1st Semester

Program Core

COURSE INFORMATION SHEET

Course code: EE501
Course title: Advanced Digital Signal Processing
Pre-requisite(s): Basics of signals and systems, transform methods, Filter theory.
Credits: 3 L T P
3 0 0
Class schedule per week: 3 Lectures
Class: M.Tech
Semester / Level: I/05
Branch: Electrical Engineering
Name of Teacher:

Course Objectives:
This course enables the students to:

A.	Enumerate the basic concepts of signals and systems, frequency response of discrete-time systems using various techniques like Z-transform**,** Hilbert transform**,** DFT, FFT;
B.	Apply digital IIR and FIR filters applying different techniques and finally construct using different realisation structures.
C.	Illustration of the concept of Decimation and Interpolation, Sampling rate conversion by a rational factor, Multi stage implementation of sampling rate conversion.
D.	Development of adaptive filter and its application. adaptive linear combiner (ALC), Signal processing applications in the area of speech and image, Adaptive signal processing applications to biomedical engineering.
E.	Apply DSP processor in processing of 1D and 2D signals.

Course Outcomes:
At the end of the course, a student should be able to:

1.	State sampling theorem and reproduce a discrete-time signal from an analog signal; frequency response of discrete-time systems by applying Z-transform**,** understand the basic of Hilbert transform, DFT, FFT algorithms, STFT for spectral analysis.
2.	Apply FIR filters using filter approximation theory, frequency transformation techniques, window techniques and finally construct different realisation structures. Realization of IIR filters.
3.	Illustrate the concept of Decimation and Interpolation, Multi stage implementation of sampling rate conversion.
4.	Development of adaptive filter and its in the area of speech and image, Adaptive signal processing applications to biomedical engineering.
5.	Construct (structure) and recommend environment-friendly filter for real- time applications. Design FIR and IIR filters used as electronic filter, digital filter,

	mechanical filter, distributed element filter, waveguide filter, crystal filter, optical filter, acoustic filter, etc. Application of DSP processor.

SYLLABUS

EE501 Advanced Digital Signal Processing

Module 1: Introduction: (8L)

Overview of discrete time signal and systems, ADC and DAC conversion, Time domain analysis of discrete-time linear time invariant systems, Analysis and characterization of LTI systems using Z-transform, Frequency domain analysis of signals using DFT and FFT algorithm. Hilbert transform, Spectral analysis using DFT, Short term DFT.

Module 2: Filter function approximation, IIR and FIR filter design and implementation:(8L)

Review of approximation of ideal analog filter response. Buttorworth, Chebyshev type I & II, Digital filter structures: Direct form I & II, Cascade, Parallel and ladder realization. IIR filter designs based on impulse invariant and Bilinear transformation.Characteristic of FIR, Symmetric and antisymmetric FIR filters, design of linear phase FIR filters using windows and frequency sampling methods, comparison of FIR and IIR filters.

Module 3: Multirate signal processing: . (8L)

Decimation: Time domain characterization, frequency domain characterization, Interpolation, Sampling rate conversion by a rational factor, Multi stage implementation of sampling rate conversion

Module 4: Adaptive Filter: . (8L)

Introduction to adaptive filter, adaptive linear combiner (ALC), Signal processing applications in the area of speech and image, Adaptive signal processing applications to biomedical engineering

Module 5: DSP Processor and applications (8L)

Introduction to DSP processor, Types of architectures, DSP support tools, code composer studio, compiler, assembler and linker, Introduction TMS320 C6x architecture, functional units, fetch and execute packets, pipe lining, registers, linear and circular addressing modes. Convolution, DFT, FFT implementation using DSP processor

Books Recommended:

Text Book

1. John G. Proakis, Dimitris G. Mamalakis, Digital Signal Processing, Principles, Algorithms and Applications.

2. Alan V. Oppenheim Ronald W. Schafer, Digital Signal Processing, PHI, India.

Reference Book

1. Antonious, Digital Filter Design, Mc-Graw-Hill International Editions.
2. S. Salivahanan C Gnanapriya, Digital Signal Processing, Tata McGraw Hill Education Private Limited.
3. A. NagoorKani, Digital Signal Processing, McGraw Hill Education Private Limited.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester EndExamination	50

INDIRECT ASSESSMENT –

1. Students' Feedback on Course Outcome

MAPPING OF COURSE OUTCOMES ONTO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	1	1
CO2	1	1	3	1	1	1
CO3	1	1	2	3	2	1
CO4	1	1	1	3	3	3
CO5	1	2	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Gaps in the syllabus (to meet Industry/Profession requirements):

1. Visualize different signal processing techniques in real time.
2. Application of real time implementation of digital filter

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments

CD3	Seminars
CD4	Industrial visits/in-plant training
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	**Course Delivery Method**
CO1	CD1, CD2, CD3,CD5
CO2	CD1, CD2, CD3,CD5
CO3	CD1, CD2, CD3,CD5
CO4	CD1, CD2, CD3, CD5
CO5	CD1, CD2, CD3,CD5

COURSE INFORMATION SHEET

Course code: EE503
Course title: Modern Control Theory
Pre-requisite(s): B.E./B.Tech. in ECE/EEE with basic courses on Control Theory
Co- requisite(s): Linear Algebra
Credits: 3L T P
3 0 0
Class schedule per week: 03
Class: M.Tech.
Semester / Level: I/05
Branch: Electrical Engineering
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	state basic concepts of state variables, state diagrams, controllability, observability;
2.	extend comprehensive knowledge of mathematical modelling of physical system;
3.	illustrate basics of transformations and decompositions for controllability and observability tests;
4.	enhance skills with application of different control strategy for designing a control problem;
5.	design controller for any type of linear plants.

Course Outcomes:

At the end of the course, a student should be able to:

CO1	demonstrate an understanding of the building blocks of basic and modern control systems by creating mathematical models of physical systems in input-output or transfer function form;
CO2	organize state representations to satisfy design requirements using transformations and decompositions;
CO3	examine state space equations for time domain analysis;
CO4	assess a system for its stability, controllability, and observability properties leading to design of controller and observer in a feedback control system;
CO5	aspire for pursuing a carrier in control, recognize the need to learn, to engage and to adapt in a world of constantly changing technology and play role of team leader or supporter of team.

SYLLABUS

EE503 Modern Control Theory

Module I

Background and Preview, Modelling, Highlights of Classical Control Theory; Block diagram, Transfer functions, State Variables and State Space description of dynamic systems, State diagrams, Differential equations to state diagrams, State diagrams to Transfer function, State diagrams to state and output equations, State equations from system's linear graph.

(8L)

Module II

Fundamentals of Matrix Algebra, Vectors and Linear Spaces, Simultaneous Linear Equations, Eigenvalues and Eigenvectors, Functions of Square Matrices, Similarity Transformations, CCF, OCF, DCF and JCF forms, Decomposition of Transfer Functions, The Caley-Hamilton Theorem and it's applications.

(8L)

Module III

Analysis of Continuous and Discrete-Time Linear State Equations, Local linearization of non-linear models, State Transition Matrix, Significance, Properties and Evaluation of STM, Stability analysis using direct method of Lyapunov.

(8L)

Module IV

Controllability and Observability concept for linear Systems, Relationship among Controllability, Observability and Transfer Functions, Invariant theorems on Controllability and Observability.

(8L)

Module V

Design of Linear Feedback Control Systems, pole placement design through state feedback,Design of servo systems, State observers, Design of Regulator Systems with observers, Design of control systems with Observers, Quadratic Optimal Regulator Systems.

(8L)

Books Recommended:

Text Book

1. Modern Control Theory by Brogan, Pearson, 3rd edition. (**T1)**
2. Systems and Control by Zak, 1st edition, Oxford University Press. **(T2)**
3. Modern Control System Theory by M. Gopal, New Age International(P) Ltd., 2nd edition. (**T3**)
4. Automatic Control Systems by F. Golnaraghi and B.C.Kuo, Wiley Student Edition, 9th edition. (**T4**)
5. Modern Control Engineering by K. Ogata, Pearson, 5th edition (**T5)**

Reference Book

1. Digital Control & State Variable Methods – M. Gopal, Tata McGraw Hill Education. (**R1**)
2. Linear Systems by Thomas Kailath, Prentice-Hall Inc.,1980. (**R2**)

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester EndExamination	50

INDIRECT ASSESSMENT –

1. Students' Feedback on Course Outcome

MAPPING OF COURSE OUTCOMES ONTO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	1	3	-	-
CO2	3	-	1	3	-	1
CO3	3	1	2	3	-	1
CO4	3	2	2	3	2	2
CO5	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus: PO5& PO6

Topics beyond syllabus/Advanced topics/Design:

Design optimization for industrial projects, Fractional order controller.

POs met through Topics beyond syllabus/Advanced topics/Design: PO5 & PO6

Course Delivery Methods

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Industrial visits/in-plant training
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	**Course Delivery Method**
CO1	CD1, CD2, CD3,CD5
CO2	CD1, CD2, CD3,CD5
CO3	CD1, CD2, CD3,CD5
CO4	CD1, CD2, CD3, CD5
CO5	CD1, CD2, CD3,CD5

COURSE INFORMATION SHEET

Course code: EE509
Course title: Advanced Power System Analysis
Pre-requisite(s): B.E./B.Tech. in ECE/EEE
Co- requisite(s):
Credits: 3 L T P
3 0 0
Class schedule per week: 03
Class: M.Tech.
Semester / Level: I/05
Branch: Electrical Engineering
Name of Teacher:

Course Objectives:

This course enables the students:

1.	to define single-phase modeling of power system components;
2.	to describe steady state operation of large-scale power systems and to solve the power flow problems using efficient numerical methods suitable for computer simulation like N-R,FDLF, Continuation Load Flow, Series Load Flow;
3.	to understand power systems under abnormal conditions (short circuit) utilizing bus impedance matrix for short circuit analysis;
4.	to understand the effect on power system for different outage events by contingency analysis and assess the state estimation;
5.	to extend the knowledge for solving harmonic load flow analysis stating the causes for harmonic content and modeling component in harmonic domain.

Course Outcomes:

After completion of the course, the learners will be able to:

CO1	draw the impedance and reactance diagram and can explain different components modeling for load flow, short circuit, contingency analysis and harmonic analysis of power system;
CO2	solve load flow problems by different methods;
CO3	analyze the different abnormal (fault) conditions in power system utilizing efficient computer algorithm;
CO4	explain different factors affecting the power system security for single and multiple contingencies and thereby to take proper corrective action.
CO5	explain numerical methods for state estimation of power system.

SYLLABUS

EE509 Advanced Power System Analysis

Module I

Introduction: Modeling of power system component, Basic single-phase modelling, Generation, Transmission line, Transformers, Shunt elements.

(8L)

Module II

Load Flow Analysis: Introduction, Nature of load flow equations, Newton Raphson method: Formulation for load buses and voltage controlled buses in rectangular and polar co-ordinates, Computational steps and flow chart, Computational Aspects of Large Scale System - Introduction, Sparsity oriented technique for reducing storage requirements, Factorization.

(8L)

Module III

Decoupled Load Flow: Formulation, Fast decoupled load flow method, Continuation load flow technique, Series load flow technique. Harmonic Analysis - Power Quality, Sources, Effects of Harmonics, Harmonic load flowanalysis, Suppression of Harmonics.

(8L)

Module IV

Short Circuit Analysis: Introduction, Bus impedance matrix and its building algorithmthrough modifications, Fault calculation uses Zbus and its computational steps. Symmetrical and Unsymmetrical faults.

(8L)

Module V

Contingency Analysis: Introduction to power system security, Factors affecting power systemsecurity, Analysis of single contingencies, Linear sensitivity factors, Analysis of multiplecontingencies, Contingency ranking. State Estimation: Introduction, weighted least square technique, Statistics, Errors and estimates.

(8L)

Text Books:

1. Power System Analysis - John J. Grainger, William D. Stevenson, Jr.
2. Power System Analysis - L. P. Singh

Reference Books:

1. Electric Energy Systems Theory - An Introduction, O.L. Elgerd.
2. Computer Modelling of Electrical Power Systems - J. Arrillaga, N.R. Watson
3. PowerSystem harmonic Analysis, J. Arrillage, B.C. Smith, et al.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester EndExamination	50

INDIRECT ASSESSMENT –

1. Students' Feedback on Course Outcome

MAPPING OF COURSE OUTCOMES ONTO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	2	2
CO3	3	3	3	2	3	2
CO4	3	3	3	2	2	3
CO5	3	3	2	2	2	3

COURSE INFORMATION SHEET

Course code: EE507
Course title: ADVANCED POWER ELECTRONICS
Pre-requisite(s): Operating Principle of Semiconductor Devices
Credits: 03 L:3 T:0 P: 0 C: 03
Class schedule per week: 03
Class: M.Tech.
Semester / Level: I/05
Branch: Electrical Engineering

Course Objectives:

This course enables the students to:

A	Remember classifications of power converters based on different criteria such as soft switching/ hard switching and isolated/non-isolated configuration etc.
B	Explain the working principle of different class of power converters and relate them with different area of application
C	Analyse shortcomings of different types of power converters.
D	Evaluate cost of power converter based topology terms of dynamic parameters of system, overall efficiency and cost.
E	Design power converter based topologies for energy management.

Course Outcomes:

At the end of the course, a student should be able to:

CO 1	List different types of semiconductor devices and remember their operating characteristics. Explain the working principle of different semiconductor devices.
CO 2	Classify different types of power converters. Show suitability of a power converter for a particular application. Solve power management related problems with application of power electronics based topologies.
CO 3	Outline shortcomings of each class of power converters and solve those using proper modifications. Identify potential areas for power electronics applications.
CO 4	Estimate the cost and long term impact of power electronics technology on a large scale project of socio-economic importance.
CO 5	Design new power converter topologies and Plan to develop a power processing unit for a particular requirement in industrial plants as well as domestic applications.

Syllabus

Module I:

Power Electronic Devices: Diodes, Thyristor, Review of switching devices- operating principle, Static & dynamic characteristics, Datasheet ratings; Thermal characteristics of power devices; Sample Gate drive circuits. [8L]

Module II:
Switched Mode Power Supply:

Forward and flyback converter circuits: operation of flyback converter and waveforms analysis, operation of forward converter and waveforms analysis, Double ended forward converter, Push Pull converter, Half Bridge isolated converter, Full bridge isolated converter, Bidirectional power supplies , small signal analysis of DC-DC converters and closed loop control. [8L]

Module III:

PWM inverter modulation strategies & dual bridge: Sine wave with third harmonic, space vector modulation and predictive current control techniques; PWM rectifier; Input side bidirectional power flow requirement for regeneration & Dual Thyristor Bridge. Multi- level inverter : Basic topology and waveform, Diode clamped multilevel inverter, Flying capacitor multilevel inverter, cascaded multilevel inverter improvement in harmonics and high voltage application, comparison of different multilevel inverters, application of multilevel inverters; [8L]

Module IV:

Resonant Inverters: Operating principle of series resonant inverter, waveforms analysis, switching trajectory, losses and control, Operating principle of series resonant inverter with bidirectional switches, Frequency response of resonant series loaded, parallel loaded, and series parallel- loaded inverter, Parallel resonant inverter, ZCS resonant converter, ZVS resonant converter. [8L]

Module V:
Introduction to application oriented chips: Industrial PWM driver chips for power supplies such as UC 3843, 3825 or equivalent; Industrial gate driver chips for PWM voltage source inverters with isolation and protection circuits. Intelligent power modules [8L]

Books recommended:
TEXT BOOK

1. M.H. Rashid,"Power Electronics: Circuits, Device and Applications",2nd Ed.n, PHI, New Jersey, 1993
2. Mohan, Underland, Robbins; Power Electronics Converters, Applications and Design, 3rd Edn., 2003, John Wiley & Sons Pte. Ltd.
3. M. D. Singh, K. B. Khanchandani, "Power Electronics", 2nd Edn., Tata McGraw- Hill, 2007.

REFERENCE BOOK

1. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control ", 1st Edn., Prentice Hall,2001
2. B. K. Bose, "Modern Power Electronics & AC Drives" , 1st Edn., Prentice Hall, 2001
3. L. Umanand, "Power Electronics: Essentials & Applications", 1st Edn. Wiley India Private Limited, 2009
4. Jeremy Rifkin, "Third Industrial Revolution: How Lateral Power is Transforming Energy, the Economy, and the World", 1st Edn., St. Martin"s, Press, 2011

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

INDIRECT ASSESSMENT –

1. Students' Feedback on Course Outcome

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	2	2	2	1
CO2	3	3	3	3	2	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Gaps in the syllabus (to meet Industry/Profession requirements) :

(1) Cost Evaluation of Power Electronics based installation based on reliability

(2) Application of artificial intelligence in power electronics.

(3) Study of impact of power electronics on society and environment

POs met through Gaps in the Syllabus: PO6

Topics beyond syllabus/Advanced topics/Design:

(1) Reliability analysis in power electronics topologies

(2) Application of adaptive algorithms in power electronics based systems

POs met through Topics beyond syllabus/Advanced topics/Design: **PO6**

Course Delivery Methods

CD 1	Lecture by use of boards/LCD projectors/OHP projectors
CD 2	Assignments/Seminars
CD 3	Laboratory experiments/teaching aids
CD 4	Industrial/guest lectures
CD 5	Industrial visits/in-plant training
CD 6	Self- learning such as use of NPTEL materials and internets
CD 7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course code: EE571
Course title: Soft Computing Techniques in Electrical Engineering
Pre-requisite(s): Basics of signals and systems, Digital Signal Processing, Filter theory.
Credits: L: 3 T: 1 P: 0 C: 3
Class schedule per week: 4 lectures week
Class :M.Tech
Semester/level: II
Branch: Electrical Engineering
Name of Teacher:

Course Objectives: This course enables the students to:

1	Understand the basic of Soft Computing Techniques.
2	Acquainted with the solving methodology of soft computing technique in power systems operation and control.
3	Analysis of ANN based systems for function approximation in application to load forecasting.
4	Evaluate fuzzy based systems for load frequency control in power systems.
5	Design of different problems of optimization in power systems and power electronics.

Course Outcomes: At the end of the course, a student should be able to:

CO1	Identify the soft computing techniques and their roles in building intelligent machines.
CO2	Recognize an appropriate soft computing methodology for an engineering problem.
CO3	Apply fuzzy logic and reasoning to handle uncertainty while solving engineering problems.
CO4	Analysis of neural network and genetic algorithms to combinatorial optimization problems.
CO5	Classify neural networks to pattern classification and regression problems and evaluated its imparts while being able to demonstrate solutions through computer programs.

Syllabus

Module - 1
Introduction to Soft Computing: Introduction, Definition of Soft Computing Techniques, Importance of Soft Computing, Main Components of Soft Computing: Fuzzy Logic, Artificial Neural Networks, Introduction to Evolutionary Algorithms, Hybrid Intelligent Systems, Single and multi-objective optimization.

[8L]

Module –2
Artificial Neural Network and Applications: Introduction, Artificial Neuron Structure, ANN Learning; Back-Propagation Learning, Properties of Neural Networks, Unsupervised learnings, Hopfield networks, Application of GN Models to Electrical Machine Modeling, Short Term Electrical Load Forecasting Using Generalized Neuron Model, Aircraft Landing Control System Using GN Model.

[8L]

Module - 3
Introduction to Fuzzy Logic and Genetic Algorithm: Introduction, Uncertainty and Information, Types of Uncertainty, Introduction of Fuzzy Logic, Fuzzy Set, Operations on Fuzzy Sets, Fuzzy Intersection, Fuzzy Union, Fuzzy Complement, Fuzzy Concentration, Fuzzy Dilation, Fuzzy Intensification, α-Cuts, Characteristics of Fuzzy Sets, Demorgan's Law, Fuzzy Cartesian Product, Various Shapes of Fuzzy

Membership Functions, Methods of Defining of Membership Functions, Fuzzy Relation, DefuzzificationMethods.Introduction to Genetic Algorithm, Crossover, Mutation, Survival of Fittest, Population Size, Evaluation of Fitness Function.

[8L]

Module-4

Applications of Fuzzy Rule Based System: Introduction, System's Modeling and Simulation Using Fuzzy Logic Approach, Selection of Variables, Normalization Range and Number of Linguistic Values, Selection of Shape of Membership Functions for Each Linguistic Value, Selection of Fuzzy Union and intersection Operators, Selection of Defuzzification Method, Steady State D.C. Machine Model, Transient Model of D.C. Machine, Fuzzy Control System, Power System Stabilizer Using Fuzzy Logic.

[8L]

Module-5

Applications of Soft Computing Techniques to Electrical Engineering: Applications of Artificial Neural Network, Genetic Algorithms, Fuzzy and Hybrid Systems for Power System Applications: voltage control, voltage stability, Economic load dispatch, Unit commitment, Condition monitoring. Applications of Soft Computing Techniques for Power Electronics and Control Applications.

[8L]

Text Books:

1Neural Networks: A Comprehensive Foundation – SimanHaykin, IEEE, Press, MacMillan, N.Y. 1994.
2. S. Rajasekaran, G. A. Vijayalakshmi, Neural Networks, Fuzzy logic and Genetic algorithms, PHI publication.
3. Fuzzy logic with Engineering Applications - Timothy J. Ross, McGraw-Hill International Editions.
4. Fuzzy Sets and Fuzzy logic: Theory and Applications - George J. Klir and Bo. Yuan, Prentice- Hall of India Private Limited.

Reference Books:

1. Chaturvedi, Devendra K, Soft Computing Techniques and its Applications in Electrical Engineering, Hardcover ISBN:- 978-3-540-77480-8, Springer.
2. Kalyanmoy Deb, Optimization for Engineering Design, PHI publication
3. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, Willey Publication
4.Kevin Warwick, Arthur Ekwue, Rag Agarwal, Artificial intelligence techniques in power systems. IEE Power Engineering Series-22.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester EndExamination	50

INDIRECT ASSESSMENT –

1. Students' Feedback on Course Outcome

MAPPING OF COURSE OUTCOMES ONTO PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1			
CO2	3	2	1	2		1
CO3	3	1	2	3		1
CO4	2	2	2	3	2	2
CO5	2	2	3	1	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Gaps in the syllabus (to meet Industry/Profession requirements):

1. Visualize different soft computing techniques in real time.
2. Hardware implementation of soft computing techniques in real time.

POs met through Gaps in the Syllabus: PO5 & PO6

Topics beyond syllabus/Advanced topics/Design:

Soft computing application to image processing, video processing.

POs met through Topics beyond syllabus/Advanced topics/Design: PO5 & PO6

Course Delivery Methods

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Industrial visits/in-plant training
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	**Course Delivery Method**
CO1	CD1, CD2, CD3,CD5
CO2	CD1, CD2, CD3,CD5
CO3	CD1, CD2, CD3,CD5
CO4	CD1, CD2, CD3, CD5
CO5	CD1, CD2, CD3,CD5

COURSE INFORMATION SHEET
(Programme Core)

Course code: EE502
Course title: Advanced Digital Signal Processing Laboratory
Pre-requisite(s): Basics of signals and systems, transform methods, Filter theory.

Credits: 2	L	T	P
	0	0	4

Class schedule per week: 4
Class: M.Tech.
Semester / Level: I/05
Branch: Electrical Engineering
Name of Teacher:

Course Objectives:
This course enables the students to:

A.	enumerate the basic concepts of signals and systems and their interconnections in a simple and easy-to-understand manner through different mathematical operations like folding, shifting, scaling, convolutions, etc. using MATLAB; also gain Knowledge of TMS kit, digital image filter;
B.	construct different realization structures;
C.	determine transfer function and predict frequency response of discrete-time systems by applying various techniques like Z-transform, DFT and FFT using MATLAB;
D.	evaluate cost of filters in terms of memory space complexity, algorithm complexity and economic values;
E.	design and compose digital IIR and FIR filters using filter approximation theory, for optimal cost.

Course Outcomes:
At the end of the course, a student should be able to:

1.	convert analog signal into digital signals and vice-versa, generation of different signals and basic knowledge of TMS kit;
2.	compute frequency response of the systems using frequency transformation technique, DFT, DIF-FFT or DIT-FFT algorithm, window techniques and visualization using MATLAB;
3.	design FIR and IIR filters;
4.	evaluate performance of filter with time variant signals;

5.	recommend environment-friendly filter for different real- time applications such as optical filter design, acoustic filter design etc.

LIST OF EXPERIMENTS

1. Name: - ADC and DAC conversion considering sampling theorem and aliasing effect.

Aim: - Generation and representation of different types of signal, Implementation of Analog to digital and digital to analog conversion suitably considering sampling theorem and aliasing effect.

2. Name:- Linear convolution, Cross-correlation, Auto-correlation of two sequences.

Aim: Analysis of interaction of digital signal with digital system using **l**inear convolution of two sequences. Perform Linear convolution of two sequence using circular matrix method.

3. **Name:-** Discrete Fourier transform and Inverse- Discrete Fourier transform
Aim: Frequency domain analysis of signals using DFT and IDFT algorithms.

4.**Name**: DFT by DIT-FFT and DIF-FFT method.
Aim: Frequency analysis of discrete signal by applying DIT-FFT and DIF-FFT algorithm.

5. **Name:** IIR filter realization.
Aim: Design and implementation of IIR filter using Direct form I and Direct form-II structure.

6. **Name:** FIR filter realization.
Aim: Design and implementation FIR filter using Direct form I and Direct form-II structure.

7.**Name:** Familiarization with TMS-320C6713 DSP starter Kit, convolution of two sequence applying TMS-320C6713 DSP starter Kit.
Aim: Implementation of interaction of digital signal and system applying TMS- 320C6713 DSP starter Kit.

8. **Name:** DFT and IDFT using TMS-320C6713 DSP starter Kit.
Aim: To perform frequency analysis using DFT and IDFT by applying TMS-320C6713 DSP starter Kit.

9. **Name: A**daptive filter design and implementation in speech processing.
Aim: To remove noise from a 1D biomedical and speech signal by applying adaptive linear combiner (ALC).

10. **Name**: Fundamentals on image processing. Noise suppression from digital image.

Aim: To change the intensity of specific part of given gray scale image. To write a program to remove Salt &pepper type noise from a given gray scale image using mean and median filters.

11. **Name:** Noise suppression from digital image using adaptive filter.
Aim: Write a program to remove Gaussian noise from given image by applying adaptive filter/ Artificial neural network.

Books Recommended:

1. Digital signal processing and applications with C6713 and C6416 DSK by RulphChassaing, wiley publication.
2. Real-Time digital signal processing based on the TMS320C6000 by Nasser Kehtarnavaz, ELSEVIER publication
3. DSP applications using C and the TMS320c6x DSK by RulphChassaing, Wiley Publication.

Reference Books:

1. Antonious,Digital Filter Design,Mc-Graw-Hill International Editions.
2. WavelateTransform,S.Rao.
3. WavelateAnalysis:"The scalable structure of Information"Springer2008–Howard L.Resinkoff,RaymondO.Wells

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Group project evaluation, Progressive and End semester evaluations

DIRECT ASSESSMENT

Direct Assessment

Assessment Tools	**% Contribution during CO Assessment**
Progressive Evaluation	60
End Semester Evaluation	40

Progressive Evaluation	**% Distribution**
Day to day performance & Lab files	30
Quiz (zes)	10
Viva	20
End Semester Evaluation	**% Distribution**
Examination Experiment Performance	30
Quiz	10

INDIRECT ASSESSMENT –

1. Students' Feedback on Course Outcome

MAPPING OF COURSE OUTCOMES ONTO PROGRAM OUTCOMES

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	-	-	-
CO2	3	2	1	2	-	1
CO3	3	1	2	3	-	1

CO4	2	2	2	3	2	2
CO5	2	2	3	1	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Gaps in the syllabus (to meet Industry/Profession requirements):
1. Visualize different signal processing techniques in real time.
2. Application of real time implementation of digital filter.

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POs met through Gaps in the Syllabus: PO5 & PO6

Topics beyond syllabus/Advanced topics/Design:
Adaptive signal processing, Image processing.

POs met through Topics beyond syllabus/Advanced topics/Design: PO5 & PO6

Course Delivery Methods

CD	Course Delivery methods
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Industrial visits/in-plant training
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Mapping Between COs and Course Delivery (CD) methods	
Course Outcome	**Course Delivery Method**
CO1	CD1, CD2, CD3,CD5
CO2	CD1, CD2, CD3,CD5
CO3	CD1, CD2, CD3,CD5
CO4	CD1, CD2, CD3, CD5
CO5	CD1, CD2, CD3,CD5