class Work	01-07-2024		
1st Spell of Instructions	01-07-2024	24-08-2024	8 Weeks
I Assignment Test	29-07-2024	03-08-2024	
I Mid examinations	26-08-2024	31-08-2024	1 Week
2nd Spell of Instructions	02-09-2024	26-10-2024	8 Weeks
II Assignment Test	30-09-2024	05-10-2024	
II Mid examinations	28-10-2024	02-11-2024	1 Week
Preparation & Practicals	04-11-2024	09-11-2024	1Week
Semester End Examinations	11-11-2024	23-11-2024	2 Weeks
2022 Batch 3rd Year 2nd Semester			
Description	**From Date**	**To Date**	**Duration**
Commencement of Class Work	25-11-2024		
1st Spell of Instructions	25-11-2024	18-01-2025	8 Weeks
I Assignment Test	23-12-2024	28-12-2024	
I Mid examinations	20-01-2025	25-01-2025	1 Week
2nd Spell of Instructions	27-01-2025	22-03-2025	8 Weeks
II Assignment Test	24-02-2025	01-03-2025	
II Mid examinations	24-03-2025	29-03-2025	1 Week
Preparation & Practicals	31-03-2025	05-04-2025	1Week
Semester End Examinations	07-04-2025	19-04-2025	2 Weeks

6/6/24
PRINCIPAL

Time Tables

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

III B.Tech., I Semester, ECE-A Class Time Table for the A.Y. 2024 - 2025								
ROOM.NO:3308					W.E.F: 01.07.2024			
	1	2	3	4		5	6	7
FROM	9:10	10:00	11:00	11:50	12:40	1:30	2:20	3:10
TO	10:00	10:50	11:50	12:40	1:30	2:20	3:10	4:00
MON	LDICA	AWP	EMI	DBMS	LUNCH BREAK	ES & R LAB		
TUE	DSP	LDICA LAB				DBMS	LDICA	PEHV
WED	AWP	DSP LAB				DSP	DBMS	EMI
THU	LDICA	AWP	EMI	AWP		DSP	LDICA	AWP
FRI	DSP	EMI	AWP	LDICA		DBMS	EMI	DSP
SAT	EMI	DSP	PEHV	AWP		EMI	LDICA	DBMS
BREAK 10:50-11:00								

THEORY

LDICA : LINEAR AND DIGITAL IC APPLICATIONS	Mr.J.NARASIMHA RAO
DSP : DIGITAL SIGNAL PROCESSING	Mr.SK.MD.SHAREEF
AWP : ANTENNAS AND WAVE PROPAGATION	Dr.B.SUNEETHA
EMI : ELECTRONIC MEASUREMENTS AND INSTURMENTATION	Mr.P.JAYA BABU
DBMS : DATABASE MANAGEMENT SYSTEMS	Ms.Y.NEELIMA
PEHV : PROFESSIONAL ETHICS AND HUMAN VALUES	Mr.J.RAJESH

DSP LAB : DIGITAL SIGNAL PROCESSING LAB	Mr.V.NAVEEN RAJA
	Mr.SK.MD.SHAREEF
	Mrs.P.VINUTHNA
	Mr.M. B. Narendra
LDICA LAB: LINEAR AND DIGITAL IC APPLICATIONS LAB	Mr.J.NARASIMHA RAO
	Mrs.G.RAJAVALI
	Mr.G.S.J.VICTOR
	Mr.P.Bhagya Raju
ES&R LAB: EMBEDDED SYSTEMS & ROBOTICS LAB	Dr.B.SUNEETHA
	Mr.P.JAYA BABU
	Dr.B.SIVANAGESWARA RAO
	Mr.M. B.Narendra

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

III B.Tech., I Semester, ECE-B Class Time Table for the A.Y. 2024 - 2025								
ROOM.NO:3314					W.E.F: 01.07.2024			
	1	2	3	4		5	6	7
FROM	9:10	10:00	11:00	11:50	12:40	1:30	2:20	3:10
TO	10:00	10:50	11:50	12:40	1:30	2:20	3:10	4:00
MON	EMI	LDICA LAB			LUNCH BREAK	LDICA	DBMS	DSP
TUE	AWP	EMI	DBMS	PEHV		ES & R LAB		
WED	LDICA	EMI	AWP	DBMS		EMI	DSP	LDICA
THU	DSP	DSP LAB				AWP	PEHV	DBMS
FRI	EMI	LDICA	DSP	AWP		LDICA	DBMS	AWP
SAT	LDICA	EMI	DSP	LDICA		DSP	AWP	DSP
BREAK 10:50-11:00								

THEORY

LDICA : LINEAR AND DIGITAL IC APPLICATIONS	Dr. B.V. Ravi Kumar
DSP : DIGITAL SIGNAL PROCESSING	Mr.Sk. Md Gouse
AWP : ANTENNAS AND WAVE PROPAGATION	Mr.N. Narayana
EMI : ELECTRONIC MEASUREMENTS AND INSTURMENTATION	Mr.A.Venkata Siva
DBMS : DATABASE MANAGEMENT SYSTEMS	Mr.A.RAMESH
PEHV : PROFESSIONAL ETHICS AND HUMAN VALUES	Mr.J.RAJESH
DSP LAB: DIGITAL SIGNAL PROCESSING LAB	Mr.V.NAVEEN RAJA
	Mr.SK.MD.SHAREEF
	Mrs.P.VINUTHNA
	Mr.G.Ramana Reddy
LDICA LAB: LINEAR AND DIGITAL IC APPLICATIONS LAB	Mr.P.Bhagya Raju
	Mrs.G.RAJAVALI
	Mr.G.S.J.VICTOR
	Mr.N. Narayana
ES&R LAB: EMBEDDED SYSTEMS & ROBOTICS LAB	Dr.B.SUNEETHA
	Mr.P.JAYA BABU
	Dr.MD.JAVEED AHAMMED
	Mr.G.Sambasiva Rao

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

III B.Tech., I Semester, ECE-C Class Time Table for the A.Y. 2024 - 2025

ROOM.NO:3315					W.E.F: 01.07.2024			
	1	2	3	4		5	6	7
FROM	9:10	10:00	11:00	11:50	12:40	1:30	2:20	3:10
TO	10:00	10:50	11:50	12:40	1:30	2:20	3:10	4:00
MON	EMI	DSP LAB				DBMS	DSP	LDICA
TUE	LDICA	AWP	PEHV	EMI		DSP	LDICA	AWP
WED	DSP	DBMS	AWP	EMI	LUNCH BREAK	ES & R LAB		
THU	AWP	LDICA LAB				DBMS	DSP	LDICA
FRI	EMI	DSP	LDICA	DBMS		AWP	EMI	DSP
SAT	PEHV	EMI	DBMS	AWP		LDICA	EMI	DSP
BREAK 10:50-11:00								

THEORY

LDICA : LINEAR AND DIGITAL IC APPLICATIONS	Mrs.G.RAJAVALI
DSP : DIGITAL SIGNAL PROCESSING	Mrs.P.VINUTHNA
AWP : ANTENNAS AND WAVE PROPAGATION	Dr. B. Siva Nageswara Rao
EMI : ELECTRONIC MEASUREMENTS AND INSTURMENTATION	Dr.MD.JAVEED AHAMMED
DBMS : DATABASE MANAGEMENT SYSTEMS	Ms.Y.NEELIMA
PEHV : PROFESSIONAL ETHICS AND HUMAN VALUES	Mr.J.RAJESH
DSP LAB: DIGITAL SIGNAL PROCESSING LAB	Mr.V.NAVEEN RAJA Mr.SK.MD.SHAREEF Mrs.P.VINUTHNA Mr.G.Ramana Reddy
LDICA LAB: LINEAR AND DIGITAL IC APPLICATIONS LAB	Mr.J.NARASIMHA RAO Mrs.G.RAJAVALI Mr.G.S.J.VICTOR Mr.N. Narayana
ES&R LAB: EMBEDDED SYSTEMS & ROBOTICS LAB	Dr.B.SUNEETHA Dr.MD.JAVEED AHAMMED Dr.B.SIVANAGESWARA RAO Mr.G.Sambasiva Rao

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

III B.Tech., I Semester, ECE-D Class Time Table for the A.Y. 2024 - 2025								
ROOM.NO:3316					W.E.F: 01.07.2024			
	1	2	3	4		5	6	7
FROM	9:10	10:00	11:00	11:50	12:40	1:30	2:20	3:10
TO	10:00	10:50	11:50	12:40	1:30	2:20	3:10	4:00
MON	LDICA	AWP	DBMS	EMI	LUNCH BREAK	DSP	LDICA	DBMS
TUE	EMI	DSP LAB				AWP	DBMS	DSP
WED	AWP	LDICA LAB				EMI	DSP	LDICA
THU	DSP	PEHV	EMI	AWP		ES & R LAB		
FRI	LDICA	PEHV	EMI	AWP		DSP	AWP	LDICA
SAT	DBMS	DSP	LDICA	EMI		DBMS	LDICA	AWP
BREAK 10:50-11:00								

THEORY

LDICA : LINEAR AND DIGITAL IC APPLICATIONS	Mrs.Sk. Asifa
DSP : DIGITAL SIGNAL PROCESSING	Dr.G.Ram Prabhu
AWP : ANTENNAS AND WAVE PROPAGATION	Mr.A.Ramesh
EMI : ELECTRONIC MEASUREMENTS AND INSTURMENTATION	Dr. R. Dinesh Kumar
DBMS : DATABASE MANAGEMENT SYSTEMS	Ms.Y.NEELIMA
PEHV : PROFESSIONAL ETHICS AND HUMAN VALUES	Mr.J.RAJESH
DSP LAB: DIGITAL SIGNAL PROCESSING LAB	Mr.V.NAVEEN RAJA Mr.SK.MD.SHAREEF
LDICA LAB: LINEAR AND DIGITAL IC APPLICATIONS LAB	Mrs.P.VINUTHNA Mr.G.Ramana Reddy Mr.J.NARASIMHA RAO Mrs.G.RAJAVALI Mr.G.S.J.VICTOR
ES&R LAB: EMBEDDED SYSTEMS & ROBOTICS LAB	Mrs.G.RAJAVALI Dr.B.SIVANAGESWARA RAO Dr.MD.JAVEED AHAMMED Mr.P.JAYA BABU Mr.G.Sambasiva Rao

Syllabus

III B.TECH- I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20EC3103	DIGITAL SIGNAL PROCESSING						

COURSE OBJECTIVES:

1. Make Enhance the analytical ability of the students in the area of signal processing.
2. Develop ability among students to observe the response of the discrete time systems for different types of discrete time sequences.
3. Demonstrate basic knowledge of Digital Signal Processing by understanding various transformations.
4. Understand different types of filters (analog/digital) and their designs.
5. Design DSP systems which are used in the area of communications and networking.

COURSE OUTCOMES: After completion of the course, the student will be able to

CO1: Analyze the signals and system in Time and Frequency domain through transformations. **[K4]**
CO2: Solve DFT and IDFT coefficients of a given discrete time sequence using FFT algorithm**. [K3]**
CO3: Examine the significance of various filter structures and responses. **[K3]**
CO4: Construct the digital filter circuits for generating desired signal wave shapes. **[K4]**
CO5: Inspect the performance of a variety of windowing techniques. **[K3]**

SYLLABUS:

UNIT-I: INTRODUCTION

Review of Discrete Time Signals: Some Elementary Discrete-Time Signals, Classification of Discrete–Time Signals, Simple Manipulations of Discrete–Time Signals, Discrete Time Systems: Input-Output Description of Systems, Block Diagram Representation of Discrete-Time Systems and Classification of Discrete-Time Systems, Frequency domain representation of Discrete Time Signals and Systems, Discrete-Time Fourier Transform (DTFT): Existence of DTFT, properties of DTFT.

UNIT-II: DISCRETE FOURIER SERIES & DISCRETE FOURIER TRANSFORMS

Discrete Fourier series: Properties of Discrete Fourier Series, DFS representation of periodic sequences. DFT: Properties of DFT, Computation of DFT, Circular & Linear Convolution of Sequences using DFT. FAST FOURIER TRANSFORMS: Radix-2 Fast Fourier Transforms (FFT), Decimation in Time and Decimation in Frequency FFT Algorithms and Inverse FFT. Review of Z-Transforms

UNIT-III: REALIZATION OF IIR & FIR FILTERS

Block Diagram Representation of Linear Constant Coefficient Difference Equations. Basic structures of IIR systems: Direct form-I realization, Direct form-II realization, transposed, cascade form, parallel form. Lattice structures of IIR systems, Conversion from Lattice structure to direct form and vice-versa. Basic structures of FIR systems: Transversal structure, linear phase, Lattice structure, Polyphase Lattice structures of FIR systems, Conversion from Lattice structure to direct form and vice-versa.

UNIT-IV: IIR DIGITAL FILTERS

Analog filters approximations: Butterworth and Chebyshev, Design of IIR digital filters from analog filters, Design examples, Frequency Transformations in Analog Domain: Low pass to Low pass filter, Low pass to High pass filter, Low pass to Band pass filter, and Low pass to Band stop filter. Frequency Transformations in digital domain: Low pass to Low pass filter, Low pass to High pass filter, Low pass to Band pass filter, and Low pass to Band stop filter.

UNIT-V: FIR DIGITAL FILTERS

Characteristics of FIR Digital Filters, Frequency Response. Design of FIR Digital Filters Using Window Techniques: Rectangular Window, Triangular or Bartlett Window, Raised Cosine Window Hanning Window, Blackman Window, Kaiser Window, Frequency Sampling Technique: Frequency Sampling Realization, Frequency Response, Design, Comparison of IIR and FIR filter.

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, ―Digital signal processing, principles, Algorithms and applications, 4th Edition, Pearson Education/PHI, 2007.
2. A.V. Oppenheim and R.W. Schaffer, ―Discrete Time Signal Processing‖, 2nd Edition, PHI, 2008.

REFERENCE BOOKS:

1. Ramesh Babu, ―Digital Signal Processing‖, SciTech Publications, 2011.
2. Andreas Antoniou, ―Digital signal processing‖, TATA McGraw Hill, 2006.
3. R S Kaler, M Kulkarni,, Umesh Gupta, ―A Text book on Digital Signal processing‖, I K International Publishing House Pvt. Ltd, 2010.
4. M H Hayes, Schaum‘s outlines, ―Digital signal processing‖, TATA Mc-Graw Hill, 2007.

Lesson Plan

NEC	**NARASARAOPETA ENGINEERING COLLEGE** **(Autonomous)** **Yallmanda(Post), Narasaraopet- 522601**

DEPARTMENT OFELECTRONICS AND COMMUNICATION ENGINEERING
LESSON PLAN

Course Code	Course Title (Regulation)	Semester	Branch	Contact Periods/Week	Sections
R20EC3103	Digital Signal Processing (R20)	V	Electronics and Communication Engineering	6	A, B, C, D

COURSE OUTCOMES: Students are able to

CO1: Analyze the signals and system in Time and Frequency domain through transformations. **[K4]**

CO2: Solve DFT and IDFT coefficients of a given discrete time sequence using Fast Fourier Transform algorithm. **[K3]**

CO3: Examine the significance of various filter structures and responses. **[K3]**

CO4: Construct the digital filter circuits for generating desired signal wave shapes. **[K4]**

CO5: Inspect the performance of a variety of windowing techniques. **[K3]**

Unit No	Course Outcome		Topics/Activity	Ref. Text book	Total Periods	Delivery Method
1	**CO 1.** **Analyze the signal and System in Time and Frequency domain through transformations [K4]**	**UNIT-1: INTRODUCTION**				
		1.1	Introduction	T1, R1	13	Chalk & Talk
		1.2	Review of Discrete Time Signals	T1, R1		Chalk & Talk
		1.3	Some Elementary Discrete-Time Signals	T1, R1		Chalk & Talk
		1.4	Classification of Discrete–Time Signals	T2, R1		Chalk & Talk
		1.5	Simple Manipulations of Discrete–Time Signals	T1, R1		Chalk & Talk

		1.6	Discrete Time Systems: Input-Output Description of Systems	T1, R1		Chalk & Talk
		1.7	Block Diagram Representation of Discrete-Time Systems and Classifications.	T2, R1		Chalk & Talk
		1.8	Frequency domain representation of Discrete Time Signals and Systems	T1, R1		Chalk & Talk
		1.9	Discrete-Time Fourier Transform (DTFT):	T1, R1		Chalk & Talk
		1.10	Existence of DTFT, properties of DTFT.	T2, R1		Chalk & Talk
		UNIT-2: DISCRETE FOURIER SERIES & DISCRETE FOURIER TRANSFORMS				
2	**<u>CO2.</u> Solve DFT and IDFT coefficients of a given discrete time sequence using Fast Fourier Transform algorithm. [K3]**	2.1	Discrete Fourier series	T1, R1	13	Chalk & Talk
		2.2	Properties of Discrete Fourier Series	T1, R1		Chalk & Talk
		2.3	DFS representation of periodic sequences.	T1, R1		Chalk & Talk
		2.4	DFT: Properties of DFT, Computation of DFT	T1, R1		Chalk & Talk
		2.5	Circular & Linear Convolution of Sequences using DFT	T1, R1		Chalk & Talk
		2.6	FAST FOURIER TRANSFORMS: Radix-2 Fast Fourier Transforms.	T1, R1		Chalk & Talk
		2.7	Decimation in Time FFT Algorithms	T1, R1		Chalk & Talk
		2.8	Decimation in Frequency FFT Algorithms	T1, R1,		Chalk & Talk, PPT
		2.9	Inverse FFT	T1, R1		Chalk & Talk
		2.10	Additional Problems	R1		Chalk & Talk
		2.11	Review of Z-Transforms	T1, R1		Chalk & Talk
		2.12	Problems.	R1		Chalk & Talk

3	**CO3.** **Examine the significance of various filter structures and responses. [K3]**	**UNIT-3: REALIZATION OF IIR & FIR FILTERS**				
		3.1	Block Diagram Representation of Linear Constant Coefficient Difference Equations	T1, R1	14	Chalk & Talk, PPT
		3.2	Basic structures of IIR systems: Direct form-I realization	T1, R1		Chalk & Talk, PPT
		3.3	Direct form-II realization, transposed	T1, R1		Chalk & Talk
		3.4	cascade form, parallel form	T1, R1		Chalk & Talk
		MID I EXAMINATION				
		3.4	Lattice structures of IIR systems, Conversion from Lattice structure to direct form and vice-versa	T1, R1		Chalk & Talk, PPT
		3.5	Basic structures of FIR systems: Transversal structure, Linear phase	T1, R1		Chalk & Talk, PPT
		3.6	Lattice structure, Polyphase Lattice structures of FIR systems	T1, R1		Chalk & Talk, PPT
		3.7	Conversion from Lattice structure to direct form and vice-versa.	T1, R1		Chalk & Talk, PPT
4	**CO4.** **Construct the digital filter circuits for generating desired signal wave shapes. [K4]**	**UNIT-4: IIR DIGITAL FILTERS**				
		4.1	Analog filters approximations: Butterworth.	T2, R1	14	Chalk & Talk, PPT
		4.2	Analog filters approximations Chebyshev.	T2, R1		Chalk & Talk, PPT
		4.3	Design of IIR digital filters from analog filters, Design examples	T2, R1		Chalk & Talk, PPT
		4.4	Frequency Transformations in Analog Domain: Low pass to Low pass filter, Low pass to High pass filter,	T2, R1		Chalk & Talk, PPT
		4.5	Low pass to Band pass filter, and Low pass to Band stop filter.	T2, R1		Chalk & Talk, PPT
		4.6	Frequency Transformations in digital domain: Low pass to Low pass filter.	T2, R1		Chalk & Talk, PPT

		4.7	Low pass to High pass filter, Low pass to Band pass filter, and Low pass to Band stop filter.	T2, R1		Chalk & Talk, PPT
5	**CO5.** **Inspect the performance of a variety of windowing techniques. [K3]**	**UNIT-5: FIR DIGITAL FILTERS**				
		5.1	Characteristics of FIR Digital Filters	T2, R1	14	Chalk & Talk
		5.2	Frequency Response	T2, R1		Chalk & Talk
		5.3	Design of FIR Digital Filters Using Window Techniques	T2, R1		Chalk & Talk, PPT
		5.4	Rectangular Window	T2, R1		Chalk & Talk, PPT
		5.5	Triangular or Bartlett Window	T2, R1		Chalk & Talk, PPT
		5.6	Raised Cosine Window Hanning Window	T2, R1		Chalk & Talk, PPT
		5.7	Blackman Window	T2, R1		Chalk & Talk, PPT
		5.8	Kaiser Window	T2, R1		Chalk & Talk, PPT
		5.9	Frequency Sampling Technique: Frequency Sampling Realization	T2, R1		Chalk & Talk, PPT
		5.10	Frequency Response, Design, Comparison of IIR and FIR filter	T2, R1		Chalk & Talk, PPT
Total Classes: 68						
MID II EXAMINATION						
END EXAMINATIONS						

Text Books:

T1	John G. Proakis, Dimitris G. Manolakis, —Digital signal processing, principles, Algorithms and applications, 4th Edition, Pearson Education/PHI, 2007.
T2	A.V. Oppenheim and R.W. Schaffer, —Discrete Time Signal Processing‖, 2nd Edition, PHI, 200

Reference Books:

R1	Ramesh Babu, —Digital Signal Processing‖, SciTech Publications, 2011.
R2	Andreas Antoniou, —Digital signal processing‖, TATA McGraw Hill, 20063.
R3	R S Kaler, M Kulkarni,, Umesh Gupta, —A Text book on Digital Signal processing‖, I K International Publishing House Pvt. Ltd, 2010.

Signature of the Faculty **Signature of the HOD** **Signature of the Principal**

CO-PO & PSO Mapping and assessment

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Name of the Subject : DIGITAL SIGNAL PROCESSING(R20EC3103)

Year/Semester : **III/I** REGULATION: **R20** **Academic Year:2024-25**

CO	CO Attainment Level (Mid)	CO Attainment Level (External)	Direct CO Attainment Level (Internal * 30%) + (External * 70%)	Indirect CO Attainment Level	Total CO Attainment Level (Direct CO Attainment * 90% + Indirect CO Attainment * 10%)
C313.1	3	3	3	3	3
C313.2	3	3	3	3	3
C313.3	3	3	3	3	3
C313.4	3	2	3	3	3
C313.5	3	3	3	3	3
C313					3

Signature of the Faculty Member

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Name of the Subject : DIGITAL SIGNAL PROCESSING(R20EC3103)

Year/Semester : **III/I** REGULATION: **R20** **Academic Year:2024-25**

CO-PO Mapping

MAPPING CO'S WITH PO'S

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C313.1	3	3	1	1	-	-	-	-	-	-	-	2	2	3	2
C313.2	3	3	2	2	-	-	-	-	-	-	-	2	2	3	3
C313.3	3	3	2	2	1	-	-	-	-	-	-	2	3	3	3
C313.4	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
C313.5	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
Average	3.00	3.00	1.75	1.75	1.00	-	-	-	-	-	-	2.00	2.50	3.00	2.75

Total CO Attainment through Direct & Indirect Assessment	
CO Attainment	3

Signature of the Faculty Member

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Name of the Subject :DIGITAL SIGNAL PROCESSING(R20EC3103)

Year/Semester : **III/I** REGULATION: **R20** **Academic Year:2024-25**

CO-PSO Mapping& PSO Attainment

CO-PSO Mapping & PSO Attainment			
COs	**PSOs**		
	PSO1	**PSO2**	**PSO3**
C313.1	**2**	**3**	**2**
C313.2	**2**	**3**	**2**
C313.3	**2**	**3**	**2**
C313.4	**2**	**3**	**2**
C313.5	**2**	**3**	**2**
C313	**2**	**3**	**2**
Total CO Attainment through Direct & Indirect Assessment			
CO Attainment			**3**

PSO Attainment			
COs	**PSOs**		
	PSO1	**PSO2**	**PSO3**
PSO Attainment	**2**	**3**	**2**

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Name of the Subject : DIGITAL SIGNAL PROCESSING(R20EC3103)

Year/Semester : **III/I** REGULATION: **R20** **Academic Year:2024-25**

PO - ATTAINMENT

CO-PO MAPPING

COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C313.1	3	3	1	2	2	1	-	-	1	3	-	3
C313.2	3	3	3	1	2	2	1	-	1	3	3	3
C313.3	3	3	3	1	2	2	1	-	1	3	3	3
C313.4	3	3	3	1	2	2	1	-	1	3	3	3
C313.5	3	1	-	1	2	2	-	-	1	3	3	3
C313	3.00	3.00	3.00	1.00	1.83	2.20	1.00	-	1.00	3.00	2.4	3

Total CO Attainment through Direct & Indirect Assessment	
CO Attainment	3

PO Attainment												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PO Attainment	3	3	3	1	1.83	2.20	1	-	1	3	2.4	3

Signature of the Faculty

CO Attainment

CO	Course Outcome Attainment
CO1	2.25
CO2	2.25
CO3	2.25
CO4	2.25
CO5	2.25
Overall course attainment level	2.25

Web Source References

NARASARAOPETA ENGINEERING COLLEGE
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Name of the Subject: DIGITAL SIGNAL PROCESSING(R20EC3103)

Year/Semester : **III/I** REGULATION: **R20** **Academic Year:2024-25**

WEB SOURCE REFERENCES:

1. **WEB SOURCE REFERENCES:**

1	https://nptel.ac.in/courses/117102060/
2	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
3	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/study-materials/
4	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/video-lectures/
5	https://nptel.ac.in/courses/108105055/

S.No.	Web Link
1	https://nptel.ac.in/courses/117102060/
2	https://www.elprocus.com/fir-filter-for-digital-signal-processing/
3	https://www.tutorialspoint.com/digital_signal_processing/dsp_discrete_fourier_transform_introduction.htm
4	https://www.mikroe.com/ebooks/digital-filter-design/bilinear-transformation
5	https://www.telecomtrainer.com/fir-finite-impulse-response/
6	https://www.dsprelated.com/freebooks/filters/Four_Direct_Forms.html

+

Student’s Roll List

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3	22471A0403	BONTHA RAJU
4	22471A0404	CHALAMCHARLA SANDHYA
5	22471A0405	MITTA CHANDU
6	22471A0406	CHENNAMRAJU SOWMYA RANI
7	22471A0407	DANDURI VENKATESH
8	22471A0408	DANNAVARAPU TIRUMULA VEERAIAH BABU
9	22471A0409	DONTHULA YAMUNA
10	22471A0410	DUDEKULA MOULALI
11	22471A0411	DUDEKULA MUNNABABA
12	22471A0412	GAJWALLI SAI DEEPAK
13	22471A0413	GALI VASUNDHARA
14	22471A0414	GALI MAHESWARI
15	22471A0416	GUDIPATI SUJITHA
16	22471A0417	GUDIPUDI CHAITHAN
17	22471A0418	GURAJALA SRINIVASU
18	22471A0420	JAVISETTY BHAVANI
19	22471A0421	KAMUJULA ROHITH REDDY
20	22471A0422	KANKANALA GNANESWAR
21	22471A0423	KANNEDARI YEDUKONDALU

22	22471A0424	KODURU SHYAMPRASAD
23	22471A0425	KOKKERA VIJAYA LAKSHMI
24	22471A0426	KOMMAVARAPU TRIVENI
25	22471A0427	KOPANATHI LOHITH
26	22471A0428	KOPPARTHI NAVYA
27	22471A0429	KOTHAKOTA GURU VENKATA NAGA TRIVENI
28	22471A0430	KRISHNAPURAPU POOJITHA
29	22471A0431	LINGALA SRINIVASA RAO
30	22471A0432	LINGALA LOKA NANDINI
31	22471A0433	MADDALA UDAY KIRAN
32	22471A0434	MADDINENI NAVYA TEJA
33	22471A0435	MADDU NITHIN
34	22471A0436	MADDULA MADHAVI
35	22471A0437	MADDULA BAJI
36	22471A0438	MADHAVI JAVVAJI
37	22471A0439	MANDA RAMAKRISHNA
38	22471A0440	MARRI HEMA
39	22471A0441	PAGIDIMARRI RAVITEJA
40	22471A0442	PALLAPATI TRIVENI
41	22471A0443	PALLAPUNENI MEGHANADH
42	22471A0444	PARASA NAGA VAMSI
43	22471A0445	PEMMASANI SRAVANI
44	22471A0446	RAMISETTY BALA PRASANNA UMADEVI
45	22471A0447	REDDY SAI MANI DEEP
46	22471A0448	REPALLE PURNA CHAND

47	22471A0449	SEGGAM RAKESH
48	22471A0450	SHAIK SAHIR
49	22471A0451	SHAIK SHABBEER
50	22471A0452	SHAIK MOTAD HARSHAD
51	22471A0453	SHAIK ABDUL RASOOL
52	22471A0454	SHAIK BELLAMKONDA ANVAR BASHA
53	22471A0455	SHAIK BHASID
54	22471A0456	SHAIK HAZEERA
55	22471A0457	SHAIK MOHAMMAD SAIF
56	22471A0458	SHAIK SAISAMEER
57	22471A0459	NEELAM SIVA SANKAR
58	22471A0460	SONTI PULLARAO
59	22471A0461	TAM TAM MOHAN RAO
60	22471A0462	THURAGA ADITHYA VARDHAN
61	22471A0464	ULLAM VENKATA KRISHNA
62	22471A0465	VANGAPALLI NAGALAKSHMI
63	22471A0466	VELPURI MAHESH BABU
64	22471A0467	VEMULA BHUVANESH
65	22471A0468	VIPPALA LAKSHMI PRIYA REDDY
66	22471A0469	YENUMALA ANIL KUMAR
67	22471A0470	YOCHANA GATTU

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S.NO	H.T.NO.	STUDENT NAME
1	22471A0471	AALLA YASASWI
2	22471A0472	ADAPALA SWATHIKA
3	22471A0473	ADUSUMALLI KARUNYA
4	22471A0474	ALAPATI AJAY KUMAR
5	22471A0475	ALOKAM KARTHIK
6	22471A0476	AMBATI SAMBASIVARAO
7	22471A0478	BADRINATH PARUCHURI
8	22471A0479	BERI BHARGAV
9	22471A0480	BHARGAVI DEVELLA
10	22471A0481	BODDU JAGADEESHBABU
11	22471A0482	CHALLA KISHORE
12	22471A0483	CHEPURI NAGA VENKATA NIKHILA SRI
13	22471A0484	DEVANABOINA ANUSHA
14	22471A0485	DHANA SEKHAR JANANI
15	22471A0486	DUGGEMPUDI VENKATA VYSHNAVI
16	22471A0487	GADE GOPI KRISHNA
17	22471A0488	GAJJALA KAVYA SUDHA
18	22471A0489	GARLAPATI SAI PHANI KUMAR
19	22471A0490	GONUGUNTLA RAMYA TEJA
20	22471A0492	GORIPARTHI PAVAN SIVAJI
21	22471A0493	GRANDHI ROHITH GUPTHA

22	22471A0494	INUKOLLU ANIL KUMAR
23	22471A0495	KANDIMALLA VENKATA NAGA NARENDRA
24	22471A0496	KONAKATI THRINADH REDDY
25	22471A0498	KOTAPATI SAI MANI DEEP
26	22471A0499	KOTHAPALLI JAYA SRI
27	22471A04A0	KUMMITHA NAGA PRASAD REDDY
28	22471A04A1	KUNCHAPU VENKATESH
29	22471A04A2	KUNDURU PRASANNA
30	22471A04A3	MALLAVARAPU JOSEPH ARAVIND
31	22471A04A4	MANDALANENI BALAJI VINAY
32	22471A04A5	MANDALANENI BALA VENKATA SAI AKHIL KUMAR
33	22471A04A6	MANNAM SIVA KRISHNA
34	22471A04A7	MATURI V N M S S NAVYA
35	22471A04A8	MOTAD YASMIN
36	22471A04A9	MOTAMARRI JITENDRA SAIKRISHNA AAKASH
37	22471A04B0	MUPPURI SRI RAMYA PAVANI
38	22471A04B1	NAVEEN BODDU
39	22471A04B2	PAGADALA LAKSHMI PRANATHI
40	22471A04B3	PALNATI MOHIT SAI
41	22471A04B4	PERICHARLA TANMAYI
42	22471A04B5	PINJARI MAHABOOB BASHA
43	22471A04B6	PINNIKA NARENDRA
44	22471A04B7	PULUKURI SRINIVASA CHARI
45	22471A04B8	PUNATI ABHINAYA
46	22471A04B9	RAMIREDDYGARI SIVA DURGA PRASAD

47	22471A04C0	SAYUMPU SALMAN RAJU
48	22471A04C1	SHAIK NASRIN SULTANA
49	22471A04C2	SHAIK IMRAN BASHA
50	22471A04C3	SHAIK MAJUNU
51	22471A04C4	SHAIK SHABANA
52	22471A04C5	SHAIK IMRAN
53	22471A04C6	SHAIK ENTHIYAZ
54	22471A04C7	SYED AFROJ
55	22471A04C8	SYED MUBEENA
56	22471A04C9	TALLA BALA PHANINDHRA REDDY
57	22471A04D0	TAMMINENI BRAHMA REDDY
58	22471A04D1	TANNIRU MOHAN SAIRAM
59	22471A04D2	THANNEERU YASODA KRISHNA
60	22471A04D3	PULAGAM V VENKATA RAGHURAMA MANOHARA REDDY
61	22471A04D4	VADDE HEMANTH CHOWDARY
62	22471A04D5	VADLAMANU MAHENDRA
63	22471A04D6	VANGAVOLU BHARGAV
64	22471A04D7	VEJARLA JOSHI
65	22471A04D8	VELAMALA HARIPRASAD
66	22471A04D9	VUTUKURI SWATHI
67	22471A04E0	YARREDDULA SAI KIRAN REDDY

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S.NO	H.T.NO.	STUDENT NAME
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3	22471A04E3	ANNAVARAPU AKHIL
4	22471A04E4	ATHOTA PHILOMIN PAUL
5	22471A04E5	BANAVATHU THIRUMALA NAIK
6	22471A04E6	BANDELA LARA
7	22471A04E7	BHAVANARI VENKATA DEVI PRASAD
8	22471A04E8	BHUKYA ESWAR NAIK
9	22471A04E9	BUDALA NAGAIAH
10	22471A04F0	BURSU SAGAR BABU
11	22471A04F1	CHALLA SUSMITHA REDDY
12	22471A04F2	CHEPARTHI THIRUPATHI RAO
13	22471A04F3	CHINTHALAPUDI JAYASRI
14	22471A04F4	CHIRLADINNE NAGA VENKATA SIVA PAVAN
15	22471A04F5	DANDUGULA VENKATA LAKSHMI
16	22471A04F6	DUDEKULA SAIDA VALI
17	22471A04F7	GARIGIPATI DHANUSH
18	22471A04F8	GORREPATI RATNA PRATHIBHA JOYAL
19	22471A04F9	GOVADA HEMANTH RAM
20	22471A04G0	GUNTI SIVA KUMAR
21	22471A04G1	GURRAM VEERANJANEYULU

22	22471A04G2	GURRAPUSALA MEGHANA
23	22471A04G3	HANUMANTHU RAHUL
24	22471A04G4	JALLELLA VISHNAVIBAI
25	22471A04G5	JANAMALA KEERTHANA
26	22471A04G6	JESTA MALLIKARJUNA
27	22471A04G7	KANKANALA ESWAR
28	22471A04G8	KOPPURAVURI SRI NIKHITA
29	22471A04G9	KOSANAM NAGA CHAITANYA KUMAR
30	22471A04H0	KOTTAMSETTI NARENDRA
31	22471A04H1	MACHERLA PRATAP
32	22471A04H2	MACHERLA CHINNI
33	22471A04H3	MADHAGONDA HANUMANTHU
34	22471A04H4	MANDA RAVI KUMAR
35	22471A04H5	MARRI GOPI RAJU
36	22471A04H6	MEKALA KASI
37	22471A04H7	MOPARTHI VEERA BABU
38	22471A04H8	MUKALLA HEMANTH
39	22471A04H9	MUKKAPATI UDAY KIRAN
40	22471A04I0	NAGIRI SRINIVASRAO
41	22471A04I1	NALABOLU ASHOK KUMAR
42	22471A04I2	PELLURI SURENDRA KUMAR
43	22471A04I3	PERECHARLA SAI
44	22471A04I4	POTLADURTHI LAKSHMI TIRUPATAMMA
45	22471A04I5	RAYIPUDI REVANTH
46	22471A04I6	SAGAM SRINIVAS

47	22471A04I7	SHAIK DACHEPALLI SHAMMI
48	22471A04I8	SHAIK SULEMAN
49	22471A04I9	SHAIK JILANI
50	22471A04J0	SHAIK SADHIKA
51	22471A04J1	SHAIK RIZWANA
52	22471A04J2	SHAIK SADIYA
53	22471A04J3	SHAIK SABIRUNNISA
54	22471A04J4	SHAIK SHABANA
55	22471A04J5	SHAIK CHINNA SUBHANI
56	22471A04J6	SHAIK JAHEED
57	22471A04J7	SHAIK SABIHA
58	22471A04J8	SHAIK SAPA AMEESH
59	22471A04J9	SHAIK SHAILU
60	22471A04K0	SRILEKHA VENNU
61	22471A04K1	TAMMISETTY GOWRI SHANKAR
62	22471A04K2	VALIVETI SATHISH KUMAR
63	22471A04K3	VEDHULLAPALLI ASHOK KUMAR
64	22471A04K4	VIJAYA LAKSHMI DERANGULA
65	22471A04K5	YALAGALA ANIL KUMAR
66	22471A04K6	YAMALA LATHEESH
67	22471A04K7	YAMPARALA ASHOK
68	22471A04K8	YARAJARLA HARI BRAHMA CHARI
69	22471A04K9	YEMPOGU RAJESH
70	22471A04L0	YENIBERA JOHN

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4	22471A04L3	ALETI MAHESH
5	22471A04L4	BETHALA VARDHANA
6	22471A04L5	BOLLEPALLI RAMESH
7	22471A04L6	CHERUKURI RAGHU
8	22471A04L7	CHIRATHALA LAKSHMI THRIVENI
9	22471A04L8	DUDEKULA BAJIBABU
10	22471A04L9	GUJJARLAPUDI AKSHAY
11	22471A04M0	SAMPATH KUMAR JANGA
12	22471A04M1	KAKUMANU INDU
13	22471A04M3	KONGA AJAY KUMAR
14	22471A04M4	KOTHA DILIP
15	22471A04M5	MACHERLA NARENDRA
16	22471A04M6	MAHESH LANJEPALLI
17	22471A04M7	MEDIBOINA AKASH
18	22471A04M8	ORCHU BRAHMAIAH
19	22471A04M9	PATTAMSETTY KAVYASREE

20	22471A04N0	PEDDIPAGA JASHUVA
21	22471A04N1	PULLAGURA VAMSI
22	22471A04N2	REGULAGADDA LEELA GANGABHAVANI
23	22471A04N3	SANIKOMMU SIVA REDDY
24	22471A04N4	SHAIK JUNEED
25	22471A04N5	SHAIK AFRID
26	22471A04N6	SHAIK MOHAMMAD SUHELA
27	22471A04N7	SURASANI YASWANTH REDDY
28	22471A04O0	TALARI VENKATA HARSHA VARDHAN
29	22471A04O1	GAJAVALLI LAKSHMI CHATURYA
30	22471A04O2	ONGOLU CHANDU
31	22471A04O3	GAJJALA VENKATA SAI ABHIRAMI REDDY
32	22471A04O5	SHAIK RAJAK
33	22471A04O6	TAMMINENI LAKSHMI NARAYANA REDDY
34	23475A0401	DEVARAKONDA VEERA BRAHMACHARI
35	23475A0402	LINGALA KOTESWARA RAO
36	23475A0403	BURLE ASHA
37	23475A0404	GORU GEETHIKA SUDHA
38	23475A0405	SHAIK MYMUNNISA
39	23475A0406	KAMBHAMPATI BALU PRAKASH
40	23475A0407	VISHNUMOLAKALA ROSHINI
41	23475A0408	SHAIK NAZMA
42	23475A0409	PALAKEETI RENUKA
43	23475A0410	SHAIK HABEEB
44	23475A0411	PENDEYALA VIJAYA LAKSHMI

45	23475A0412	PILLI AKSHAY
46	23475A0413	PORUMAMILLA VENKATA VARA PRASAD
47	23475A0414	POLURI KIRAN KUMAR
48	23475A0415	POLISETTY SAI RAM
49	23475A0416	KANKANALAPATI MANIKANTA
50	23475A0417	PERAMANA VENKAT VISHNU
51	23475A0418	BONKURI NAVEEN KUMAR
52	23475A0419	YARRAGORLA RAJESWARI
53	23475A0420	NADIMINTI MOHANA RAO
54	23475A0421	GUMMADIDALA SIVA SANKAR
55	23475A0422	KOKKILIGADDA PRUDHVI
56	23475A0423	RALLABANDI ASHOK RAJU
57	23475A0424	PULIPAKA SHALEM RAJU
58	23475A0425	PAPASANI POORNA CHANDRA REDDY
59	23475A0426	SHAIK IMRAN
60	23475A0427	MALLALA SRIKANTH